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User Guide

Sentrius™ RS1xx

Version 1.0

Revision History

Version	Date	Notes	Contributor	Approver
1.0	05 Dec 2017	Initial version	Christopher Hofmeister	Jonathan Kaye

CONTENTS

1 ABOUT THIS GUIDE

This document is the parent guide of the *RS1xx Configuration Guide*. It provides a comprehensive guide on how to configure the Sentrius™ RS186 and RS191 sensors to suit the intended application. It covers all Sentrius™ RS1xx functionality, including Bluetooth and LoRa configurations in detail, as well as setting up the sensor on a LoRa network server.

Note: Step by step instructions, screen shots, and pictures are based on the Sentrius™ RS191, but the same are applicable for the Sentrius™ RS186. Any differences are noted.

2 INTRODUCTION

2.1 Product Overview

The Sentrius™ RS1xx LoRa-Enabled Sensor from Laird is the ultimate in secure, scalable, robust LoRa solutions for end-to-end control of your private LoRaWAN network. Based on the Semtech SX1272 chipset, it offers a long range up to ten miles, perfect for highly scalable, flexible IoT networks. The Sentrius™RS1xx Sensor works with Laird's Sentrius™RG1xx Series Gateways for simple out-of-the-box integration and is compatible with third-party cloud and LoRa partners.

1. Temperature and humidity sensor
2. Bluetooth button
3. LEDs
4. Fixing holes

Figure 2: Back side of the Sentrius™ RS1xx Sensor

Figure 1: Top of the Sentrius™ RS1xx Sensor

Note: Laird has a comprehensive staff of design services engineers available to help customize the sensor. Please contact your local Laird sales representative for more details.

2.2 Specifications

See the RS1xx product brief for detailed specifications. It's available from the Documentation tab of the RS1xx Series product page: https://www.lairdtech.com/products/rs1xx-lora-sensors

2.3 Architecture Overview

The major pieces of a LoRa network can be seen in the figure below. The RS1xx sensor is an "End Note" in the diagram below. The RS1xx requires the other components in the diagram below to operate.

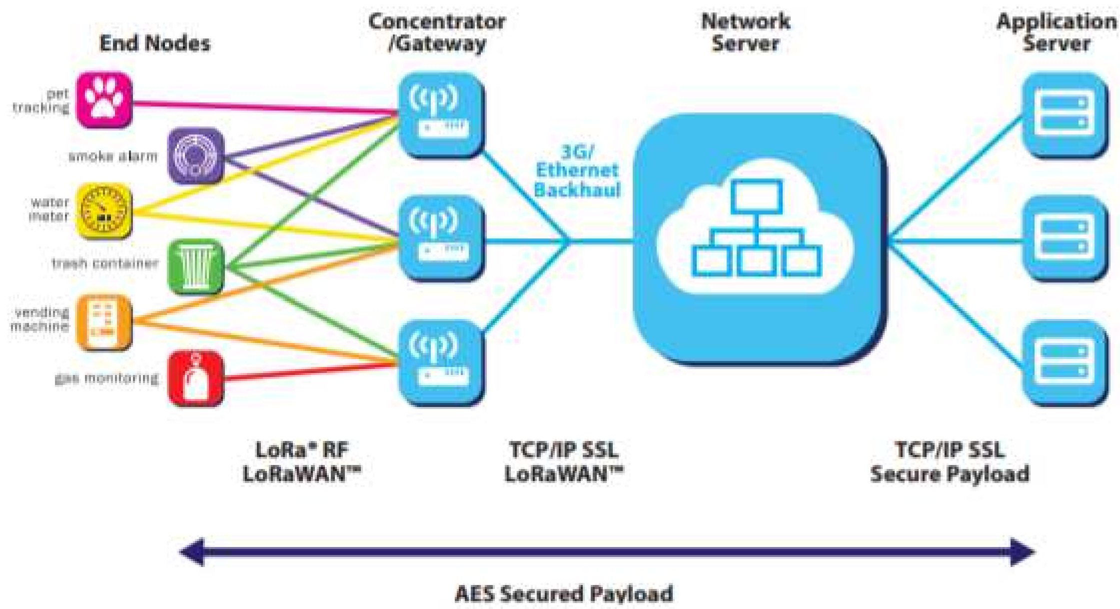

Figure 3: LoRa Architecture

3 Powering Up the Sensor

Note: The Sentrius™ Sensor has no power switch. Inserting the batteries powers up the device.

