



Wireless Acceleration-Based Movement Sensor User Guide

VERSION 1.5
JANUARY 2020

TABLE OF CONTENTS

1. QUICK START	2
2. OVERVIEW	2
2.1. Sensor Overview	2
2.2. Revision History	3
2.3. Document Conventions	3
2.4. Part Numbers	3
3. TECHNICAL SPECIFICATIONS	4
3.1. Absolute Maximum Ratings	4
4. BATTERY LIFE	5
5. TEST MESSAGES	6
6. MESSAGE PROTOCOL	6
6.1. Common Messages	6
6.2. Uplink Messages	7
6.3. Downlink Messages	7
6.4. Settling Window	9
7. MECHANICAL DRAWINGS	10
7.1. INDOOR RBSX01 SENSORS	10
7.2. ARMORED OUTDOOR/INDUSTRIAL RBSX06 SENSORS	11
8. REGULATORY AND COMPLIANCE	12
8.1. Federal Communications Commission (FCC)	12
8.2. Harmonized Commodity Description (HS Code)	12
8.3. Export Control Classification Number (ECCN)	12
9. CUSTOMER SUPPORT	13
10. DISCLAIMERS	13
11. LEGAL NOTICES	13
12. TRADEMARKS AND COPYRIGHT	13

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.

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 acceleration-based movement sensor described in this document uses an internal accelerometer to detect movement events such as an asset being moved from a stationary position. When movement is detected that exceeds a certain threshold, an alert is sent over the wireless network. Note that this product should *not* be used for vibration detection. For vibration detection applications, such as detecting when a motor has turned on/off, see the Vibration Sensor products from Radio Bridge.

Features include:

- Built-in radio that talks directly with LoRaWAN wireless networks
- 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. Available on the RBSx01, RBSx05, and RBSx06 sensors.
 - Wall mount tamper detects if the sensor has been removed from the wall or mounting point. Available on the RBSx01 and RBSx05 sensors.
- 200,000+ transmissions on a single battery and a 5-10 year battery life depending on usage. See Battery section for more detail.
- 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	July 2018	Initial release of the document
1.1	August 2018	Updated protocol definitions
1.2	October 2018	Regulatory and FCC
1.3	March 2019	Add International Part Numbers
1.4	September 2019	Updated common sections
1.5	January 2020	Best practice notes

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	Rating	Wireless	Region
RBS301-ABM-US	Indoor	LoRaWAN	North America, South America
RBS301-ABM-EU	Indoor	LoRaWAN	Europe
RBS301-ABM-AU	Indoor	LoRaWAN	Australia, South America
RBS306-ABM-US	Outdoor/Industrial	LoRaWAN	North America, South America
RBS306-ABM-EU	Outdoor/Industrial	LoRaWAN	Europe

3. TECHNICAL SPECIFICATIONS

3.1. Absolute Maximum Ratings

Table 4 Absolute Maximum Ratings

Parameter	Rating	Units
Operating ambient temperature (Indoor Version)	-30 to +70	°C
Operating ambient temperature (Outdoor Version)	-40 to +70	°C
Storage ambient temperature	-40 to +100	°C

4. BATTERY LIFE

This device uses a lithium non-rechargeable battery and is capable of 200,000+ 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 device.



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 device is inactive) for high power radio technologies such as LoRaWAN. This means that the battery life for most devices 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 devices 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 device 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 device can be triggered to send test messages by placing a magnet next to the side of the enclosure. The location of the magnet is indicated by the triangular notch on the side of RBSx01 and RBSx05 sensors. RBSx04 sensors do not have this capability. There is a small magnetic Hall effect sensor 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 device.



Radio Bridge provides a web-based console at console.radiobridge.com to configure and monitor devices. 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 device data and configure the device through downlink messages.

6.1. Common Messages

There are common messages across all wireless devices 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 0x0e: Movement Event

Byte	Description
0	Movement event

The movement event byte is defined in the following table

Table 6 Movement Event Definitions

Event	Description
0x00	Movement started
0x01	Movement has stopped (see Settling Window)

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 0x0e

Byte	Description
3	Disable reporting (see Disable Reporting table below)
2	Scaling (See Scaling table below)
1	Settling window time (see section Settling Window)
0	Acceleration change threshold for any axis (X, Y, or Z). Bits 6:0 only

The table below describes the bit definitions for the Disable Reporting byte from the downlink command. In each case setting the bit will disable the reporting and clearing the bit will enable reporting.

Table 8 Disable Reporting Bit Definitions

Bit	Description
7:2	Not used
1	Disable reporting for movement stop
0	Disable reporting for movement start

The table below defines the scaling parameter in the downlink command.

Table 9 Scaling

Setting	Description	Units for Threshold
0x00	+/- 2g	0.016g
0x01	+/- 4g	0.032g
0x02	+/- 8g	0.062g
0x03	+/- 16g	0.186g

The scaling parameter defines the G-force (1g is the force of gravity) range that the internal accelerometer operates with, and the lower settings will be more sensitive than higher settings. The threshold setting will have units based on the scaling factor as shown in the table above. For example, if the scaling is set to +/- 2g (2x the force of gravity), then the threshold setting can be multiplied by 0.016g to calculate the total G-force threshold. The accelerometer is measured every 250ms and if the difference between two consecutive measurements exceeds the threshold, then a message is sent.

