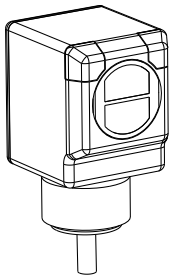
Q40 Sensors: dc-Voltage Series

Datasheet

Self-contained, dc-operated sensors

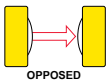
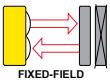


- Featuring EZ-BEAM® technology for reliable sensing without the need for adjustments
- Rectangular 40 mm plastic housing with 30 mm threaded mounting base in opposed, retroreflective or fixed-field modes
- Completely epoxy-encapsulated to provide superior durability, even in harsh sensing environments rated to IP69K
- Innovative dual-indicator system for simple sensor performance monitoring
- Advanced diagnostics to warn of marginal sensing conditions or output overload
- 10 to 30 V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA maximum each)

WARNING: Not To Be Used for Personnel **Protection**

Never use this device as a sensing device for personnel **protection.** Doing so could lead to serious injury or death. This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

Models

Model[1]	Sensing Mode		Range	LED	Output
Q406E		Opposed	60 m (200 ft)	Infrared, 950 nm	-
Q40SN6R					NPN
Q40SP6R					PNP
Q40SN6LP		Polarized **Retro-reflective**	6 m (20 ft)	Visible red, 680 nm	NPN
Q40SP6LP					PNP
Q40SN6FF200		Fixed Field	200 mm (8 in) cutoff	Infrared, 880 nm	NPN
Q40SP6FF200					PNP
Q40SN6FF400			400 mm (16 in) cutoff		NPN
Q40SP6FF400					PNP
Q40SN6FF600			600 mm (24 in) cutoff		NPN
Q40SP6FF600					PNP

Fixed-Field Mode Overview

Q40 Series 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, Q406E W/30).
- To order 4-pin Euro-style QD models: add suffix "Q" (for example, Q406EQ). A model with a QD connector requires a mating cable.

Fixed-Field Sensing – Theory of **Operation**

The Q40FF 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 model Q40FF sensors is fixed at 200, 400 or 600 millimeters (8 inches, 16 inches, 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).

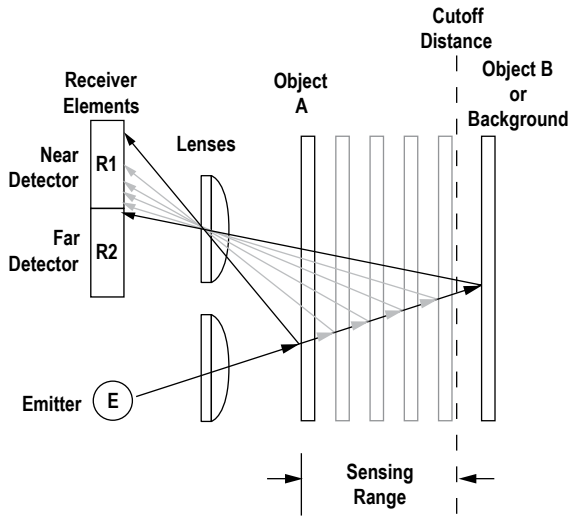


Figure 1. Fixed-Field Concept

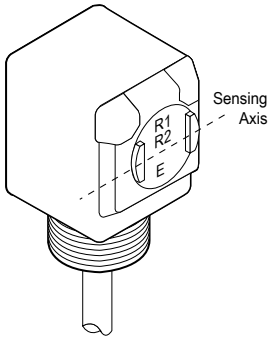


Figure 2. Fixed-Field Sensing Axis

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 millimeters (1.5 inches). 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.

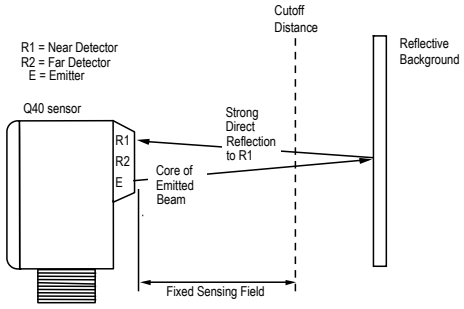


Figure 3. Reflective Background - Problem

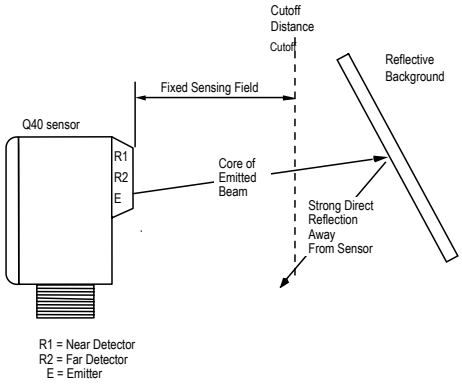
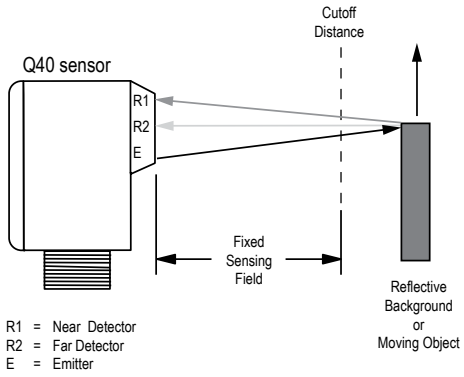
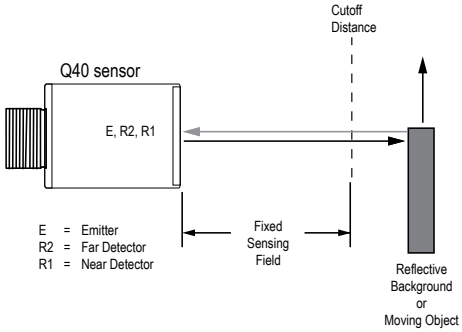