3.1 Battery Types

The Sentrius™ Sensor is designed to be used with primary cell AA batteries, either lithium or alkaline 1.5V cells. Lithium batteries have more capacity, but are costlier. Lithium batteries also have a lower temperature range of -40° C, as opposed to -20° C for alkaline. You must specify the type of battery being used because the algorithm that determines the percentage of remaining battery life must account for the battery type.

Default Battery Type for the Sentrius™ Sensor: Alkaline batteries

3.1.1 Changing Battery Type

The battery type can be changed via the Sentrius™ mobile application. Refer to the Configuration section for details.

3.2 Inserting Batteries

Insert the batteries as indicated in Figure 2.

Note: The battery door cover has a gasket inside to keep out liquids. It is important that both screws on the back of the unit are properly inserted and tightened. Failure to do so could result in liquid ingress which would void the warranty on the device.

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4 Connecting to a LoRa network Server

The exact steps needed to connect to a LoRa network server vary by network provider but in all cases, the three LoRa keys described below must be known by the external LoRa network server.

4.1 AppEUI

The AppEUI is an 8-byte ID used to uniquely identify your application and/or installation. For example, imagine you are installing the Sentrius™ Sensor in a store chain. You could use a specific AppEUI to identify a specific store or perhaps the entire chain of stores.

4.1.1 Default AppEUI

The default AppEUI is 0xf9,0xc6,0x0e,0xce,0xa3,0xad,0xc6,0xbd, and it is set in the device by Laird at the time of manufacturing.

4.1.2 Reading or Changing the AppEUI

The AppEUI can be read or changed via the Sentrius™ mobile application. The number is generated by the end-user, so any number can be used.

4.2 DevEUI

The DevEUI is an 8-byte ID used to uniquely identify your device. It is assigned and set in the device by Laird at the time of manufacturing.

4.2.1 Reading the DevEUI

4.2.1.1 Back Label

The DevEUI is printed on the back label of the sensor as highlighted in red in Figure 4.

The large area of whitespace can be used to apply a secondary label, or write in information.

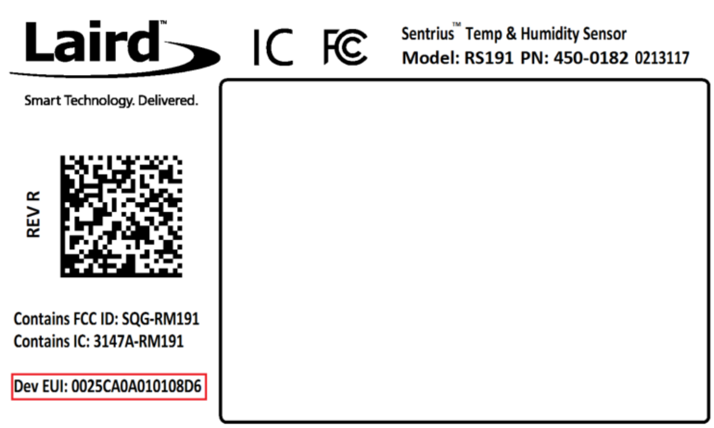


Figure 4: Back label

4.2.1.2 *Barcode*

The DevEUI is also accessible via the 2D barcode on the back label where the last comma separated value is the DevEUI.