The minimum setting for the acceleration change threshold is 5. If a lower number is programmed, the sensor will not generate an event.



For best practice, use the largest scaling factor that the system will allow and the smallest threshold. For example, use a threshold of 5 with scaling factor 4g instead of threshold of 10 with 2g.

6.4. Settling Window

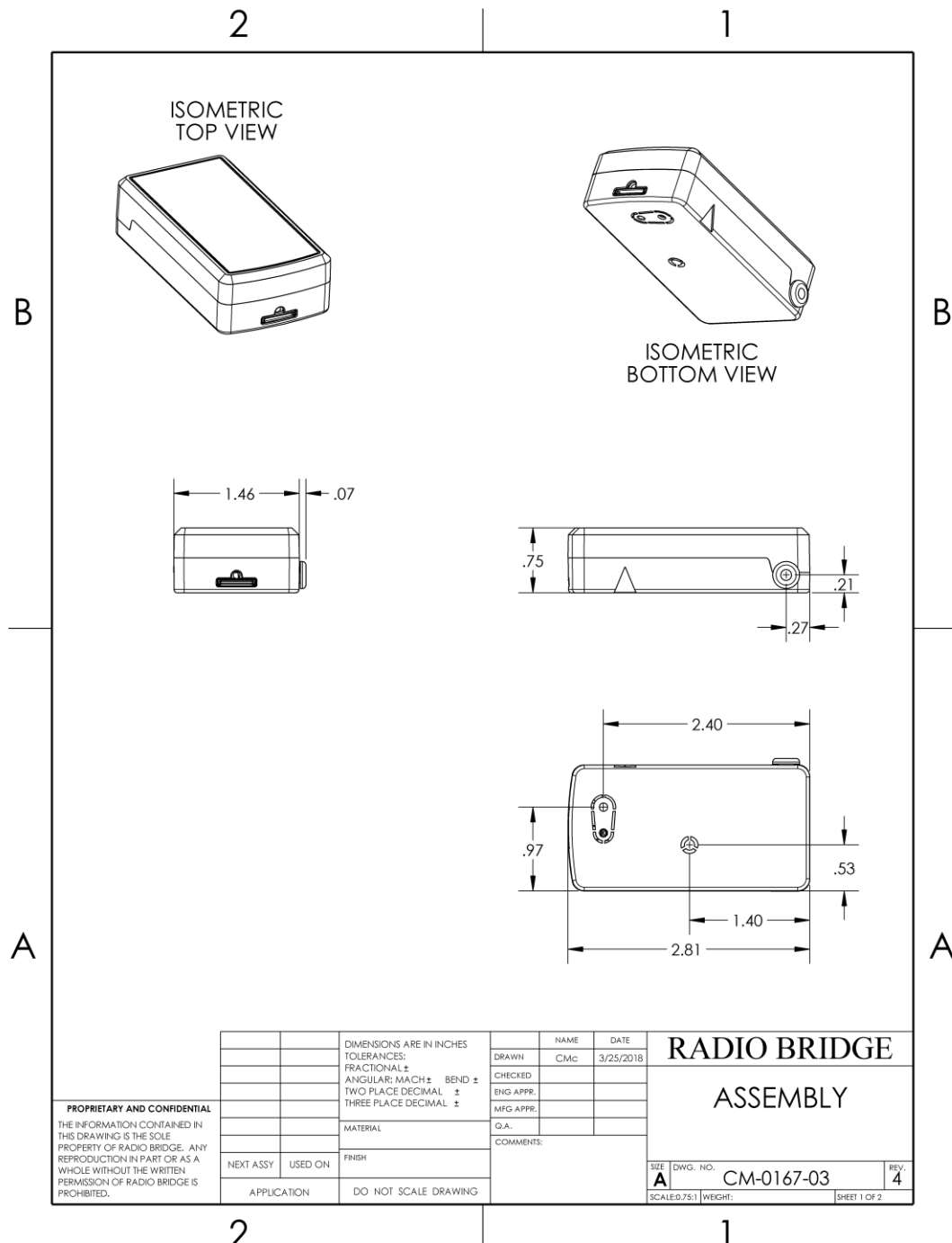
In order to prevent continuous reporting of movement events, a “settling window” is used to ensure movement has stopped before the sensor reports a new event. In other words, the settling window defines the amount of time where the acceleration of all axis must stop changing before the sensor will report another event.

The settling window time sets has units of 250ms increments (range of 250ms to 63 seconds). The default settling window is 5 seconds.

