



# R-GAGE™ QT50R Retroreflective\* Sensor

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

## Features



- FMCW (true-presence) radar detects moving and stationary objects
- Retro-wave sensor —use of 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
- Ignores objects in the background beyond the retroreflective target
- Sensing field is configured via remote TEACH
- Sensitivity and output settings configured with simple DIP switches
- Sensing functions are unaffected by wind, rain, fog, light, humidity and air temperatures
- Sensor operates in Industrial, Scientific, and Medical (ISM) telecommunication band; no special license required
- Rugged IP67 housing withstands harsh environments

\* Patent(s) issued or pending



## Models

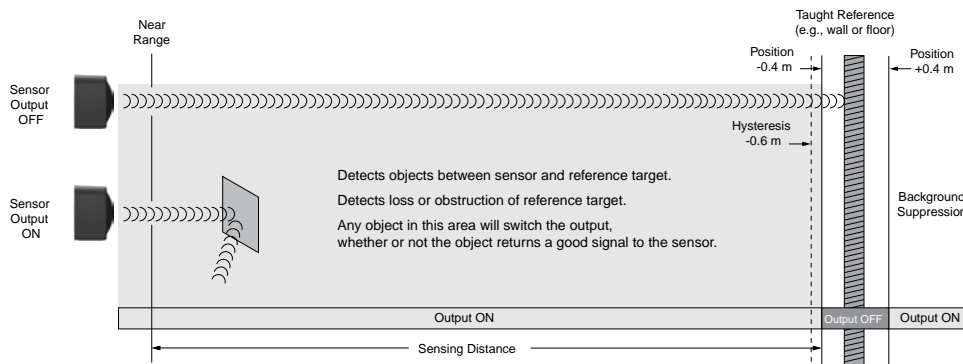
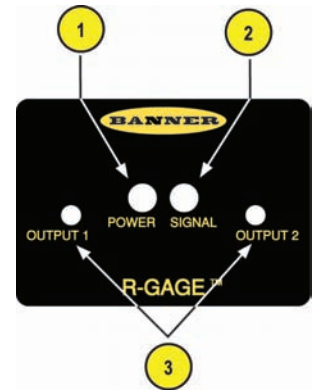
Models*	Maximum Range	Connection	Supply Voltage	Telecom Approval	Output
QT50RAF-US-R	12 m (39')	5-wire 2 m (6.5') Integral cable	12 to 30V dc	Telecom approved for US, Canada and Mexico	Bipolar NPN/PNP DIP-switch-selectable N.O. or N.C.
QT50RAF-CN-R				Telecom approved for China	
QT50RAF-EU-R				Telecom approved for Europe (except UK), Australia and New Zealand	
QT50RAF-UK-R				Telecom approved for UK	

\* Cabled models only are listed. For integral 5-pin Euro-style (M12) quick-disconnect fitting, add suffix "Q" to the model number (e.g., QT50RAFQ-xx). QD models require a mating cordset; see [Quick-Disconnect \(QD\) Cordsets](#) on page 7.



## Overview

The R-GAGE sensor emits a well-defined beam of high-frequency radio waves from an internal antenna. This emitted energy reflects off 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. Power LED: Green (power ON)
2. Signal Strength LED: Red (flashes in proportion to signal strength)
3. Output LEDs: Yellow (output energized); Red (configuration)

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

**Figure 1.** Sensor detects radio waves reflected from corner cube reflector or background. Any object blocking the signal results in an output change

## Sensor Configuration

The sensitivity and output configuration can be selected via the DIP switches on the back of the sensor. The sensing distance must be configured via remote TEACH wire.

Use the included spanner to open the screw-off cover on the back of the sensor and access the DIP switches.

