Wireless Tilt Sensor

User Guide

VERSION 1.2
OCTOBER 2018

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1. QUICK START

To start using your sensor, simply go to:

https://console.radiobridge.com

From here you can register your device and immediately start receiving messages from the sensor.

The sensor configuration, message monitoring, and setting up alerts is usually self-explanatory through the user interface. For further explanations of any sensor features, you may refer to this user guide.

2. OVERVIEW

2.1. Sensor Overview

The wireless sensors designed and manufactured by Radio Bridge provide full sensor to cloud solutions for Internet of Things (IoT) applications. The tilt sensor uses an accelerometer to detect transitions between horizontal and vertical orientation, as well as reporting the angle of tilt. When the sensor is rotated from horizontal to vertical or visa versa, an alert is sent to the wireless network. The thresholds for triggering a tilt event are configurable over the air. Versions of the sensor support the major LPWAN standards such as Sigfox, LoRa/LoRaWAN, and SubGig.

Features include:

- Built-in radio that talks directly with the wireless network. Standards include:
  - Sigfox
  - LoRa/LoRaWAN
  - SubGig®
- Two types of tamper detection: enclosure tamper and wall mount tamper
  - Enclosure tamper detects if the packaging of the sensor itself is opened or broken
  - Wall mount tamper detects if the sensor has been removed from the wall or mounting point
- 20,000-1M+ transmissions on a single battery and a 5-10 year battery life depending on usage (see Battery section)
- Fully integrated internal antenna
- Over the air sensor configuration in the field
- Automatic low battery reporting and supervisory messages

2.2. Revision History

Table 1 Revision History

Revision	Date	Description
1.0	April 2018	Initial release of the document
1.1	August 2018	Updated protocol definitions
1.2	October 2018	Regulatory and FCC

2.3. Document Conventions

Table 2 Document Conventions

Font / Icon	Meaning
	Important notes
	Warnings and cautions

2.4. Part Numbers

Table 3 Part Numbers

Part Number	Wireless Standard	Region
RBS101-TILT-RCZ2	Sigfox	North America
RBS201-TILT-315	SubGig	North America
RBS301-TILT-US	LoRa	North America

3. TECHNICAL SPECIFICATIONS

3.1. Absolute Maximum Ratings

Table 4 Absolute Maximum Ratings

Parameter	Rating	Units
Operating ambient temperature	-30 to +70	°C
Storage ambient temperature	-40 to +100	°C

4. BATTERY LIFE

The sensor uses a lithium non-rechargeable battery and is capable of 20,000 to 1,000,000+ total messages depending on the wireless standard and usage. For an accurate estimate of battery life, please refer to the "Sensor Battery Estimator.xlsx" spreadsheet on the Radio Bridge website. This spreadsheet combines usage information such as average number of messages per day and estimates the battery life for a particular sensor.

Refer to the spreadsheet "Sensor Battery Estimator.xlsx" on the Radio Bridge website for specific battery life estimates.

The power required for a message transmission is much greater than the "sleep current" (the power consumed when the sensor is inactive) for high power radio technologies such as Sigfox and LoRaWAN. This means that the battery life for most sensors is primarily dependent on the number of transmissions per day.

Different battery types will deplete over time with different voltage profiles. For instance, a lithium battery will maintain a relatively high voltage for the life of the battery and then experience a rapid drop near the end, whereas an alkaline battery will experience a more gradual reduction in voltage over time. Radio Bridge sensors are shipped with lithium batteries, and these are recommended when the battery needs to be eventually replaced.

Temperature also plays a role in battery life. The battery life estimates in the online spreadsheet assume room temperature, but temperatures close to the maximum and minimum ratings will have a negative impact on battery life. For example, battery voltage tends to be lower in cold temperatures and the internal circuitry needs a certain minimum voltage to operate properly before it will shut down. Thus, battery life will tend to be shorter when running the sensor in cold environments.

Battery voltage will be lower in cold temperatures and thus battery life will be reduced in cold environments.

The battery voltage is reported by the supervisory messages as well as a low battery indicator. See the section on Message Protocol for more detail.

5. TEST MESSAGES

The sensor can be triggered to send test messages by placing a magnet next to the triangular notch on the side of the sensor. There is a small magnetic reed switch that will detect the presence of a magnet and send a message. This can be used for diagnostic purposes to ensure the sensor is within range and connected to the network.

6. MESSAGE PROTOCOL

This section defines the protocol and message definitions for the sensor.

Radio Bridge provides a web-based console at console.radiobridge.com to configure and monitor sensors. Usage of this console is highly recommended for most customers rather than implementing the protocols defined in this section.