Example readout: 450-0182,1,915 MHz Sentrius™ Sensor,0213117,0025CA0A010108D6

4.2.1.3 *Reading or Changing the DevEUI via Mobile App*

Normally there would be no need to change the DevEUI, however it can be read or changed via the Sentrius™ mobile application, if necessary. The generation of this number is governed by IEEE so a user changing the DevEUI must be familiar with these standards.

4.3 AppKey

The AppKey is a 16-byte security key assigned to the device. It is assigned and set in the device by Laird at the time of manufacturing.

4.3.1 Reading the AppKey

4.3.1.1 *Back Label*

The AppKey is printed on a **removeable** label that is attached to the device when it is shipped (Figure 5).

Important!	It is the user's responsibility to keep track of what AppKey has been assigned to the device and to keep this key secure.

AppKey:
0xA7,0xCB,0x8C,0x94,0x9B,0x4C,0x7B,0xD6,0xB7,0x01,0x32,0xA0,0x34,0x02,0xFE,0xFD

Figure 5: AppKey label

4.3.1.2 *Barcode*

The AppKey is also accessible via the 2D barcode on the back label.

4.3.1.3 *Reading or Changing the AppKey*

Normally there would be no need to change the AppKey, however it can be changed via the Sentrius™ mobile application in case that need arises.

Note: This key is write-only as there is a security risk in making it readable via the mobile application.

5 Adaptive Data Rate (ADR)

See the LoRaWAN Specification for a complete discussion of ADR. The LoRaWAN specification can be obtained from the LoRa Alliance.

5.1 Definitions

Knowledge of the following terms is important for this section:

- Uplink/Upstream – Transmissions originating from the sensor and received by the LoRa Network Server via the LoRa Gateway.
- Downlink/Downstream – Transmissions originating from the LoRa Network Server and received by the sensor via the LoRa Gateway.

5.2 Data Rates in LoRaWAN

5.2.1 902-928 MHz US and Canada

5.2.1.1 Uplink/Upstream (Sensor > Gateway)

Table 1: 902-928 MHz upstream data rates

Data Rate	Bit Rate (bit/sec)	Max Packet Size	Max Packet On-Air Time (mS)	Approximate Link Margin (dB) with Sentrius™ Gateway
0	980	11	289	152
1	1760	53	329	149
2	3125	129	380	147
3	5470	242	380	144
4	12500	242	167	141

5.2.1.2 Downlink/Downstream (Gateway > Sensor)

Table 2: 902-928 MHz downstream data rates

Data Rate	Bit Rate	Max Packet Size	Max Packet On-Air Time (mS)	Approximate Link Margin (dB) with Sentrius™ Sensor
10	3900	222	502	153
11	7000	222	277	150
12	12500	222	154	147
13	21900	222	87	144

5.2.2 863-870 MHz EU

5.2.2.1 Uplink/Upstream (Gateway > Sensor)

Table 3: 863-870 MHz upstream data rates

Data Rate	Bit Rate (bit/sec)	Max Packet Size	Max Packet On-Air Time (mS)	Approximate Link Margin (dB) with Sentrius™ Gateway
0	250	51	2466	157
1	440	51	1315	154
2	980	51	616	152
3	1760	115	615	149

Data Rate	Bit Rate (bit/sec)	Max Packet Size	Max Packet On-Air Time (mS)	Approximate Link Margin (dB) with Sentrius™ Gateway
4	3125	222	615	147
5	5470	222	348	144
6	11000	222	174	141

5.2.2.2 Downlink/Downstream (Gateway > Sensor)

Table 4: 863-870 MHz downstream data rates

Data Rate	Bit Rate (bit/sec)	Max Packet Size	Max Packet On-Air Time (mS)	Approximate Link Margin (dB) with Sentrius™ Sensor
0	250	51	2466	162
1	440	51	1315	160
2	980	51	616	158
3	1760	115	615	155
4	3125	222	615	152
5	5470	222	348	149
6	11000	222	174	147

5.3 Data Rate, Sensor Performance, and Tradeoffs

5.3.1 Range

Referencing Data Rates in LoRaWAN, as the data rate decreases the RF range increases.

