R-GAGE® QT50R-AF2 Sensor

Datasheet
Radar-based dual-zone sensors for detecting moving and stationary targets

- Fourth generation FMCW (true-presence) radar detects moving and stationary objects
- 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; no special license required
- Rugged IP67 housing withstands harsh environments

Protected by US patents

<table>
<thead>
<tr>
<th>Models</th>
<th>Maximum Range</th>
<th>Supply Voltage</th>
<th>Connection</th>
<th>Telecom Approval</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>QT50R-US-AF2</td>
<td>24 m (78 feet)</td>
<td>12 to 30 V dc</td>
<td>5-wire 2 m (6.5 ft) Integral cable</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-AF2</td>
<td>12 to 24 V dc</td>
<td>Telecom approved for Europe, UK, Australia, New Zealand, China, and Japan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QT50R-KR-AF2</td>
<td>12 to 24 V dc</td>
<td>Telecom approved for South Korea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QT50R-TW-AF2</td>
<td>12 to 30 V dc</td>
<td>Telecom approved for Taiwan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

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 pre-calibrated 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.

1 Cabled models only are listed. To order the integral 5-pin M12 quick-disconnect fitting, add suffix "Q" to the model number (for example, QT50R-xx-AF2Q). QD models require a mating cordset; see Quick Disconnect (QD) Cordsets on page 6.

2 For additional countries, contact Banner Engineering.
1. **Power LED**: Green (power ON)
2. **Signal Strength LED**: Red, flashes in proportion to signal strength. Steady on at 4x excess gain. Only indicates signal amplitude, not target distance.
3. **Output LEDs**: Yellow (output energized) / Red (configuration)

Access the DIP switches behind the threaded cap on the sensor back (not shown)

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<table>
<thead>
<tr>
<th>DIP Switch Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Switch</strong></td>
</tr>
<tr>
<td>1, 2, 3</td>
</tr>
<tr>
<td>4, 5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
</tbody>
</table>

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

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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</td>
<td>0</td>
<td>0</td>
<td>3 m (9.8 ft)</td>
<td>3.5 m (11.5 ft)</td>
<td>8 m (26.2 ft)</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4 m (13.1 ft)</td>
<td>4 m (13.1 ft)</td>
<td>10 m (32.8 ft)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6 m (19.7 ft)</td>
<td>6 m (19.7 ft)</td>
<td>12 m (39.4 ft)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8 m (26.2 ft)</td>
<td>8 m (26.2 ft)</td>
<td>16 m (52.5 ft)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8 m (26.2 ft)</td>
<td>8 m (26.2 ft)</td>
<td>20 m (65.6 ft)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>10 m (32.8 ft)</td>
<td>10 m (32.8 ft)</td>
<td>20 m (65.6 ft)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>10 m (32.8 ft)</td>
<td>10 m (32.8 ft)</td>
<td>24 m (78.7 ft)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>12 m (39.4 ft)</td>
<td>12 m (39.4 ft)</td>
<td>24 m (78.7 ft)</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*</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>
<tr>
<td>1</td>
<td>1</td>
<td>1 (Low)</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. 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

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
- ARIB STD T-73
- 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 entraîner 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-IO3B24100.2TR0.1 South Korea Class A Certification

Este produto é classificado como equipamento de Classe A. Em ambientes residenciais, este equipamento pode causar interferência prejudicial e, nesse caso, o usuário será solicitado a corrigir a interferência a seu próprio custo.
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.

Wiring

![Wiring Diagram]

**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 (6 ft)</td>
<td>Straight</td>
<td>![MQDEC2-506 Straight Diagram]</td>
<td></td>
</tr>
</tbody>
</table>
| MQDEC2-515     | 4.57 m (15 ft) |           |                  | 1 = Brown  
|                |            |           |                  | 2 = White  
|                |            |           |                  | 3 = Blue   
|                |            |           |                  | 4 = Black  
|                |            |           |                  | 5 = Gray   |
| MQDEC2-530     | 9.14 m (30 ft) |           |                  |                  |
| MQDEC2-550     | 15.2 m (50 ft) |           |                  |                  |
| MQDEC2-506RA   | 1.83 m (6 ft) | Right-Angle | ![MQDEC2-506RA Right-Angle Diagram] | 1 = Brown  
|                |            |           |                  | 2 = White  
|                |            |           |                  | 3 = Blue   
|                |            |           |                  | 4 = Black  
|                |            |           |                  | 5 = Gray   |
| MQDEC2-515RA   | 4.57 m (15 ft) |           |                  |                  |
| MQDEC2-530RA   | 9.14 m (30 ft) |           |                  |                  |
| MQDEC2-550RA   | 15.2 m (50 ft) |           |                  |                  |
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 = 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 (1/4 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 Deflector**

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

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