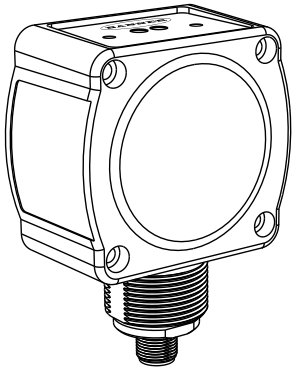
R-GAGE® QT50R-RH Sensor

Datasheet

Radar-Based Retroreflective Sensors for Detection of Moving and Stationary Targets



- FMCW radar detects moving and stationary objects
- Retro-wave sensor—use of a reference signal (retroreflective target) enables reliable detection of weak targets in the foreground
- Retro-wave detection—output activates for objects detected in the foreground OR for loss of detection of the retroreflective target
- Easy setup and configuration of range, sensitivity, and output with simple DIP switches
- Ignores objects in the background beyond the retroreflective target
- Double reflection immunity technology
- Sensing field is configured via remote TEACH
- 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

Models [1]	Maximum Range	Connection	Supply Voltage	Telecom Approval [2]	Output
QT50R-US-RH	12 m (39 ft)	5-wire 2 m (6.5 ft) Integral cable	12 to 30 V DC	Telecom approved for US, Canada and Brazil	Bipolar NPN/PNP DIP-switch-selectable N.O. or N.C.
QT50R-EU-RH				Telecom approved for Europe, UK, Australia, New Zealand, China, and Japan	
QT50R-KR-RH			12 to 24 V DC	Telecom approved for South Korea	
QT50R-TW-RH			12 to 30 V DC	Telecom approved for Taiwan	

Overview

The R-GAGE sensor emits a well-defined beam of high-frequency radio waves from an internal antenna. This emitted energy reflects off of a retroreflective target and returns to the receiving antenna. As long as the antenna is receiving reflected radio waves, the output will remain off. If an object blocks radio waves, the output will turn on. The distance range for the retroreflective target can be configured via remote TEACH wire. Objects beyond the retroreflective target are ignored (also called background suppression). In Normally Closed mode, the output operates like a foreground suppression sensor.

[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-RHQ**). Quick-disconnect models require a mating cordset; see Quick Disconnect (QD) Cordsets on p. 7.

[2] For additional countries, contact Banner Engineering.

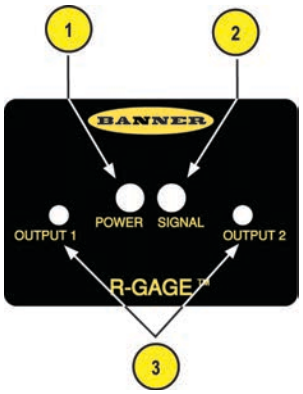
Original Document
169604 Rev. F

11 June 2021

169604

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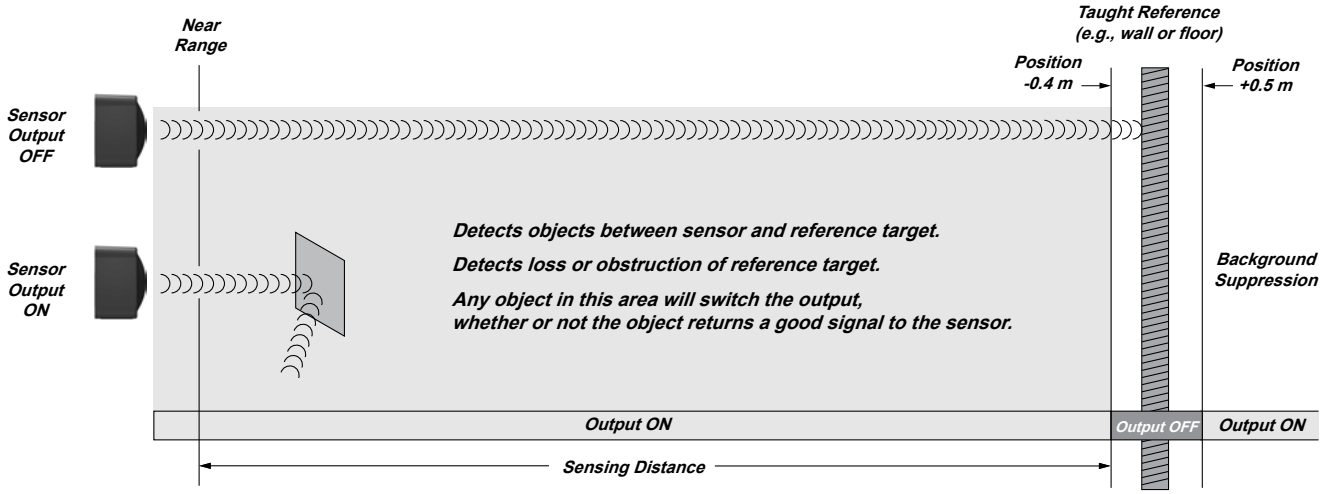
Figure 1. R-GAGE features



