Q25 DC Sensors

Instruction Manual

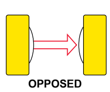
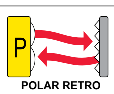
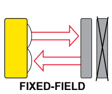
Self-Contained, DC-Operated Sensors

- Featuring EZ-BEAM® technology for reliable sensing without the need for adjustments
- Rectangular 25 mm plastic housing with 18 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 IEC IP69K
- Innovative dual-indicator system takes the guesswork out of sensor performance monitoring
- Advanced diagnostics to warn of marginal sensing conditions or output overload
- 10 V 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

Sensing Mode	Model[1]	Output	Range	LED
	Q256E	—	20 m (65.6 ft)	Infrared, 950 nm
	Q25SN6R	NPN		
	Q25SP6R	PNP		
	Q25SN6LP	NPN	2 m (6.6 ft)	Visible red, 680 nm
	Q25SP6LP	PNP		
	Q25SN6FF25	NPN	25 mm (0.9 in) cutoff	Infrared, 880 nm
	Q25SP6FF25	PNP		
	Q25SN6FF50	NPN	50 mm (1.9 in) cutoff	
	Q25SP6FF50	PNP		
	Q25SN6FF100	NPN	100 mm (3.9 in) cutoff	
	Q25SP6FF100	PNP		

Fixed-Field Mode Overview

Q25 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.
- 9 m (30 ft) cable: add suffix "W/30" (for example, Q256E W/30).
- 4-pin Euro-style QD models: add suffix "Q" (for example, Q256EQ). A model with a QD connector requires a mating cable.

Fixed-Field Sensing – Theory of Operation

The Q25FF 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 Q25FF sensors is fixed at 25, 50 or 100 millimeters (0.9 in, 1.9 in, or 3.9 in). 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).

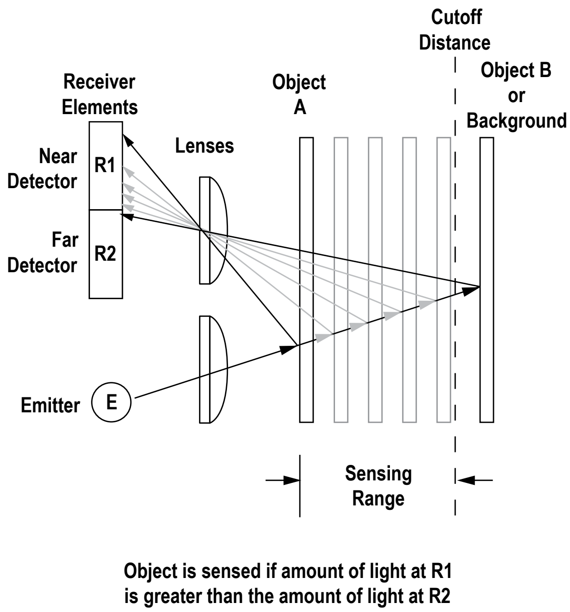


Figure 1. Fixed-Field Concept

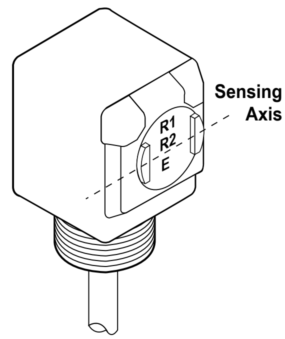


Figure 2. Fixed-Field Sensing Axis

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.

Device Setup

Sensing Reliability

For highest sensitivity, position the target for sensing at or near the point of maximum excess gain. See the Performance Curves section for excess gain curves. 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.