5.3.2 Battery Life

Referencing Data Rates in LoRaWAN, as the data rate decreases the radio is on longer, decreasing battery life.

5.3.3 Bandwidth

Referencing Data Rates in LoRaWAN, as the data rate decreases it takes longer to transmit a packet, decreasing available bandwidth on the network and increasing the probability of RF collisions or interference.

5.3.4 EU Considerations

In the EU, many bands are highly restricted regarding how much bandwidth a device can use. For example, many bands allow only a 0.1% duty cycle. The duty cycle is the transmit time of the device relative to the non-transmit time. If a device transmitted a packet that was one second long, it could not transmit for another 1000 seconds (1/1000 = 0.1%) (1000 seconds is over 15 minutes). Keep in mind that any LoRa Gateway also has duty cycle limitations that need to be considered.

Careful planning must be done to ensure that a device does not exceed this duty cycle limitation, including possible retries. The LoRa stack running inside the sensor monitors the duty cycle of the device and does not allow a device to transmit if it exceeded the allowable duty cycle.

5.4 ADR and the LoRa Standard

According to the LoRaWAN standard a mote (sensor) device is responsible for lowering the data rate, while the network server is responsible for raising the data rate.

5.4.1 902-928 MHz US and Canada

On power up, the Sentrius™ Sensor starts transmitting on data rate 1.

5.4.2 863-870 MHz US and Canada

On power up, the Sentrius™ Sensor starts transmitting on data rate 3.

5.4.3 ADR Operation

In both US and EU modes, the sensor drops its data rate by one if three consecutive packets are not acknowledged by the LoRa network server.

After 20 packets are received by the LoRa network server, an algorithm is applied on the link margin data of these packets and an appropriate data rate is selected. The goal of the algorithm is to operate at a data rate as high as possible while maintaining a solid link margin. This maximizes battery life and minimizes bandwidth without sacrificing the RF link.

5.4.4 Important Note About LoRa Network Server

The Sentrius™ Sensor is intended to work with any LoRa network server that implements ADR. Without this feature implemented on the LoRa network server, the sensor operates at a very low data rate which has a negative impact on battery life and network bandwidth.

At the time of this writing, The Things Network (TTN), Loriot, and Senet implement ADR. Other LoRa network servers may provide this functionality, this is not intended to be an exhaustive list.

6 Device Operation

6.1 Care and Maintenance

The sensor can be cleaned with a mild, non-abrasive detergent. It is not waterproof so do not immerse it in water.

The sensor does not require any calibration.

6.2 Positioning of the Sensor

For optimum response to temperature, position the sensor in a way that air can flow though the sensor air channel.

Note: The white material is a Gortex cover that allows airflow through the channel, while preventing liquids from coming in contact with the sensor.

In addition, placing the sensor on a large thermal mass negatively impacts the temperature response.

Figure 6: Air flow through sensor

6.3 LoRa Messages

The LoRa API is available in the RS1xx_LoRa_Protocol Guide.

6.4 Join Sequence

Before any temperature/humidity data can be sent, the sensor must first join the network. On power-up, the sensor attempts to join the network. If a join-response message is received by the sensor, it moves on to an internal state where it waits for the device to get the network time from the server.

If a join-response message is not received by the sensor or the network time is not received, it continues to try and join the network server every minute.