1. Power LED: Green (power ON)
2. Signal Strength LED: Red (flashes in proportion to the signal strength)
3. Output LEDs: Yellow (output energized); Red (configuration)

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

Figure 2. Sensor detects radio waves reflected from corner cube reflector or background. Any object blocking the signal results in an output change



Sensor Configuration

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

Switch	Function
1, 2, 3	Retro Sensitivity (contrast between retroreflective target and foreground targets)
4, 5	Foreground Sensitivity (improve detection of near-field mirror-like targets)
6	Normally open/normally closed output functionality
7, 8	Response Speed

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

Retro Sensitivity Selection

Switch 1	Switch 2	Switch 3	Sensitivity	Contrast
0	0	0	8	Use for weak retro with strong targets

Switch 1	Switch 2	Switch 3	Sensitivity	Contrast
0	0	1	7	
0	1	0	6	
0*	1*	1*	5*	Use for normal retro with normal targets
1	0	0	4	
1	0	1	3	
1	1	0	2	
1	1	1	1	Use for strong retro with weak targets

* Default settings

Foreground Sensitivity/Double Reflection Immunity

* Default settings

If a radar sensor encounters a mirror-like target in the near field, for example, the roof of a vehicle, it is possible for the sensor to detect the radio waves from the ceiling or wall behind the sensor that are being reflected by the target. The target object may not be detected in this type of situation. Typically, this is only an issue on top-down target detection when the sensor is mounted directly to a metal ceiling.

The Foreground Sensitivity DIP switch settings alleviate double reflections (mirror reflections). These settings are similar to secondary echo rejection in ultrasonic sensors. Set the Foreground Sensitivity DIP switch to Highest for best performance in top-down metal ceiling-mounted vehicle detection applications.

However, if there are strong reflections from peripheral objects within the full beam pattern of the sensor, the Highest setting may cause unwanted detection of the peripheral objects. In this case, set the Foreground Sensitivity DIP switch to Medium. Foreground sensitivity is designed for double reflections, not for strong peripheral reflections. When peripheral reflections are too strong, determine whether eliminating double reflections or peripheral reflections is more important. Depending on the decision, the foreground sensitivity may be turned to low when strong peripheral reflections are detected.

The Foreground Sensitivity DIP switch has four settings ranging from highest to low. The factory default setting is low.

Switch 4	Switch 5	Sensitivity	Use
0	0	Highest	Mirror targets (double reflections) with no peripheral reflections (widest effective beam pattern)
0	1	High	
1	0	Medium	Mirror targets (double reflections) with weak peripheral reflections that need to be ignored
1*	1*	Low	Strong peripheral reflections that need to be ignored (narrowest effective beam pattern). Double reflection immunity is disabled.

Output Configuration

Switch 6	Normally Open/Normally Closed
0*	N.O.
1	N.C.

* Default settings

Response Speed

Switch 7	Switch 8	ON (ms)	OFF (ms)	Total (ms)
0	0	30	70	100
0	1	30	120	150
1*	0*	50	300	350
1	1	50	600	650

* Default settings

Installation

For optimal performance, the sensor should be aimed perpendicular to the surface of the retroreflective target. Angling the sensor greater than 15 degrees with respect to a flat surface is not recommended.

