Q25 AC Sensors

Instruction Manual
Self-Contained, AC-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
- 20 V to 250 V ac (3-wire hookup); SPST solid-state switch output, maximum load 300 mA

**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

<table>
<thead>
<tr>
<th>Sensing Mode</th>
<th>Model1</th>
<th>Output</th>
<th>Range</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPPOSED</td>
<td>Q253E</td>
<td>—</td>
<td>20 m (65.6 ft)</td>
<td>Infrared, 950 nm</td>
</tr>
<tr>
<td></td>
<td>Q25AW3R</td>
<td>LO</td>
<td>2 m (6.6 ft)</td>
<td>Visible red, 680 nm</td>
</tr>
<tr>
<td></td>
<td>Q25RW3R</td>
<td>DO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>POLAR RETRO</td>
<td>Q25AW3LP</td>
<td>LO</td>
<td>25 mm (0.9 in)</td>
<td>Infrared, 880 nm</td>
</tr>
<tr>
<td></td>
<td>Q25RW3LP</td>
<td>DO</td>
<td>50 mm (1.9 in)</td>
<td></td>
</tr>
<tr>
<td>FIXED-FIELD</td>
<td>Q25AW3FF25</td>
<td>LO</td>
<td>100 mm (3.9 in)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q25RW3FF25</td>
<td>DO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q25AW3FF50</td>
<td>LO</td>
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<td></td>
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<tr>
<td></td>
<td>Q25RW3FF50</td>
<td>DO</td>
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</tr>
<tr>
<td></td>
<td>Q25AW3FF100</td>
<td>LO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q25RW3FF100</td>
<td>DO</td>
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</table>

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.

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1 Standard 2 m (6.5 ft) cable models are listed.
2 9 m (30 ft) cable: add suffix "W/30" (for example, Q253E W/30).
3 4-pin Micro-style QD models: add suffix "Q1" (for example, Q253EQ1). 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).

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

Figure 1. Fixed-Field Concept

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.
**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 (0.8 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
20 V to 250 V ac (50 Hz/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; light operate or dark operate, depending on model

Light Operate: Output conducts when sensor sees its own (or the emitter's) modulated light

Dark Operate: Output conducts when the sensor sees dark

Output Protection Circuitry
Protected against false pulse on power-up

Output Response
Time Opposed mode: 16 ms ON, 8 ms OFF
Other models: 16 ms ON and OFF

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

Repeatability
Opposed mode: 2 ms
Other models: 4 ms
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 1.5 times) in light condition

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

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

Connections
2 m (6.5 ft) attached cable, or 4-pin Micro-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

<table>
<thead>
<tr>
<th>Supply Wiring (AWG)</th>
<th>Required Overcurrent Protection (Amps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>5.0</td>
</tr>
<tr>
<td>22</td>
<td>3.0</td>
</tr>
<tr>
<td>24</td>
<td>2.0</td>
</tr>
<tr>
<td>26</td>
<td>1.0</td>
</tr>
<tr>
<td>28</td>
<td>0.8</td>
</tr>
<tr>
<td>30</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Table 2: Polarized Retroreflective Mode Sensors

<table>
<thead>
<tr>
<th>Beam Pattern</th>
<th>Excess Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISTANCE</td>
<td>Q25 Series</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.5 m (1.6')</td>
<td>10</td>
</tr>
<tr>
<td>1.0 m (3.2')</td>
<td>100</td>
</tr>
<tr>
<td>1.5 m (4.8')</td>
<td>1000</td>
</tr>
<tr>
<td>2.0 m (6.4')</td>
<td></td>
</tr>
<tr>
<td>2.5 m (8.0')</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Fixed-Field Mode Sensors Excess Gain

<table>
<thead>
<tr>
<th>Fixed-Field — 25 mm</th>
<th>Fixed-Field — 50 mm</th>
<th>Fixed-Field — 100 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 10 mm spot size at 8 mm focus</td>
<td>Ø 10 mm spot size at 10 mm focus</td>
<td>Ø 10 mm spot size at 20 mm focus</td>
</tr>
<tr>
<td>Ø 10 mm spot size at 25 mm cutoff</td>
<td>Ø 10 mm spot size at 50 mm cutoff</td>
<td>Ø 10 mm spot size at 100 mm cutoff</td>
</tr>
<tr>
<td>Using 18% gray test card: cutoff distance will be 95% of value shown.</td>
<td>Using 18% gray test card: cutoff distance will be 90% of value shown.</td>
<td>Using 18% gray test card: cutoff distance will be 85% of value shown.</td>
</tr>
<tr>
<td>Using 6% black test card: cutoff distance will be 90% of value shown.</td>
<td>Using 6% black test card: cutoff distance will be 85% of value shown.</td>
<td>Using 6% black test card: cutoff distance will be 75% of value shown.</td>
</tr>
</tbody>
</table>

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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

<table>
<thead>
<tr>
<th>Model</th>
<th>Length</th>
<th>Style</th>
<th>Dimensions</th>
<th>Pinout (Female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQAC-406</td>
<td>1.83 m (6 ft)</td>
<td>Straight</td>
<td>4-10 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
<tr>
<td>MQAC-415</td>
<td>4.57 m (15 ft)</td>
<td>Straight</td>
<td>28 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
<tr>
<td>MQAC-430</td>
<td>9.14 m (30 ft)</td>
<td>Straight</td>
<td>32 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
<tr>
<td>MQAC-406RA</td>
<td>1.83 m (6 ft)</td>
<td>Right-Angle</td>
<td>4-10 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
<tr>
<td>MQAC-415RA</td>
<td>4.57 m (15 ft)</td>
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<tr>
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<td>32 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
</tbody>
</table>

QD Models

Wiring Diagrams

Cabled Emitters

<table>
<thead>
<tr>
<th>Model</th>
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<th>Pinout (Female)</th>
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<tr>
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<tr>
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</tr>
<tr>
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<td>4.57 m (15 ft)</td>
<td>Right-Angle</td>
<td>28 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
<tr>
<td>MQAC-430RA</td>
<td>9.14 m (30 ft)</td>
<td>Right-Angle</td>
<td>32 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
</tbody>
</table>

All Other Cabled Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Length</th>
<th>Style</th>
<th>Dimensions</th>
<th>Pinout (Female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQAC-406</td>
<td>1.83 m (6 ft)</td>
<td>Straight</td>
<td>4-10 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
<tr>
<td>MQAC-415</td>
<td>4.57 m (15 ft)</td>
<td>Straight</td>
<td>28 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
<tr>
<td>MQAC-430</td>
<td>9.14 m (30 ft)</td>
<td>Straight</td>
<td>32 Typ.</td>
<td>1/2-20 UNF-28</td>
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<tr>
<td>MQAC-406RA</td>
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<td>MQAC-430RA</td>
<td>9.14 m (30 ft)</td>
<td>Right-Angle</td>
<td>32 Typ.</td>
<td>1/2-20 UNF-28</td>
</tr>
</tbody>
</table>

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

Cordsets

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