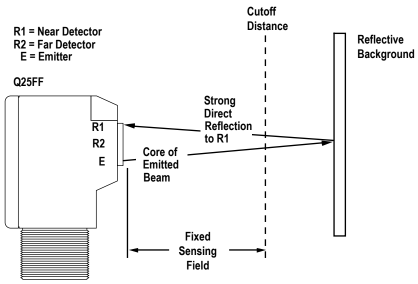


Figure 3. Reflective Background - Problem

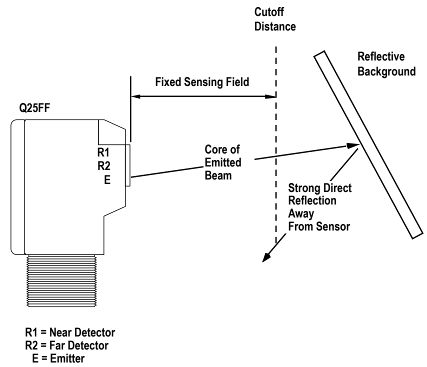
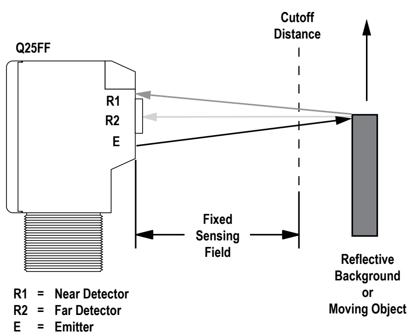
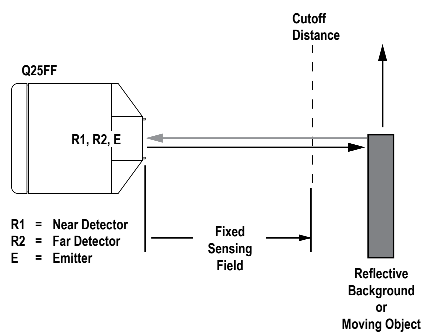


Figure 4. Reflective Background - Solution



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 20 mm (8 in) for the 25 mm (1 in) cutoff model, for example; and 20 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.

Specifications

Supply Voltage and Current
10 V dc 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; NPN (current sinking) or PNP (current sourcing) outputs, depending on model
Light Operate: N.O. (normally open) output conducts when sensor sees its own (or the emitter's) modulated light
Dark Operate: N.C. (normally closed) output conducts when the sensor sees dark; the N.C. output may be wired as a normally open marginal signal alarm output, depending upon hookup to power supply

Environmental Rating
Leakproof design rated NEMA 6P, DIN 40050 (IEC IP69K)

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

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 http://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 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 µA at 30 V dc
ON-state saturation voltage: < 1 V at 10 mA dc; < 1.5 V at 150 mA dc

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, Fixed-Field and Diffuse: 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, Fixed-Field and Diffuse: 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 1.5 times) in light condition

Connections
2 m (6.5 ft) or 9 m (29.5 ft) attached cable or 4-pin Euro-style quick-disconnect fitting

Operating Conditions
Temperature: −40 °C to +70 °C (−40 °F to +158 °F)
Humidity: 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

Performance Curves

Table 1: Opposed Mode Sensors

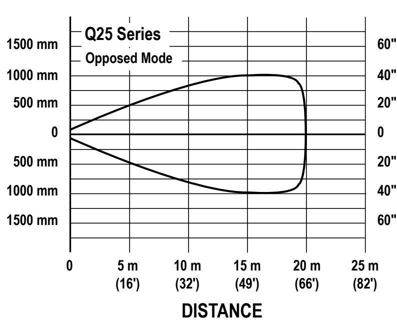
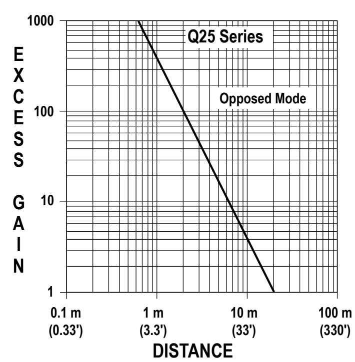
Beam Pattern	Excess Gain
	

Table 2: Polarized Retroreflective Mode Sensors[2]

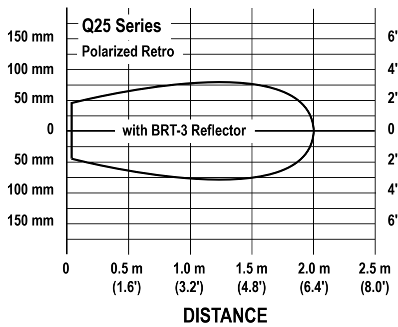
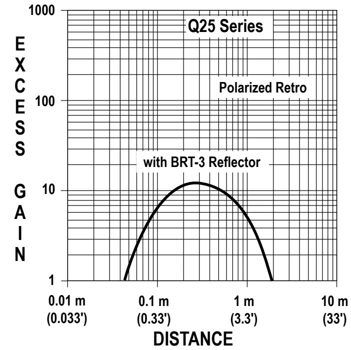
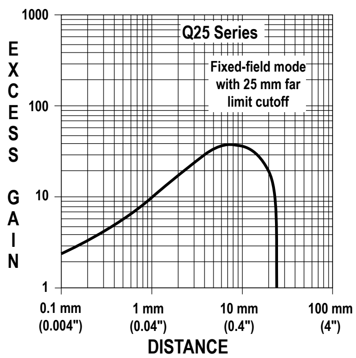
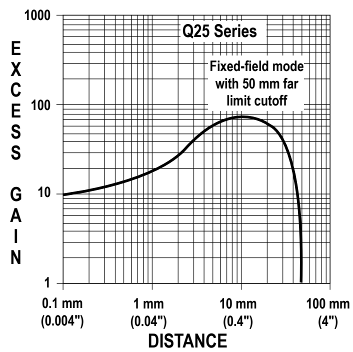
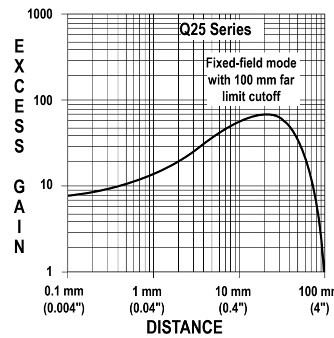
<table>
<tr><th>Beam Pattern</th><th>Excess Gain</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Table 3: Fixed-Field Mode Sensors Excess Gain[3]