\* Default settings

### DIP Switch Functions

Switch	Function
1, 2, 3	Not used
4, 5, 6	Sensitivity (contrast between retroreflective target and foreground targets)
7	Normally open/normally closed output functionality
8	Response speed

### Sensitivity Selection

Switch 4	Switch 5	Switch 6	Sensitivity	Contrast
0	0	0	8	Use for weak retro with strong targets ↓
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

### Output Configuration

Switch 7	Normally Open/Normally Closed
0*	N.O.
1	N.C.

### Response Speed

Switch 8	ON	OFF	ON/OFF
0	32 ms	68 ms	100 ms
1*	258 ms	998 ms	1256 ms

## 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	<ul style="list-style-type: none"> <li>Double-pulse the remote line</li> </ul> 	<ul style="list-style-type: none"> <li>Output LEDs ON Red</li> </ul>
Teach distance	<ul style="list-style-type: none"> <li>Single-pulse the remote wire</li> </ul> 	<ul style="list-style-type: none"> <li>Output 1 LED flashes Red 10x</li> </ul>
Return to Run Mode	<ul style="list-style-type: none"> <li>If the TEACH is successful, the sensor will be in a non-sensing state (output LEDs OFF)</li> </ul>	<ul style="list-style-type: none"> <li>Output LEDs OFF</li> </ul>

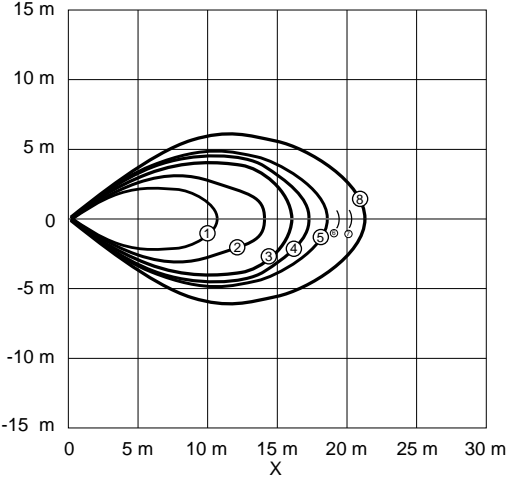
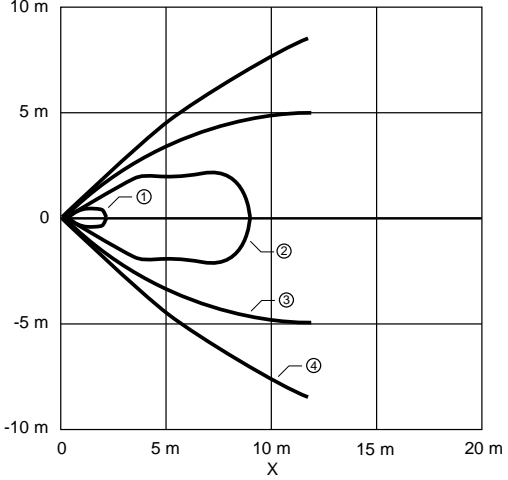
NOTE: A successful TEACH can be verified by placing an object in between the sensor and the retroreflective target after the TEACH has been performed. This should cause both Output LEDs to turn ON.

