



# Wireless External Probe Temp Sensor User Guide

VERSION 1.3  
NOVEMBER 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 external probe temperature sensor measures temperature using an external temperature probe. If the temperature rises above or falls below the configured thresholds, an alert is sent over the wireless network. Versions of the sensor support the major LPWAN standards such as Sigfox, LoRa/LoRaWAN, and SubGig.

Temperature is sampled every 15 seconds and averaged over 1 minute. Thus, the sensor is not appropriate for applications that need to detect rapid changes in temperature within periods of less than a minute.

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
1.3	November 2018	Periodic reporting with minute resolution

## 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-TEMP-EXT-RCZ2	Sigfox	North America
RBS201-TEMP-EXT -315	SubGig	North America
RBS301-TEMP-EXT -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](http://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](http://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.




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

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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 0x09: Temperature Event*

Byte	Description
0	Temperature Event Payload (see Temperature Event Payload Definitions)
1	Current temperature in degrees Celsius
2	Relative temperature measurement

The temperature event is defined in the following table.

*Table 6 Temperature Event Payload Definitions*

Event Payload	Description
0x00	Periodic report
0x01	Temperature has risen above upper threshold
0x02	Temperature has fallen below lower threshold
0x03	Report on change increase
0x04	Report on change decrease

The current temperature field in the temperature event uplink message is the current temperature in degrees Celsius. The temperature has been calibrated with controlled temperature chambers.

The relative temperature measurement is the raw (analog to digital) measurement and ranges on a scale from 0-255. This value can be used with different calibration tables defined by the user.



When a temperature is out of range, it will be reported as 0x7f (highest positive signed number) on the high end and 0x80 on the low end.

### 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 0x09*

Byte	Description
0	Mode: 0x00 for Threshold, or 0x01 for Report on Change
1-6	Defined by Mode (See Mode sections)

The mode byte selects one of two modes: threshold based alerts or report-on-change alerts. The remainder of the payload (bytes 1-6) are determined by the mode selected and defined in the next two sections.

#### 6.3.1.Threshold Mode

Threshold mode is set when byte 0 of the payload is set to 0x00. The remainder of the payload is defined in the following table.

*Table 8 Downlink Configuration Message for Threshold Mode*

Byte	Description
0	0x00 (Threshold mode)
1	Periodic reporting in 1 minute or 1 hour intervals. Default is 0 (disabled)
2	Restoral margin (bits 3:0 only). Default 5 degrees C.
3	Lower temperature threshold. Default 10 degrees C.
4	Upper temperature threshold. Default 90 degrees C.

The upper and lower temperature thresholds are *signed* values with units of one degree Celsius (range is -40 to 100 degrees C). Note that if the configuration settings exceed the maximum ratings on the sensor, the sensor may not report an event.

The Restoral Margin is used for the upper and lower thresholds and requires the temperature value to cross back over the threshold a certain amount before a new event is reported. This prevents excessive event messages if the temperature is at or near the threshold.

For example, consider an upper temp threshold set at 30 degrees Celsius and the restoral margin set at 5 degrees. If the temperature initially exceeds 30 degrees then an event is generated and a message is sent to the network. The temperature must now drop to 25 degrees and then exceed 30 degrees before another event is reported.

The restoral margins are *unsigned* values with units of 1 degree Celsius (range is 1-15 degrees C). If a restoral margin is set to 0, it is disabled.

Periodic reporting is described in the section Periodic Reports.

### 6.3.2. Report on Change Mode

Report on Change mode is set when byte 0 of the payload is set to 0x01. The remainder of the payload is defined in the following table.

*Table 9 Downlink Configuration Message for Report on Change Mode*

Byte	Description
0	0x01 (Report on Change mode)
1	Periodic reporting in 1 minute or 1 hour intervals. Default is 0 (disabled)
2	Not used
3	Temperature increase
4	Temperature decrease

If the temperature increase or decrease are non-zero, then the sensor will send an alert any time the temperature changes by the specified amount. For example, if the temperature increase and decrease are set to 5 degrees, then an alert is sent every time the temperature changes 5 degrees from the last report. The temperature increase and decrease are unsigned values with units in degrees C.

Periodic reporting is described in the section Periodic Reports.

### 6.3.3.Periodic Reports

The temperature sensor can also send periodic updates, and this is defined in byte 1 of both modes. A setting of 0 will disable periodic reporting. The period is defined in 1 hour increments when the most significant bit is 0, and it is defined in 1 minute increments when the most significant bit is 1 as shown in the following table.

