R-GAGE™ QT50R-AFH-FL Sensor

Datasheet

Radar-based sensors for detecting moving and stationary targets

- FMCW radar detects moving and stationary objects
- Adjustable sensing field—ignores objects beyond setpoint
- Easy setup and configuration of range, sensitivity, and output with simple DIP switches
- Sensing functions are unaffected by wind, falling rain or snow, fog, humidity, air temperatures, or light
- Sensor operates in Industrial, Scientific, and Medical (ISM) telecommunication band
- Rugged IP67 housing withstands harsh environments

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

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum Range</th>
<th>Connection</th>
<th>Supply Voltage</th>
<th>Telecom Approval</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>QT50R-US-AFH-FL</td>
<td>24 m (78 ft)</td>
<td>5-wire 2 m (6.5 ft) integral cable</td>
<td>12 to 30 V DC</td>
<td>Telecom approved for US and Canada</td>
<td>Bipolar NPN/PNP DIP-switch-selectable N.O. or N.C</td>
</tr>
<tr>
<td>QT50R-EU-AFH-FL</td>
<td></td>
<td></td>
<td></td>
<td>Telecom approved for Europe, UK, Australia, New Zealand, China, and Japan</td>
<td></td>
</tr>
</tbody>
</table>

Overview

Output 1 and 2 LEDs: Yellow (output energized); Red (configuration)
- Power LED: Green (power ON)
- Signal LED: Red (flashes in proportion to the signal strength)
- Access the DIP switches behind the threaded cap on the sensor back (not shown)

The R-GAGE sensor emits a well-defined beam of high-frequency radio waves from an internal antenna. Some of this emitted energy reflects back to the receiving antenna. Signal processing electronics in the sensor determine the distance from the sensor to the object based on the time delay of the return signal. The sensor can be configured (via DIP switches) to sense objects up to a specific distance, ignoring objects beyond this distance (also called background suppression).

R-GAGE setpoint distances, minimum and maximum (sensor will detect objects up to setpoint and ignore objects beyond the setpoint).

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1 Integral 2 m (6.5 ft) unterminated cable models are listed.
2 To order the 5-pin M12 integral quick disconnect model, add the suffix “Q” to the model number. However, the Q is added before the last hyphen. For example, QT50R-xx-AFHQ-FL.
3 Models with a quick disconnect require a mating cordset. See Quick Disconnect (QD) Cordsets on p. 5.
4 For additional countries, contact Banner Engineering.
Sensor Configuration

The sensing zone distance, sensitivity, and output configuration can be selected via the DIP switches on the back of the sensor. Use the included spanner to open the screw-off cover on the back of the sensor and access the DIP switches.

**Important:** Tighten the DIP switch cover a full quarter turn after contact to maintain the watertight seal.

### DIP Switch Functions

<table>
<thead>
<tr>
<th>Switch</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3</td>
<td>Sensing distance (detects objects from sensor face to this point)</td>
</tr>
<tr>
<td>4, 5</td>
<td>Sensitivity (higher sensitivity sees weaker objects and has a larger beam pattern)</td>
</tr>
<tr>
<td>6</td>
<td>Normally open/normally closed output functionality</td>
</tr>
<tr>
<td>7, 8</td>
<td>Response Speed</td>
</tr>
</tbody>
</table>

DIP switch 1 is on the left and DIP switch 8 is on the right.

### Distance Settings

<table>
<thead>
<tr>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2 m (6.6 ft)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3 m (9.8 ft)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4 m (13.1 ft)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>6 m (19.7 ft)</td>
</tr>
<tr>
<td>1*</td>
<td>0*</td>
<td>0*</td>
<td>8 m (26.2 ft)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>12 m (39.4 ft)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>16 m (52.5 ft)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>24 m (78.7 ft)</td>
</tr>
</tbody>
</table>

* Default settings

**Note:** Highest sensitivity is achieved only if sensing distance is 8 m (26.2 ft) or less.

**Note:** Near-field sensitivity boost is enabled when set to 4 m (13.1 ft) or less.

### Sensitivity Selection

<table>
<thead>
<tr>
<th>Switch 4</th>
<th>Switch 5</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0*</td>
<td>0*</td>
<td>4 (Highest)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>3 (High)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>2 (Medium)</td>
</tr>
</tbody>
</table>

3 Typical dead zone: 0.4 m (1.3 ft) for moving and 1.0 m (3.3 ft) for stationary targets, but varies with target reflectivity.
**Switch 4** | **Switch 5** | **Sensitivity**
---|---|---
1 | 1 | 1 (Low)

* Default settings

**Note:** Use the sensitivity selection to ignore unwanted weak reflections within the field of view, and not to narrow the beam width. Narrow-beam R-GAGE sensor models are available.

### Output Configuration

| Switch 6 | Normally Open/Normally Closed |
---|---|
0* | Normally open |
1 | Normally closed |

* Default settings

### Response Time

| Switch 7 | Switch 8 | On Total (ms) | Off Total (ms) | Total (ms) |
---|---|---|---|---|
0 | 0 | 1000 | 1000 | 2000 |
0* | 1* | 2000 | 1000 | 3000 |
1 | 0 | 1000 | 2000 | 3000 |
1 | 1 | 2000 | 6000 | 8000 |