## Specifications

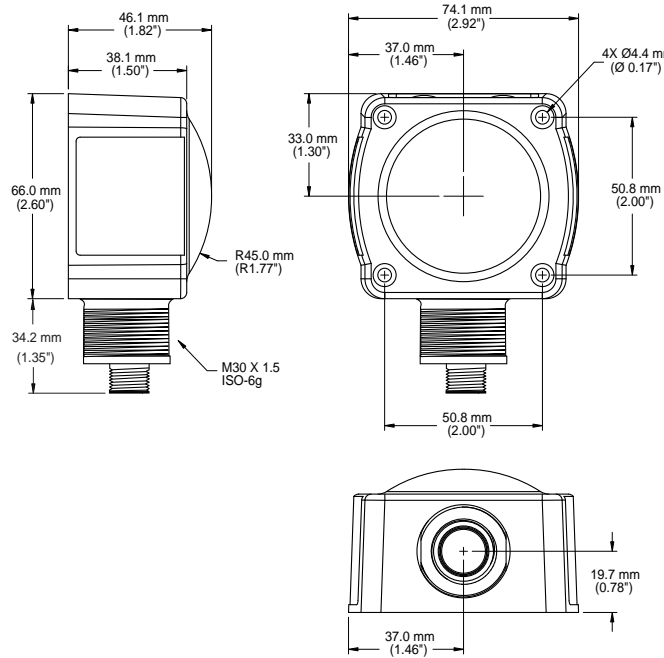
Feature	Description
<b>Range</b>	The sensor is able to detect a proper retroreflective target (see below) up to 12 meters, depending on target.
<b>Detectable Objects</b>	Objects containing metal, water, or similar high-dielectric materials.
<b>Operating Principle</b>	Frequency modulated continuous-wave (FMCW) radar
<b>Operating Frequency</b>	24.00 to 24.25 GHz, ISM Band (varies slightly with model, depending on national telecom regulations)
<b>Supply Voltage</b>	12 to 30V dc, less than 100 mA, exclusive of load
<b>Supply Protection Circuitry</b>	Protected against reverse polarity and transient overvoltages
<b>Delay at Power-up</b>	Less than 2 seconds
<b>Output Configuration</b>	Bipolar NPN/PNP output, 150mA; DIP switch 7 selects N.O. (default) or N.C. operation
<b>Output Protection</b>	Protected against short circuit conditions
<b>Indicators</b>	<p><b>Power LED:</b> Green (power ON)</p> <p><b>Signal Strength LED:</b> Red, flashes in proportion to signal strength. Steady on at 4x the sensitivity adjusted baseline (indicating 4x excess gain). Only indicates signal amplitude, not target distance.</p> <p><b>Output LEDs:</b> Yellow (output energized)/Red configuration</p> <p>See Figure 2.</p>

Feature	Description
Response time	DIP-switch 8 selects ON/OFF response time
Adjustments	DIP-switch-configurable sensitivity and output configuration; remote line teach of the retroreflective target
Construction	<b>Housing:</b> ABS/polycarbonate <b>Lightpipes:</b> Acrylic <b>Access Cap:</b> Polyester
Operating Temperature	-40° to +65° C (-40° to +149° F)
Environmental Rating	IP67
Connections	Integral 5-wire 2 m (6.5') cable or M12 Euro-style QD fitting. QD models require a mating cordset; see page 4.
Certifications	 and ETSI/EN 300 440; FCC part 15; Industry Canada; for others, consult the Factory.

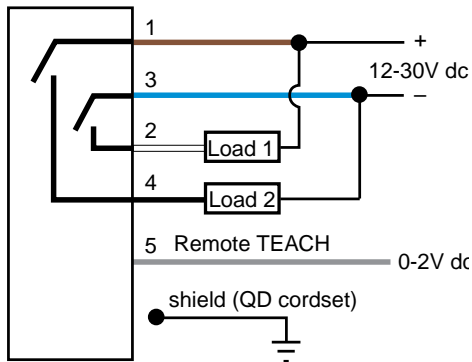
## Beam Pattern

Typical Beam Pattern (with BRTR-CC20E Radar Target, RCS = 50 m <sup>2</sup> )	Typical Beam Pattern (with 4 different targets) at sensitivity level 5
	
1-8: Indicates sensitivity level X: Distance	1: Weak Object - RCS = 0.25 m <sup>2</sup> 2: Car - RCS = 3 m <sup>2</sup> 3: Large Truck - RCS = 50 m <sup>2</sup> 4: Passenger Train - RCS = 300 m <sup>2</sup>
<p>NOTE: The effective beam pattern depends on sensitivity level and target properties.</p> <p>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.</p>	