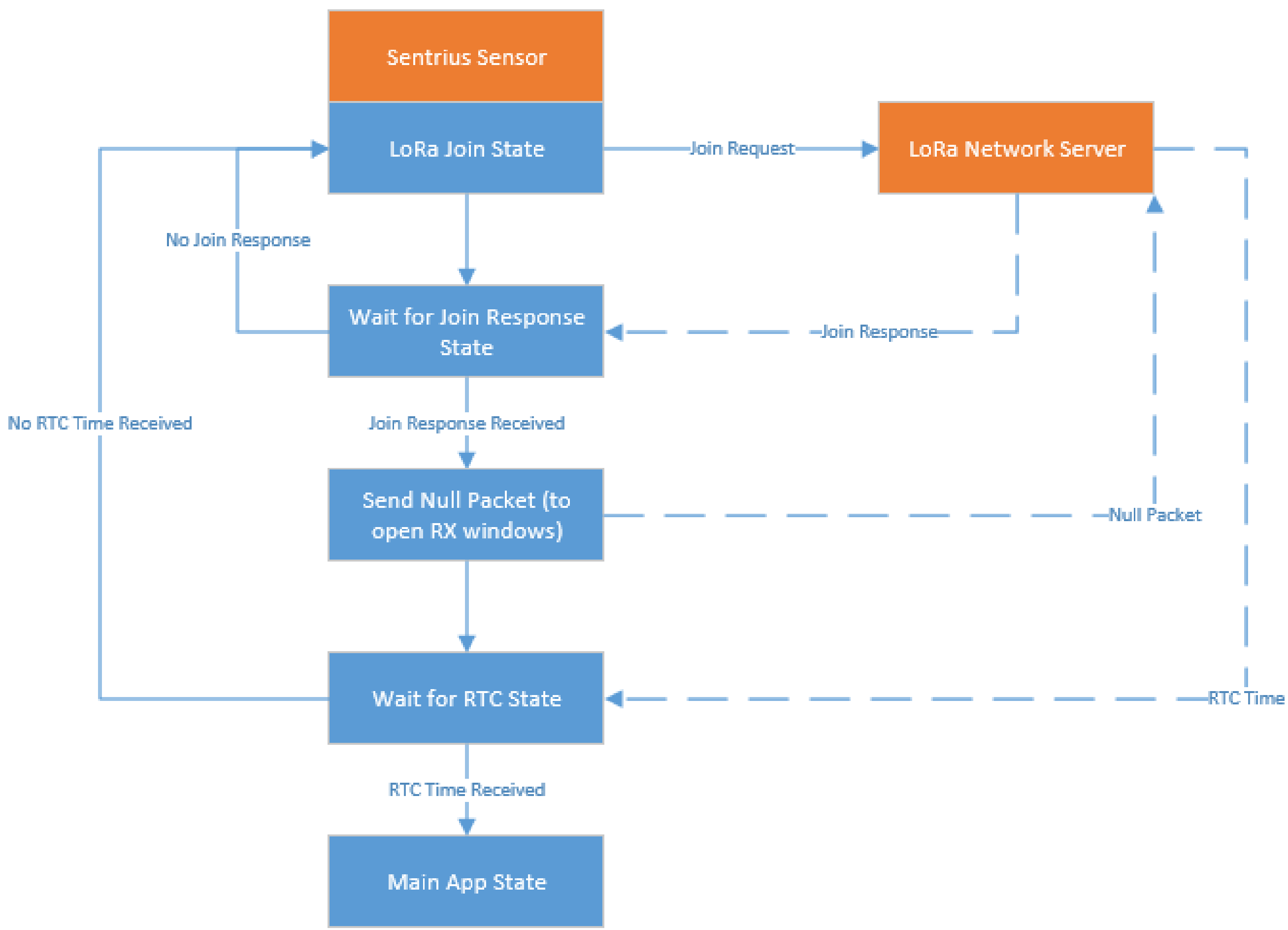


Figure 7: Join Procedure

6.5 Ack/Retires

Sensor to LoRa network server RF messages are set using the acknowledgement mechanism. Every RF message sent to the network server is expecting an acknowledgement message back from the network server telling the sensor, in effect, “got your message”. The sensor retransmits the message a certain number of times depending on the current data rate if an acknowledgement is not received. Every two unsuccessful attempts at a data rate causes the sensor to lower its data rate by one. See the tables below for how many attempts are made at each data rate.