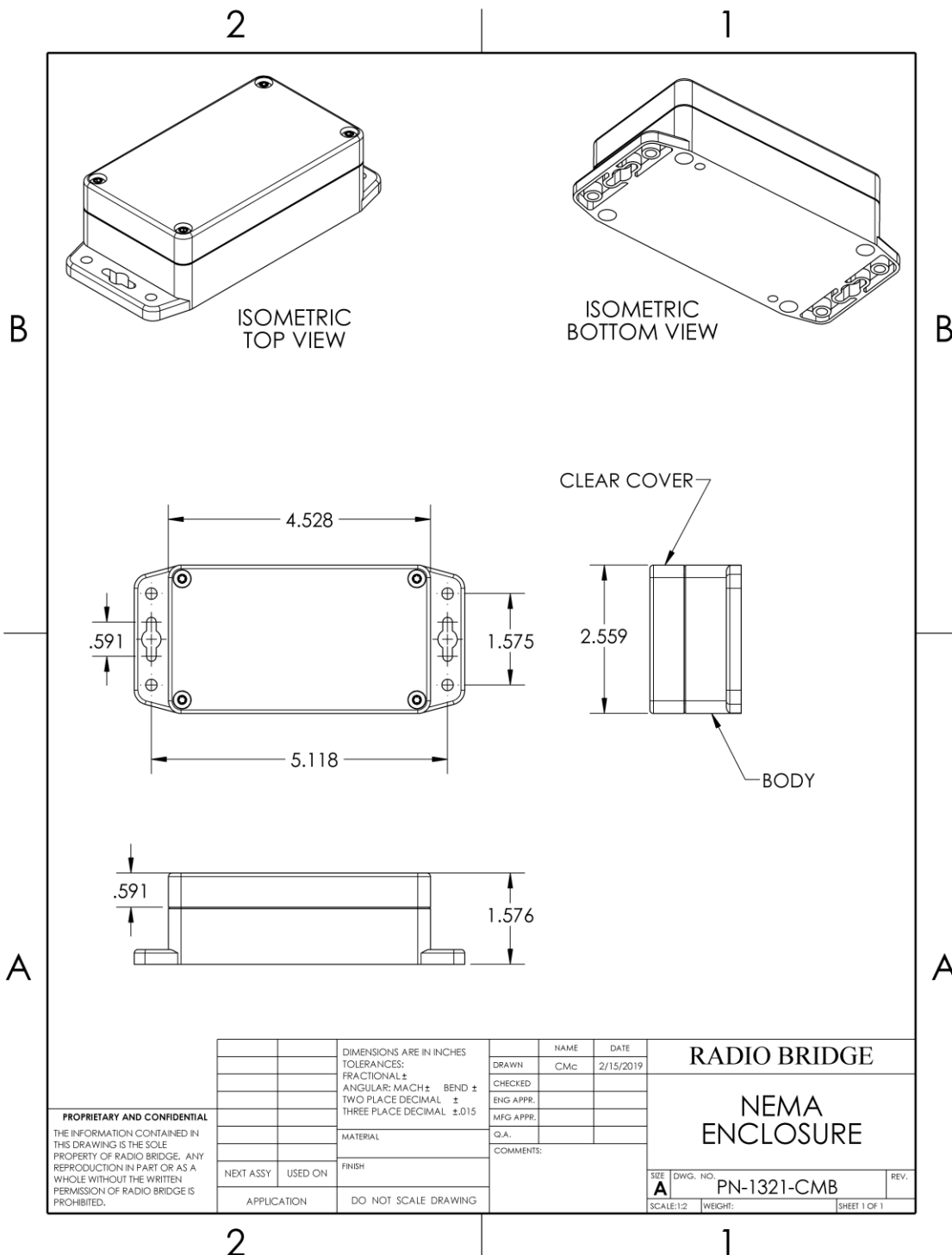
7. MECHANICAL DRAWINGS

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

7.1. INDOOR RBSx01 SENSORS



7.2. ARMORED OUTDOOR/INDUSTRIAL RBSx06 SENSORS



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 RBS101, RBS104, and RBS105 sensors FCC ID: 2APNUSFM10R2

LoRaWAN RBS301, RBS304, and RBS305 sensors FCC ID: 2APNUCMABZ

LoRaWAN RBS306 sensors: This device contains FCC IAU792U13A16858

This device contains equipment certified under IC: 125A-0055

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: 8531.90.9001

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

Information in this document is subject to change without notice and does not represent a commitment on the part of Radio Bridge. Radio Bridge provides this document “as is,” without warranty of any kind, expressed or implied, including, but not limited to, the implied warranties of fitness or merchantability for a particular purpose. Radio Bridge may make improvements and/or changes in this manual or in the product(s) and/or the software described in this manual at any time.

11. LEGAL NOTICES

See the [Legal Notices](#) section of the website for up to date information on Radio Bridge’s warranty, returns policy, privacy statement, terms of sale, and terms of service.

12. TRADEMARKS AND COPYRIGHT

Radio Bridge™, SubGig®, Armored Sensor™ and BridgeBee® are trademarks of Radio Bridge Inc in the United States.

© 2019 Radio Bridge Inc. All rights reserved