## Dimensions



## Hookup



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

### Quick-Disconnect (QD) Cordsets

Style	Model	Length	Dimensions	Pinout
5-pin Euro-style straight with shield	<b>MQDEC2-506</b>	2 m (6.5')		<p>Female</p>
	<b>MQDEC2-515</b>	5 m (15')		
	<b>MQDEC2-530</b>	9 m (30')		
5-pin Euro-style right-angle with shield	<b>MQDEC2-506RA</b>	2 m (6.5')		<p>1 = Brown 2 = White 3 = Blue 4 = Black 5 = Gray (not used)</p>
	<b>MQDEC2-515RA</b>	5 m (15')		
	<b>MQDEC2-530RA</b>	9 m (30')		

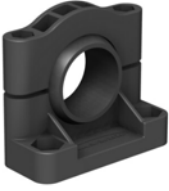

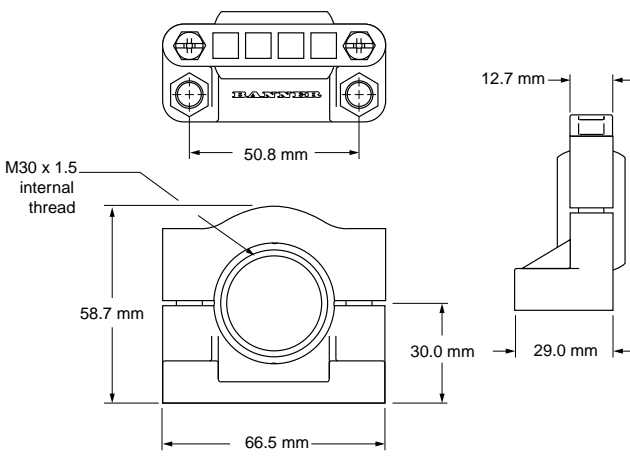
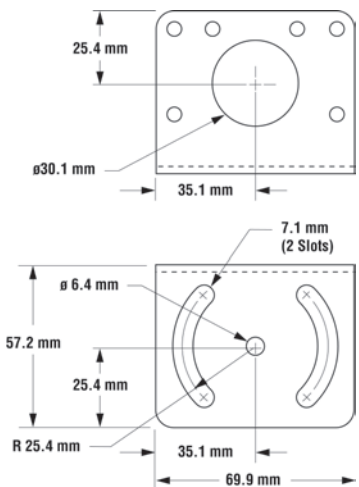
### Retroreflective Target

Model	Description
<b>BRTR-CC20E</b>	<ul style="list-style-type: none"> <li>• Large corner-cube reflector in protective plastic enclosure</li> <li>• Provides 7x excess gain at 6 m</li> </ul>

### Weather Deflector

Model	Description
<b>QT50RCK</b>	<ul style="list-style-type: none"> <li>• Required if the R-GAGE is exposed to rain or snow</li> <li>• Prevents buildup of water or ice from interfering with sensor performance</li> </ul>

## Mounting Brackets

<b>SMB30SC</b>		<b>SMB30MM</b>	
<ul style="list-style-type: none"> <li>30 mm split clamp with swivel, black reinforced thermoplastic polyester</li> <li>Stainless steel hardware included</li> </ul>		<ul style="list-style-type: none"> <li>30 mm, 11-gauge, stainless steel bracket with curved mounting slots for versatile orientation</li> <li>Clearance for M6 (1/4") hardware</li> </ul>	
			

**Caution...Make No Modifications to this Sensor**

Any modifications to this sensor not expressly approved by Banner Engineering could void the user's authority to operate the sensor. **Contact the Factory for more information.**

**WARNING . . . Not To Be Used for Personnel Protection**

**Never use this product as a sensing device for personnel protection. Doing so could lead to serious injury or death**

This product 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 deenergized sensor output condition. Consult your Banner Safety Products catalog for safety products that meet OSHA, ANSI and IEC standards for personnel protection.