US – RS191

Table 5: US retransmissions per data rate

Uplink Data Rate	Total number of retransmissions
DR4	8
DR3	8
DR2	6
DR1	4
DR0	2

EU – RS186

Table 6: EU retransmissions per data rate

Uplink Data Rate	Total number of retransmissions
DR7	8
DR6	8
DR5	8
DR4	8
DR3	8
DR2	6
DR1	4
DR0	2

For example, if in the US and at DR4, the maximum number of transmissions before a message is considered lost is eight. This means it transmits twice at DR4, twice at DR3, twice at DR2, and twice at DR1. If all transmissions are unsuccessful, the next time the device transmits, it is at DR0. If any of the data rates before that are successful, the unit remains at that data rate until the server deems its link is good enough to step up the data rate via ADR.

6.6 Disconnect

If the sensor detects three consecutive RF messages are lost, the sensor assumes the connection to the server is lost and stops sending data. It reverts to the join sequence described in the Join Sequence section of this guide.

6.7 Network Time

After the sensor joins a network, it must get the network time. This is sent in epoch time, number of seconds since January 1, 2015. Once the network time is received, the device begins sending sensor data.

Important!	The Sentrius™ Sensor is intended to work with a LoRa network server that provides network time. Without this feature implemented on the LoRa network server, the sensor does not operate.

6.8 Backlog Feature

If the sensor fails to successfully send data to the network server, this data is logged to FLASH. Each backlog data has its associated timestamp. Separate areas in FLASH are kept to store alarm and normal (non-alarm) data. During data retrieval, the alarm section is prioritized over the non-alarm data. Each section can store 4096 records.

The backlog data can be retrieved via the LoRa interface or the Bluetooth interface. Note that in some situations, such as the EU, it may not be practical to retrieve backlog data over LoRa due to bandwidth limitations.

6.8.1 Backoff Period

One of the LoRa messages that can be sent to the sensor from the server (see the *RS1xx LoRa Protocol Guide* which is available from the RS1xx product page) is the backoff period. Because retrieving the backlog may consume a large percentage of the bandwidth, it may be wise to make use of the Backoff message. This message can be used to stop the sensor from sending data for a period of time, thus opening more bandwidth for the sensor. While a unit is in the backoff state, it continues to read the sensor but it stores its data to FLASH. The backoff period could be assigned to the sensor from which the backlog is extracted, other sensors in the network, or both, depending on the application.

6.8.2 Operation at 902-928 US with DR0

Normally the sensor attempts to package up to six backlog readings into a single backlog uplink message. This keeps the total number of bytes in the packet less than 51 bytes, which is the limiting factor in the EU. See **Error! Reference source not found.** for details. As noted in **Error! Reference source not found.**, only 11 payload bytes are available when operating at DR0 in the 902-928 (NA) band. At this data rate, the sensor only sends one backlog message at a time as this is all the data that can be fit into an 11-byte message.

6.9 Measuring Humidity

Measuring humidity accurately in certain circumstances can be difficult. Temperature swings, dew points, and other factors can lead to condensation on the sensor, leading to inaccurate humidity readings. To combat this, there is a heating element on the sensor itself which can be turned on to burn off this condensation and restore the sensor to proper operation.

Because the factors that can lead to condensation vary considerably between applications, an interface to the sensor heater over LoRa is provided. This allows the API server (see Figure 3**: LoRa Architecture**) to contain the algorithm. Refer to the SiLABS si7021 datasheet for details on the Heater Control Register.

6.10 Setting up the Sensor

6.10.1 Sensor Read Period

The read period defines how often the sensor is read. For example, for a setting of 60, the sensor is read every 60 seconds.

6.10.2 Sensor Aggregate

The aggregate number is used to aggregate or bundle multiple sensor readings into a single RF packet. For example, with an aggregate number of two and a sensor read period of 60, a RF message is sent every (60 seconds x 2) 120 seconds. Obviously setting the aggregate count has a big effect on the battery life of the device; the less the device talks, the longer the batteries will last.