If the standard Radio Bridge console (console.radiobridge.com) is not used, refer to this section to decode the sensor data and configure the sensor through downlink messages.

6.1. Common Messages

There are common messages across all wireless sensors that are defined in the document "Common Sensor Messages" which is available on the Radio Bridge website.

Refer to the document "Common Sensor Messages" for definitions of all common messages. Common messages are not defined in this document.

Common messages include basic error messages, tamper, supervisory, and downlink ack. It is important to refer to that document prior to decoding the messages defined in this section.

6.2. Uplink Messages

The uplink message (sensor to web application) specific to the sensor is defined in following table. The common uplink messages are not included in this section (see common messages document).

Table 5 Uplink Message 0x0A: Tilt Event

Byte	Description
0x00	Tilt event
0x01	Tilt angle from vertical axis

The tilt events are defined in the following table.

Table 6 Uplink Tilt Event Definitions

Event	Description
0x00	Sensor transitioned to vertical
0x01	Sensor transitioned to horizontal
0x02	Report on change toward vertical
0x03	Report on change toward horizontal

The first two event messages are sent when the tilt angle exceeds the horizontal threshold or falls below the vertical threshold. Note that the angle is relative to a vertical orientation, so small angles are closer to vertical and large angles are closer to horizontal.

The report-on-change messages are sent when the tilt angle increases (toward horizontal) or decreases (toward vertical) a specified amount from the last report. For example, consider a report-on-change value that is set to 5 degrees and the current angle from the vertical axis is 15 degrees. If the angle increases to 20 degrees an 0x03 event is sent. If the angle decreases back to 15 degrees, an 0x02 event is sent.

6.3. Downlink Messages

The downlink message (web application to sensor) specific to the sensor configuration is defined in following table. The common downlink messages are not included in this section (see common messages document).

Table 7 Downlink Configuration Message

Bytes	Description
0	Control byte (see the table Control Byte Bit Definitions)
1	Angle for transition to horizontal state in degrees. Default 55 degrees.
2	Angle for transition to vertical state in degrees. Default 35 degrees.
3	Vertical hold time
4	Horizontal hold time
5	Report-on-change toward vertical (0-90 degrees)
6	Report-on-change toward horizontal (0-90 degrees)

6.3.1. Thresholds

The angle in bytes 1 and 2 define the angle in degrees off of the vertical axis that the sensor needs to be tilted to generate an alert. For example, if the sensor is used to detect garage open/close events, the vertical threshold might be set at 35 degrees and the horizontal threshold may be set at 55 degrees. It is not recommended to set both to the same values (both at 45 degrees for instance) since this may generate multiple alerts when it is oriented near the threshold. The range for each threshold is 0-90 degrees where 0 is completely vertical and 90 is completely horizontal.

6.3.2. Hold Time

The hold times are 8-bit values that represent the amount of time the tilt sensor must be held in a particular orientation before a message is sent. The hold time values range from 1-255 and are represented in 250ms increments. This gives the hold times a range of 250 milliseconds – 1 minute. If the hold time is 0, the feature is disabled and an alert will be sent any time the orientation changes.

6.3.3. Report-On-Change

The report-on-change feature will create an alert when the angle of the tilt increases or decreases by a specified amount. This allows for detecting a tilt when the initial orientation is not completely vertical. For example, one could place the sensor on a telephone pole and set a report-on-change event for 10 degrees. This configuration will send an alert if the pole leans another 10 degrees from its current position.

The minimum value for the report-on-change angle is 5 degrees. A setting less than this will disable the feature.