The retroreflective target must be the strongest target in the field of view. If another equally strong background target is in the field of view, the sensor may be taught the wrong target, or the sensing state may oscillate.

After installing, a remote TEACH must be performed to teach the sensor the retroreflective target. The sensor will not operate correctly until a TEACH is performed. A TEACH must be performed each time the sensor is moved or the retroreflective target changes.

Remote Line TEACH

The adjustable field, retroreflective target, and background suppression distances are set using a remote wire. For remote programming, connect a switch or digital input to the gray wire (remote line); length of the individual pulses is equal to the value **T: 0.064 seconds < T < 0.8 seconds**

Step	Procedure	Result
Access Remote Line Teach	• Double-pulse the remote line 	Output LEDs ON Red
Teach Distance	• Single-pulse the remote wire 	Output 1 LED flashes Red 10x
Return to Run Mode	If the TEACH is successful, the sensor will be in a non-sensing state (output LEDs OFF)	Output LEDs OFF

Note: A successful TEACH can be verified by placing an object in between the sensor and the retroreflective target after the TEACH has been performed. This should cause both Output LEDs to turn ON.

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.

Specifications

Range
The sensor is able to detect a proper retroreflective target (see Detectable Objects) up to 12 m (39.4 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

Maximum Output Power
ERP: 3.3 mW, 5 dBm
EIRP: 100 mW, 20 dBm

Supply Voltage
12 V DC to 30 V DC, less than 100 mA, exclusive of load
For KR models: 12 V DC 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
Bipolar NPN/PNP output, 150mA; DIP switch 6 selects N.O. (default) or N.C. operation

Output Protection
Protected against short circuit conditions

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)
See Figure 1 on p. 2

Adjustments
DIP-switch-configurable sensitivity, response time, and output configuration; remote line teach of the retroreflective target

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

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

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

Environmental Rating
IP67

Certifications
CE
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.



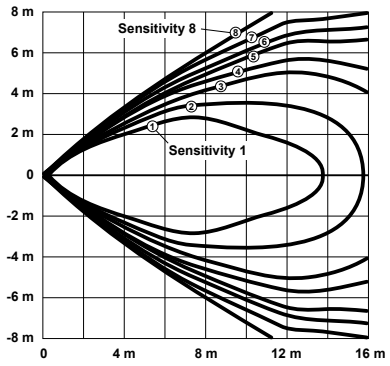
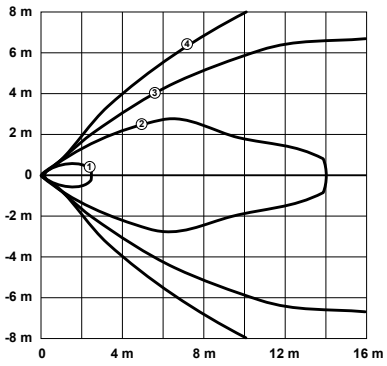
Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados.

SRD24-IO3B24100.2TR0.1 South Korea Class A Certification

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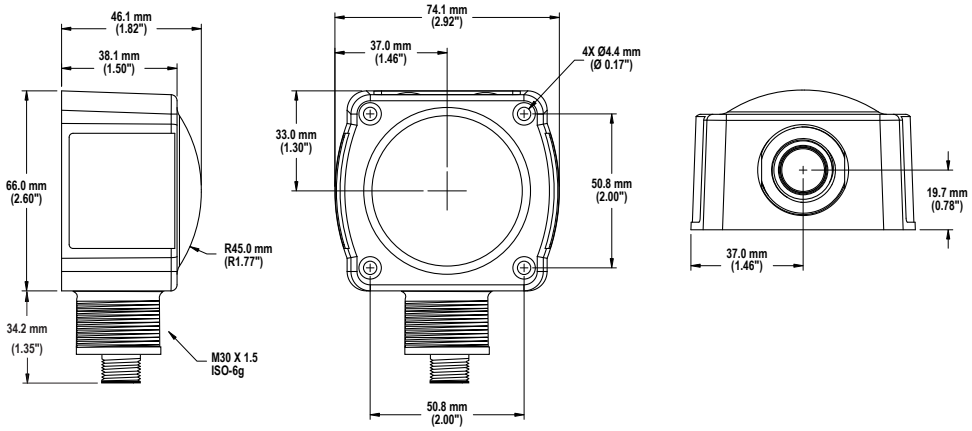
Beam Patterns