Figure 4. Reflective Background - Solution



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**

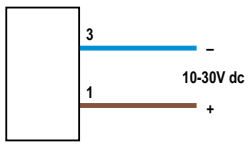
The effects of object reflectivity on cutoff distance, though small, may be important for some applications. It is expected that at any given cutoff setting, the actual cutoff distance for lower reflectance targets is slightly shorter than for higher reflectance targets. This behavior is known as color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

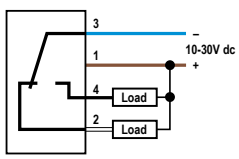
Wiring Diagrams

Cabled **Emitters**



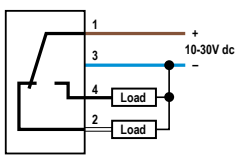
NPN (Sinking) Outputs

Standard Hookup



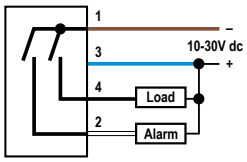
PNP (Sourcing) Outputs

Standard Hookup

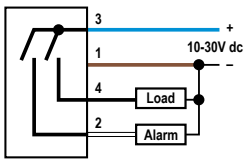


Note: QD hookups are functionally identical.

Alarm Hookup



Alarm Hookup



Specifications

Supply Voltage and Current
10 to 30 V dc (10% max. ripple)
Supply current (exclusive of load current):
Emitters: 25 mA
Receivers: 20 mA
Polarized **Retroreflective:** 30 mA
Fixed-Field: 35 mA

Supply **Protection** Circuitry
Protected against reverse polarity and transient voltages

Output **Configuration**
SPDT solid-state dc switch; Choose NPN (current sinking) or PNP (current sourcing) models
Light Operate: N.O. output conducts when sensor sees its own (or the emitter's) modulated light
Dark Operate: N.C. output conducts when the sensor sees dark; the N.C. (normally closed) output may be wired as a normally open marginal signal alarm output, depending upon hookup to power supply (U.S. patent 5087838)

Output **Rating**
150 mA maximum (each) in standard hookup.
When wired for alarm output, the total load may not exceed 150 mA.
OFF-state leakage current: < 1 microamp at 30 V dc
ON-state **saturation** voltage: < 1V at 10 mA dc; < 1.5 V at 150 mA dc

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 and continuous overload or short circuit of outputs

Output Response Time
Opposed mode: 3 ms ON, 1.5 ms OFF
Retro and Fixed-Field: 3 ms ON and OFF

Note: 100 ms delay on power-up; outputs do not conduct during this time.

Repeatability
Opposed mode: 375 µs
Retro and Fixed-Field: 750 µs
Repeatability and response are independent of signal strength

Indicators
Two LEDs (Green and Amber)
Green ON steady: power to sensor is ON
Green **flashing:** output is overloaded
Amber ON steady: N.O. output is conducting
Amber **flashing:** excess gain marginal (1 to 1.5x) in light condition

Construction
PBT polyester housing; acrylic lens

Environmental **Rating**
Leakproof design rated NEMA 6P, IEC IP67. QD Models rated IEC IP69K per DIN 40050-9.

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

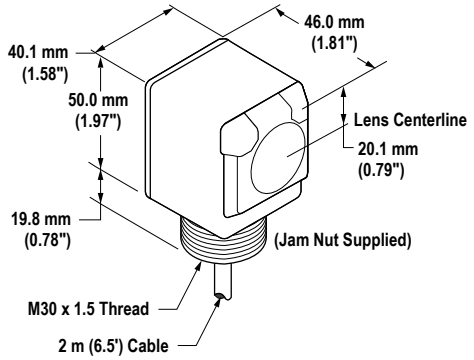
Operating Conditions
Temperature: –40 °C to +70 °C (–40 °F to +158 °F)
90% at +50 °C maximum relative humidity (non-condensing)

Vibration and Mechanical Shock
All models meet Mil. Std. 202F requirements. Method 201A (Vibration; frequency 10 Hz to 60 Hz, max., double amplitude 0.06 inch acceleration 10G). Method 213B conditions H&I. Shock: 75G with unit operating; 100G for non-operation