6.3.4. Control Byte

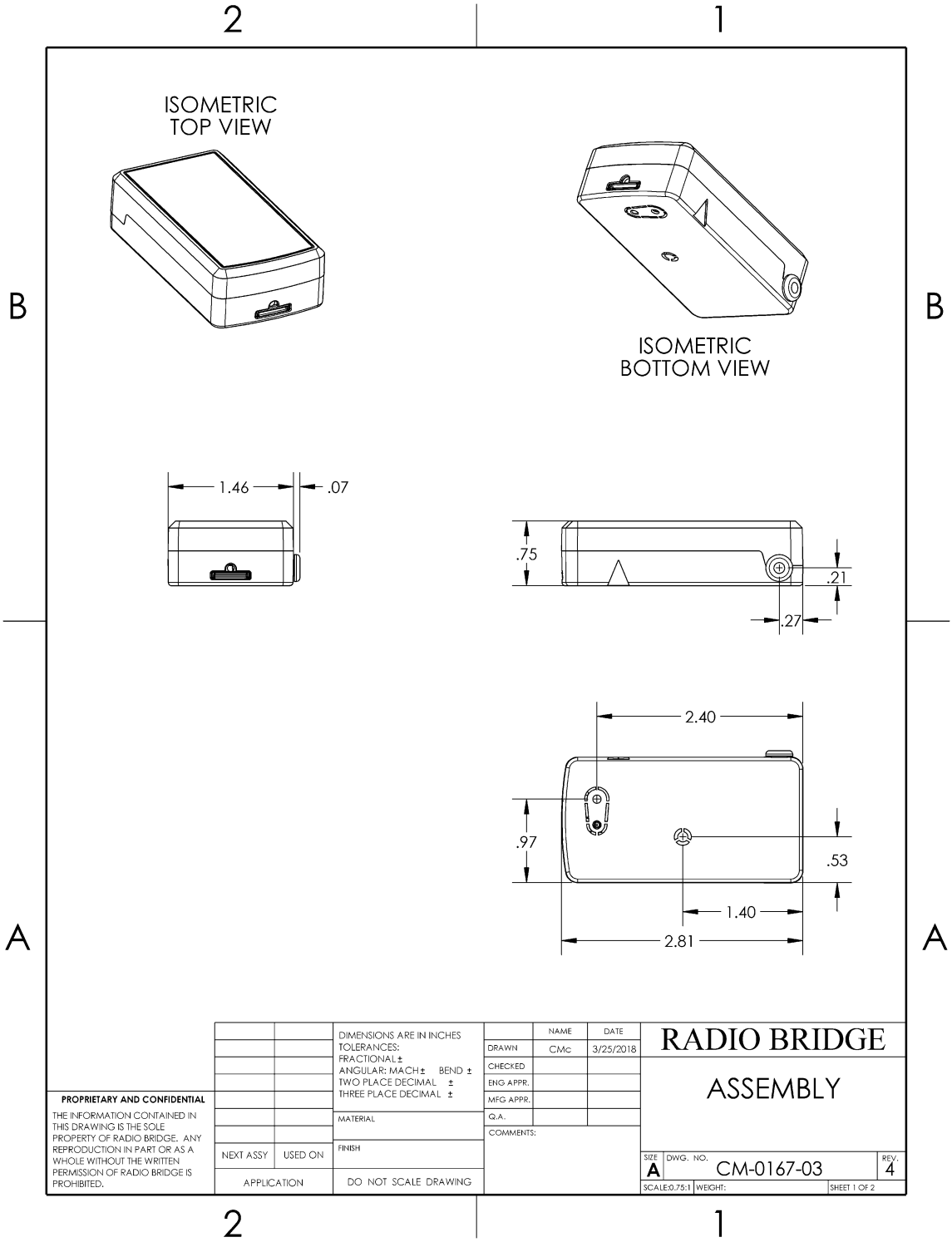
The table below describes the control byte bit definitions.

Table 8 Control Byte Bit Definitions

Bits	Description
7:4	Not used
3	Disable report-on-change toward vertical. Default disabled
2	Disable report-on-change toward horizontal. Default disabled
1	Disable transitions to vertical orientation only. Default enabled
0	Disable transitions to horizontal orientation only. Default enabled

7. MECHANICAL DRAWINGS

The mechanical drawings provided in this section are for the main body of the sensor. All dimensions are inches unless otherwise noted.



8. REGULATORY AND COMPLIANCE

8.1. Federal Communications Commission (FCC)

Per FCC 15.19(a)(3) and (a)(4) 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.

Per FCC 15.21, Changes or modifications not expressly approved by Radio Bridge could void authority to operate the devices.

(Sigfox) FCC ID: 2APNUSFM10R2

(LoRa) FCC ID: 2APNUCMABZ

8.2. Harmonized Commodity Description (HS Code)

The Harmonized Commodity Description and Coding System generally referred to as "Harmonized System" or simply "HS" is a multipurpose international product nomenclature developed by the World Customs Organization (WCO).

HS Code: 8531.90

8.3. Export Control Classification Number (ECCN)

ECCNs are five character alpha-numeric designations used on the Commerce Control List (CCL) to identify dual-use items for export control purposes. An ECCN categorizes items based on the nature of the product, i.e. type of commodity, software, or technology and its respective technical parameters.

ECCN: 5a992.c

9. CUSTOMER SUPPORT

Radio Bridge offers free technical support at:

https://support.radiobridge.com

Radio Bridge also offers technical support plans and service packages to help our customers get the most out of their Radio Bridge products.

10. DISCLAIMERS

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