*Table 10 Period Bye (byte 1) from Downlink Configuration Message*

Bit 7	Bits 6:0
0	Period defined in hours (1-127 hours)
1	Period defined in minutes (1-127 minutes)

For example, to receive a report every 4 hours, byte 1 would be set to 0x04. To receive a periodic report every 15 minutes, byte 1 would be set to 0x8f.

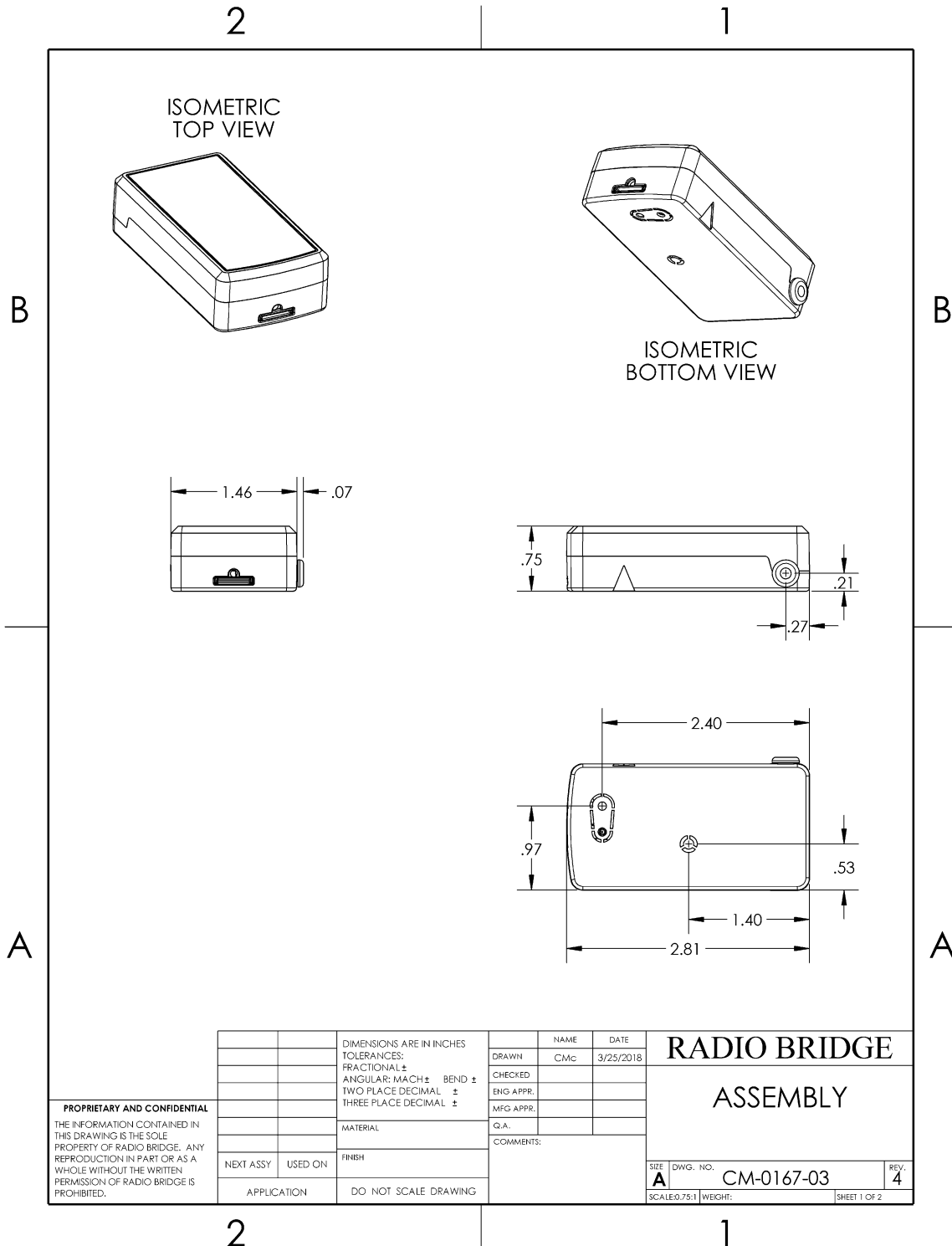
Note that **prior to firmware version 1.3, only hourly reporting is available**. The firmware version can be found in the reset message and is logged on the Radio Bridge console.



Periodic reporting is not recommended as it will increase data service fees and significantly reduce battery life. Wherever possible, use thresholds or report-on-change only.

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. REGULATORY AND COMPLIANCE

### 7.1. 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

### 7.2. 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

### 7.3. 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

## 8. 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.

## 9. DISCLAIMERS

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## 10. TRADEMARKS AND COPYRIGHT

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