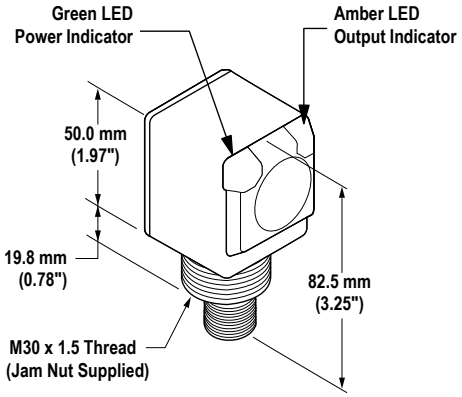
Certifications

Dimensions

Cabled Models



QD Models

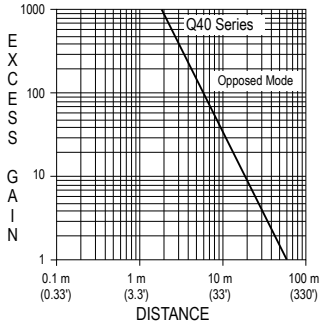


All measurements are listed in millimeters [inches], unless noted otherwise.

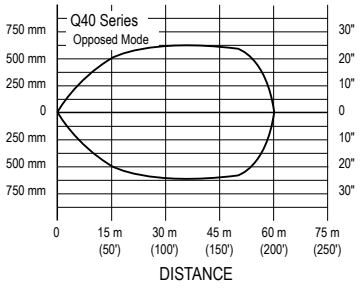
Performance Curves

Opposed Mode

Excess Gain



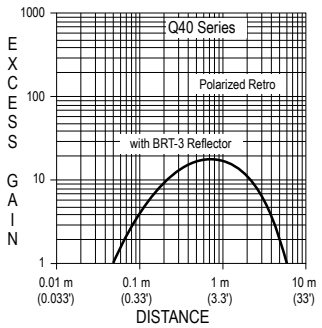
Beam **Pattern**



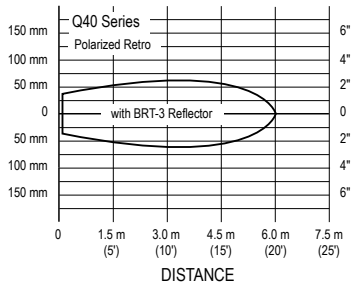
Polarized **Retroreflective**

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



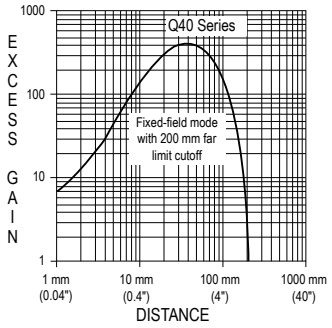
Beam **Pattern**



Fixed Field

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

Fixed-Field—200 mm



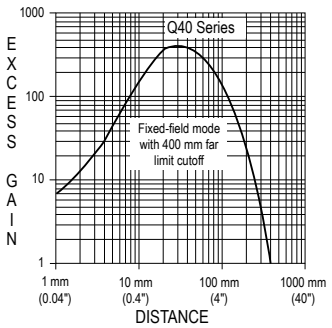
Ø 16 mm spot size @ 35 mm focus

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



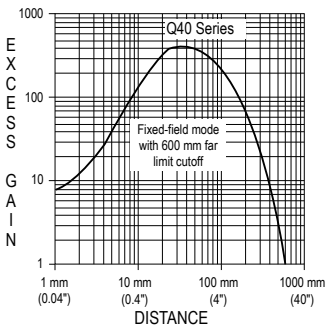
Ø 17 mm spot size @ 35 mm focus

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



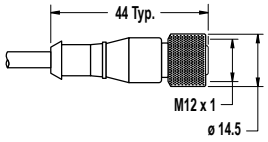
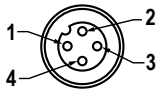
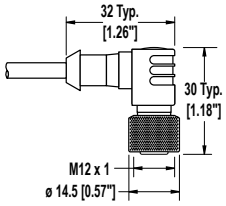
Ø 17 mm spot size @ 35 mm focus

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 Threaded M12/Euro-Style Cordsets				
Model	Length	Style	Dimensions	Pinout (Female)
MQDC-406	1.83 m (6 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black
MQDC-415	4.57 m (15 ft)			
MQDC-430	9.14 m (30 ft)			
MQDC-450	15.2 m (50 ft)			
MQDC-406RA	1.83 m (6 ft)	Right-Angle		
MQDC-415RA	4.57 m (15 ft)			
MQDC-430RA	9.14 m (30 ft)			
MQDC-450RA	15.2 m (50 ft)			

Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp. Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is identified as not intended for such purposes will void the product warranty. Any modifications to this product without prior express approval by Banner Engineering Corp will void the product warranties. All specifications published in this document are subject to change; Banner reserves the right to modify product specifications or update documentation at any time. Specifications and product information in English supersede that which is provided in any other language. For the most recent version of any documentation, refer to: www.bannerengineering.com.

© Banner Engineering Corp. All rights reserved