* Default settings

### Specifications

- **Supply Voltage**: 12 V DC to 30 V DC, less than 100 mA, exclusive of load
- **Range**: The sensor is able to detect a proper object (see Detectable Objects) from 1 m to 24 m (3.3 ft to 78.7 ft), depending on target
- **Detectable Objects**: Objects containing metal, water, or similar high-dielectric materials
- **Operating Principle**: Frequency modulated continuous-wave (FMCW) radar
- **Operating Frequency**
  - US Models: 24.075–24.175 GHz, ISM Band
  - EU Models: 24.050–24.250 GHz, ISM Band
- **Maximum Output Power**
  - ERP: 3.3 mW, 5 dBm
  - EIRP: 100 mW, 20 dBm
- **Supply Protection Circuitry**: Protected against reverse polarity and transient overvoltages
- **Delay at Power-up**: Less than 2 seconds
- **Output Configuration**: Bipolar NPN/PNP output, 150mA; DIP switch 6 selects N.O. (default) or N.C. operation
- **Response Time**: DIP switches 7 & 8 select ON/OFF response time

#### Indicators
- **Power LED**: Green (power ON)
- **Signal Strength LED**: Red, flashes in proportion to signal strength. Steady on at 4x excess gain. Only indicates signal amplitude, not target distance.
- **Output LEDs**: Yellow (output energized) / Red (configuration)

#### Adjustments
- DIP-switch-configurable sensing distance, sensitivity, response time, and output configuration

#### Construction
- **Housing**: ABS/polycarbonate
- **Lightpipes**: Acrylic
- **Access Cap**: Polyester

#### Output Protection
- Protected against short circuit conditions

#### Operating Temperature
- –40 °C to +65 °C (–40 °F to +149 °F)

#### Environmental Rating
- IP67

#### Connections
- Integral 5-wire 2 m (6.5 ft) cable or M12 Euro-style QD fitting. QD models require a mating cordset

#### Certifications
- ETSI/EN 300 440
- FCC part 15
- RSS-210
- CMIIT Category G
- ARIB STD T-75
- For others, contact Banner Engineering
- Country of Origin: USA

FCC ID: UE3QT50RUS—This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
IC: 7044A-QT50RCA—This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme aux CNR exempts de licence d’Industrie Canada. Son fonctionnement est soumis aux deux conditions suivantes:(1) Ce dispositif ne peut causer des interférences; et(2) Ce dispositif doit accepter toute interférence, y compris les interférences qui peuvent entraîner un mauvais fonctionnement de l'appareil.

**Beam Pattern**

<table>
<thead>
<tr>
<th>Typical Beam Pattern (with BRTR-CC20E Radar Target, Radar Cross Section = 50 m²)</th>
<th>Typical Beam Pattern (with 4 different targets) at highest sensitivity level</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Left-Right Beam Pattern" /></td>
<td><img src="image2" alt="Left-Right Beam Pattern" /></td>
</tr>
</tbody>
</table>

1–4: Indicates sensitivity level

1: Weak Object (Radar cross section = 0.25 m²)
2: Car (Radar cross section = 3 m²)
3: Large Truck (Radar cross section = 50 m²)
4: Passenger Train (Radar cross section = 300 m²)

**Note:** The effective beam pattern depends on the sensitivity level and target properties.

**Dimensions**

![Dimensions Diagram](image3)
### Wiring

There is no connection to the gray (gy) wire.

**Note:** Banner recommends that the shield wire (quick-disconnect cordsets only) be connected to earth ground or dc common. Shielded cordsets are recommended for all quick-disconnect models.

### Accessories

#### Quick Disconnect (QD) Cordsets

<table>
<thead>
<tr>
<th>Model</th>
<th>Length</th>
<th>Style</th>
<th>Dimensions</th>
<th>Pinout (Female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQDEC2-506</td>
<td>2 m (6.56 ft)</td>
<td>Straight</td>
<td>44 Typ.</td>
<td>1 = Brown, 2 = White, 3 = Blue, 4 = Black, 5 = Gray</td>
</tr>
<tr>
<td>MQDEC2-515</td>
<td>5 m (16.4 ft)</td>
<td>Straight</td>
<td>ø 14.5 M12 x 1</td>
<td></td>
</tr>
<tr>
<td>MQDEC2-530</td>
<td>9 m (29.5 ft)</td>
<td>Straight</td>
<td>32 Typ. (1.26”)</td>
<td></td>
</tr>
<tr>
<td>MQDEC2-550</td>
<td>15 m (49.2 ft)</td>
<td>Right-Angle</td>
<td>ø 14.5 [0.57”]</td>
<td></td>
</tr>
<tr>
<td>MQDEC2-506RA</td>
<td>2 m (6.56 ft)</td>
<td>Right-Angle</td>
<td>30 Typ. (0.15”)</td>
<td></td>
</tr>
<tr>
<td>MQDEC2-515RA</td>
<td>5 m (16.4 ft)</td>
<td>Right-Angle</td>
<td>ø 14.5 [0.57”]</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Note:** Pin 5 is not used.

#### Mounting Brackets

All measurements are listed in millimeters, unless noted otherwise.

**SMB30SC**
- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included

Hole center spacing: A = ø 50.8
Hole size: A = ø 7.0, B = ø 30.0

**SMB30MM**
- 12-ga. stainless steel bracket with curved mounting slots for versatile orientation
- Clearance for M6 (¼ in) hardware
- Mounting hole for 30 mm sensor

Hole center spacing: A = 51, A to B = 25.4
Hole size: A = 42.6 x 7, B = ø 6.4, C = ø 30.1
Weather Deflectors and Shields

QT50RCK Weather Deflector
- Required if the R-GAGE is exposed to rain or snow
- Prevents buildup of water or ice from interfering with sensor performance

QT50RWS Weather Shield
- Coated to help repel water and maximize signal strength
- Hardware included for easy installation and replacement

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