R-GAGE® QT50R-AF2W Sensor

Datasheet

Radar-Based Dual-Zone Narrow-Beam Sensors for Detection of Moving and Stationary Targets

- Fourth generation FMCW (true-presence) radar detects moving and stationary objects
- Narrow beam pattern
- Two independent, adjustable sensing zones
- 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

Protected by US patents

!! CAUTION: Make No Modifications to this Product !!

Any modifications to this product not expressly approved by Banner Engineering could void the user’s authority to operate the product. Contact Banner Engineering for more information.

!! 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>Models1</th>
<th>Maximum Range</th>
<th>Connection</th>
<th>Supply Voltage</th>
<th>Telecom Approval2</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>QT50R-US-AF2W</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, Canada and Brazil</td>
<td>DIP-switch-selectable NPN or PNP and N.O. or N.C.</td>
</tr>
<tr>
<td>QT50R-EU-AF2W</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 Europe, UK, Australia, New Zealand, China, and Japan</td>
<td></td>
</tr>
<tr>
<td>QT50R-KR-AF2W</td>
<td>24 m (78 ft)</td>
<td>5-wire 2 m (6.5 ft) integral cable</td>
<td>12 to 24 V dc</td>
<td>Telecom approved for South Korea</td>
<td></td>
</tr>
<tr>
<td>QT50R-TW-AF2W</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 Taiwan</td>
<td></td>
</tr>
</tbody>
</table>

1 Cabled models only are listed. For integral 5-pin Euro-style (M12) quick-disconnect fitting, add suffix "Q" to the model number (for example, QT50R-xx-AF2WQ). QD models require a mating cordset; see Quick Disconnect (QD) Cordsets on page 6.

2 For additional countries, contact Banner Engineering.
Overview

The R-GAGE sensor emits a well-defined beam of high-frequency radio waves from an internal antenna. Some of this emitted energy is reflected back to the receiving antenna. Signal processing electronics determine the distance from the sensor to the object based on the time delay of the return signal. The sensor can be configured to two independent sensing zones.

The two sensing zones are factory pre-set to default distances; they can be reconfigured for different distances using the DIP switches on the back of the sensor. The sensor is plug-in ready for immediate operation.

The sensitivity was precalibrated at the factory, assuming that the sensing field will be clear of obstacles. The sensitivity can be adjusted using the DIP switches on the back of the sensor.

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>Zone 1 and Zone 2 distance pairs</td>
</tr>
<tr>
<td>4, 5</td>
<td>Sensitivity</td>
</tr>
<tr>
<td>6</td>
<td>Dual NPN/PNP output functionality</td>
</tr>
<tr>
<td>7</td>
<td>Normally Open/Normally Closed output functionality</td>
</tr>
<tr>
<td>8</td>
<td>Response Speed</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>EU, KR Models</th>
<th>TW, US Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Minimum Zone 1 setpoint distance</td>
<td>3 m (9.8 ft)</td>
</tr>
<tr>
<td>Y</td>
<td>Maximum Zone 1 setpoint distance</td>
<td>12 m (39.4 ft)</td>
</tr>
<tr>
<td>A</td>
<td>Minimum Zone 2 setpoint distance</td>
<td>8 (26.2 ft)</td>
</tr>
<tr>
<td>B</td>
<td>Maximum Zone 2 setpoint distance</td>
<td>24 (78.7 ft)</td>
</tr>
<tr>
<td>D</td>
<td>Dead Zone³</td>
<td></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.
Distance Settings

* Default settings

<table>
<thead>
<tr>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>EU, KR Models Zone 1</th>
<th>TW, US Models Zone 1</th>
<th>All Zone 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0</td>
<td>3 m (9.8 ft)</td>
<td>3.5 m (11.5 ft)</td>
<td>8 m (26.2 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 0 1</td>
<td>4 m (13.1 ft)</td>
<td>4 m (13.1 ft)</td>
<td>10 m (32.8 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 0</td>
<td>6 m (19.7 ft)</td>
<td>6 m (19.7 ft)</td>
<td>12 m (39.4 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 1 1</td>
<td>8 m (26.2 ft)</td>
<td>8 m (26.2 ft)</td>
<td>16 m (52.5 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1* 0* 0*</td>
<td>8 m (26.2 ft)</td>
<td>8 m (26.2 ft)</td>
<td>20 m (65.6 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 0 1</td>
<td>10 m (32.8 ft)</td>
<td>10 m (32.8 ft)</td>
<td>20 m (65.6 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1 0</td>
<td>10 m (32.8 ft)</td>
<td>10 m (32.8 ft)</td>
<td>24 m (78.7 ft)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1 1</td>
<td>12 m (39.4 ft)</td>
<td>12 m (39.4 ft)</td>
<td>24 m (78.7 ft)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Sensitivity Selection

* Default settings

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

Output Configuration

* Default settings

<table>
<thead>
<tr>
<th>Switch 6</th>
<th>NPN / PNP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0*</td>
<td>NPN</td>
</tr>
<tr>
<td>1</td>
<td>PNP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Switch 7</th>
<th>NO / NC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0*</td>
<td>NO</td>
</tr>
<tr>
<td>1</td>
<td>NC</td>
</tr>
</tbody>
</table>

Response Speed

* Default settings

<table>
<thead>
<tr>
<th>Switch 8</th>
<th>On Total</th>
<th>Off Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>1*</td>
<td>50</td>
<td>300</td>
<td>350</td>
</tr>
</tbody>
</table>
Specifications

Range
The sensor is able to detect a proper object (see Detectable Objects) from 1 to 24 m (3.3 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, TW Models: 24.075–24.175 GHz, ISM Band
EU, KR Models: 24.050–24.250 GHz, ISM Band

Supply Voltage
12 to 30 V dc, less than 100 mA, exclusive of load
For KR models: 12 to 24 V dc, less than 100 mA exclusive of load

Supply Protection Circuitry
Protected against reverse polarity and transient overvoltages.