<table>
<tr><th>Fixed-Field — 25 mm</th><th>Fixed-Field — 50 mm</th><th>Fixed-Field — 100 mm</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Ø 10 mm spot size at 8 mm focus

Ø 10 mm spot size at 25 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.</td><td>Ø 10 mm spot size at 10 mm focus

Ø 10 mm spot size at 50 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.</td><td>Ø 10 mm spot size at 20 mm focus

Ø 10 mm spot size at 100 mm cutoff

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

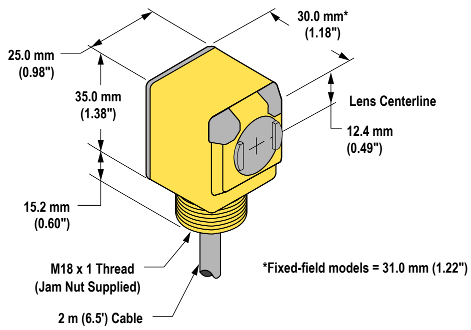
Using 6% black test card: cutoff distance will be 75% of value shown.</td></tr>
</table>

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

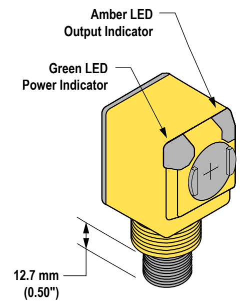
[3] *Performance based on use of a 90% reflectance white test card. Focus and spot sizes are typical.*

Dimensions

Cabled Models

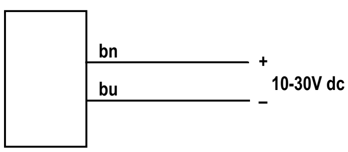


QD Models

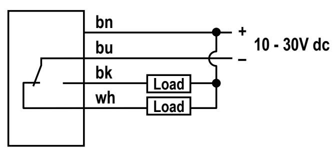


Wiring Diagrams

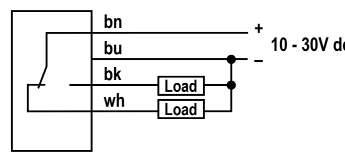
Cabled Emitters



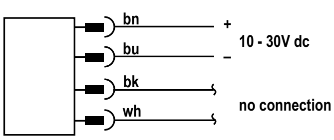
NPN (Sinking) Outputs Standard Hookup



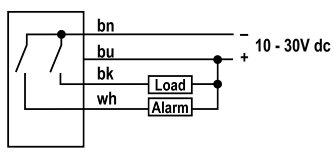
PNP (Sourcing) Outputs Standard Hookup



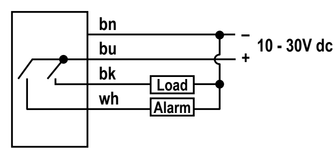
QD Emitters



NPN (Sinking) Outputs Alarm Hookup



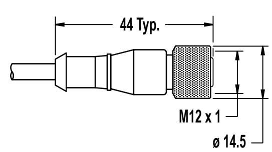
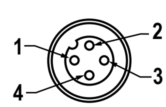
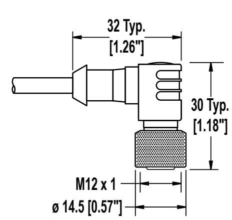
PNP (Sourcing) Outputs Alarm Hookup



NOTE: Cabled hookups are shown. QD hookups are functionally identical.

Cordsets

All measurements are listed in millimeters (inches), unless noted otherwise.

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)			