Typical Beam Pattern (with BRTR-CC20E Radar Target, Radar Cross Section = 50 m^2)	Typical Beam Pattern (with 4 different targets) at sensitivity level 5
Left-Right Beam Pattern	Left-Right Beam Pattern
	
Distance	Distance
1–8: Indicates sensitivity level	1. Weak Object (Radar cross section = 0.25 m^2) 2. Car (Radar cross section = 3 m^2) 3. Large Truck (Radar cross section = 50 m^2) 4. Passenger Train (Radar cross section = 300 m^2)

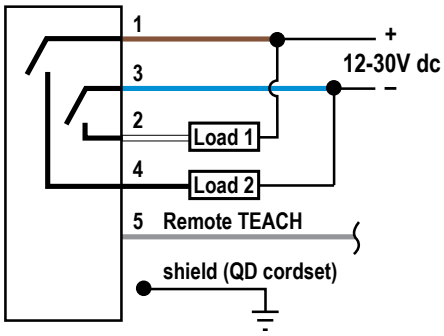
Note: The effective beam pattern depends on the sensitivity level and target properties.

The diagrams show the beam pattern with respect to the retroreflective target. The effective beam pattern for detection of foreground objects will be the size of the retroreflective target. For a flat retroreflective surface, the beam size is a 15 degree cone.

Dimensions



Wiring

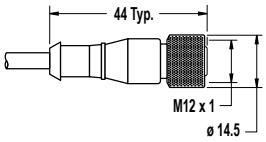
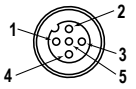
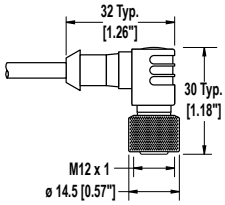


Wiring Key:
1 = Brown
2 = White
3 = Blue
4 = Black
5 = Gray (Float or connect to V+ for idle operation. Switch to ground for remote TEACH operation)

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

Accessories

Quick Disconnect (QD) Cordsets

5-Pin Threaded M12 Cordsets with Shield—Single Ended				
Model	**Length**	**Style**	**Dimensions**	**Pinout (Female)**
MQDEC2-506	2 m (6.56 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray
MQDEC2-515	5 m (16.4 ft)			
MQDEC2-530	9 m (29.5 ft)			
MQDEC2-550	15 m (49.2 ft)			
MQDEC2-506RA	2 m (6.56 ft)	Right-Angle		
MQDEC2-515RA	5 m (16.4 ft)			
MQDEC2-530RA	9 m (29.5 ft)			
MQDEC2-550RA	15 m (49.2 ft)			

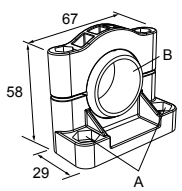
Note: Pin 5 is not used.

Mounting Brackets

All measurements are listed in millimeters, unless noted otherwise.

SMB30SC

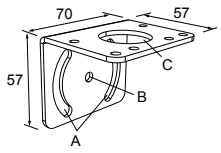
- Swivel bracket with 30 mm mounting hole for sensor
- Black reinforced thermoplastic polyester
- Stainless steel mounting and swivel locking hardware included



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

Retroreflective Target

BRTR-CC20E

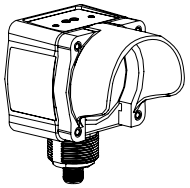
- Large corner-cube reflector in protective plastic enclosure
- Provides 7x excess gain at 6 m



Weather Deflectors and Shields

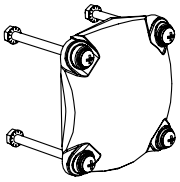
QT50RCK Weather Deflector

- 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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