Delay at Power-up
Less than 2 seconds.

Output Configuration
DIP switch 6 selects dual NPN (default) or dual PNP operation; DIP switch 7 selects N.O. (default) or N.C. operation; 150mA each
- Zone 1 output: white wire
- Zone 2 output: black wire

Output Protection
Protected against short circuit conditions.

Response Time
DIP switch 8 selects ON/OFF response time.

Indicators
Power LED: Green (power ON)
Signal Strength LED: Red, flashes in proportion to signal strength. Stayed on at 4x excess gain. Only indicates signal amplitude, not target distance.
Output LEDs: Yellow (output energized) / Red (configuration)
See Figure 1 on page 2.

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

Construction
Housing: ABS/polycarbonate
Lightpipes: Acrylic
Access Cap: Polyester

Operating Temperature
−40 °C to +65 °C (−40 °F to +149 °F)

Environmental Rating
IEC 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
- ANATEL Category II
- CMIIT Category G
- KC mark - MSIP/RRA
- NCC
  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-QR50RCA—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 entrainer un mauvais fonctionnement de l’appareil.

Este equipamento opera em caráter secundário, isto é, não tem direito à proteção contra interferência prejudicial, mesmo de estações do mesmo tipo e não pode causar interferência a sistemas operando em caráter primário.

SRD24-I03B24100.2TR0.1 South Korea Class A Certification
A급 (업무용 방송통신기자재)
Dimensions

Beam Pattern

Typical Beam Pattern (with BRTR-CC20E Radar Target, Radar Cross Section = 50 m²)

Typical Beam Pattern (with 4 different targets) at highest sensitivity level

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.

Windows

The R-GAGE sensor can be placed behind a glass or a plastic window, but the configuration must be tested and the distance from the sensor to the window must be determined and controlled prior to installation. There is typically a 20% signal reduction when the sensor is placed behind a window.
Polycarbonate at 4 mm thickness performs well in most situations, but the performance depends on filler materials. Thinner (1 to 3 mm) windows have high reflection. The amount of reflection depends on the material, thickness, and distance from the sensor to the window.

Locate the sensor in a position of minimum reflection from the window, which will repeat every 6.1 mm of distance between the sensor and the window. The positions of maximum reflection from the window repeat between the minimums, and decrease in effect until the window is approximately 150 mm (5.9 in) away. Consult the factory for pre-tested window materials which can be used at any distance without issue.

Additionally, the face of the window should be protected from flowing water and ice by use of a flow diverter or hood directly above the window. Falling rain or snow in the air in front of the window, light water mist, or small beads on the face of the window are typically not an issue. However, a thick, continuous surface of water or ice directly on the face of the window can be detected as a dielectric boundary.

**Weather**

The R-GAGE sensor can be used in the extreme weather conditions found in port harbors and near oceans. The water in the air does not affect the radar beam, but thick water or ice on the face of the radome can affect performance. In heavy rain or ice conditions, to prevent build-up of water or ice on the radome, use the SAQT50R-91611 accessory. This is a hydrophobic end cap that is easily attached over the sensor radome. This end cap, which is field-replaceable, will take the regular wear and tear from port operation to protect the sensor radome and prolong the life of the radar sensor.

**Wiring**

**Wiring Key:**
1 = Brown  
2 = White  
3 = Blue  
4 = Black  
5 = Gray (Do not connect)

**NOTE:** Banner recommends that the shield wire (quick disconnect (QD) fitting cordsets only) be connected to earth ground or dc common. Shielded cordsets are recommended for all QD 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>1.83 m</td>
<td>Straight</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
<tr>
<td>MQDEC2-515</td>
<td>4.57 m</td>
<td>Straight</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
<tr>
<td>MQDEC2-530</td>
<td>9.14 m</td>
<td>Straight</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
<tr>
<td>MQDEC2-550</td>
<td>15.2 m</td>
<td>Straight</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
<tr>
<td>MQDEC2-506RA</td>
<td>1.83 m</td>
<td>Right-Angle</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
<tr>
<td>MQDEC2-515RA</td>
<td>4.57 m</td>
<td>Right-Angle</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
<tr>
<td>MQDEC2-530RA</td>
<td>9.14 m</td>
<td>Right-Angle</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
<tr>
<td>MQDEC2-550RA</td>
<td>15.2 m</td>
<td>Right-Angle</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Female Pinout" /></td>
</tr>
</tbody>
</table>
NOTE: Pin 5 is not used.

Mounting Brackets

All measurements are in mm

**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=\(50.8\)
Hole size: A=\(7.0\), B=\(30.0\)

**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 = \(6.4\), C = \(30.1\)

Weather Deflector

**SAQT50R**
- Coated to help repel water and maximize signal strength
- Mounts using screws for easy application and replacement
- Required if the R-GAGE is exposed to rain or snow
- Prevents buildup of water or ice interfering with sensor performance

Banner Engineering Corp. Limited Warranty

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