6.10.2.1 Operation at 902-928 NA with DR0

As noted in Table 1, only 11 payload bytes are available when operating at DR0 in the 902-928 band. This can create a conflict with an aggregate count greater than one, as the sensor cannot fit all the sensor data into the packet. In this case the sensor sends the last sensor reading to the LoRa API server and logs the remaining data to FLASH. A flag is set in the uplink message notifying the server of the configuration error. It is the responsibility of the server to update the sensor configuration to use an aggregate count of one if it is desired not to backlog data in this case.

6.10.3 Alarm Levels

Minimum and maximum alarm levels may be set for both temperature and humidity. When an alarm is triggered, the sensor immediately sends the data to the server. Thereafter it resumes sending data at its normal frequency based on the sensor read period and aggregate count. If the alarm condition persists, the sensor again sends the alarm message in one hour, ensuring the server is aware of the condition.

In addition, setting alarm levels puts sensor backlog data into a separate section of FLASH so that it may be prioritized during backlog retrieval.

6.10.4 LED Behavior

The first LED indicator is used for LoRa status (see Figure 1: Top of the Sentrius™ RS1xx Sensor). The device can be configured to flash a LED based on the LoRa network status. A green LED flash indicates that the device is connected to the LoRa network server, an orange LED flash indicates that the device is not connected to the LoRa network server. See the Sensor Configuration section of this guide.

The second LED indicator is used for Bluetooth. The device can be configured to flash a blue LED when the device is connectable, or advertising. See the Sensor Configuration section of this guide.

6.11 Sensor Firmware Version

The sensor firmware version can be requested from the sensor by the LoRa network server.

7 CONFIGURATION

7.1 Label (back label space)

The large open white space on the back label can be used to apply a secondary label by the end user. For example, it may be useful to write a friendly name on the device.

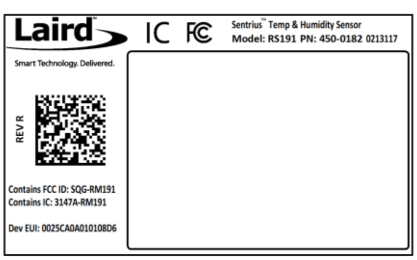


Figure 8: Back label white space

7.2 Device Configuration

Table 7: Device configuration

Name	Description	Bluetooth	LoRa
Format App FLASH	Format the external FLASH on the device to clear out backlog data.		x
Set Battery Type	Set the battery type being used on the device.	x	x
Set BLE LED Behavior	Configure Blue LED to flash when advertising (connectable)	x	x
Set Humidity Alarm Thresholds	Set the min/max humidity values that will trigger an alarm condition.	x	x
Set LoRa AppEUI	Read/Write	x	
Set LoRa AppKey	Write Only	x	
Set LoRa DevEUI	Read/Write	x	
Set LoRa LED Behavior	Configure Green/Orange LED behavior based on LoRa status.	x	x
Set Temperature Alarm Thresholds	Set the min/max temperature values that will trigger an alarm condition.	x	x
Set Temp Humidity Sensor Read Options	Set parameters related to reading the sensor and sending data over LoRa.	x	x
Set Friendly Name	Set a user-friendly name on the device.	x	

8 Mobile Application

8.1 Overview

The Sentrius™ mobile application allows a user to configure a device, troubleshoot a device, see real-time sensor data, and update firmware.

8.2 Install **Sentrius™** Sensor Mobile App on Device

Search the appropriate app store (Apple or Android) for the Sentrius Sensor App and install on device.

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

8.3 Connect to Sentrius™ Sensor

Press the Bluetooth button (see #2 on Figure 9).

Figure 9: Top of the Sentrius

The Sentrius™ Sensor begins advertising and become connectable.

8.3.1 Select Device

The DevEUI printed on the pack of the label is sent as part of the Bluetooth advertisement. Look for that DevEUI in the Device List as shown in Figure 10.

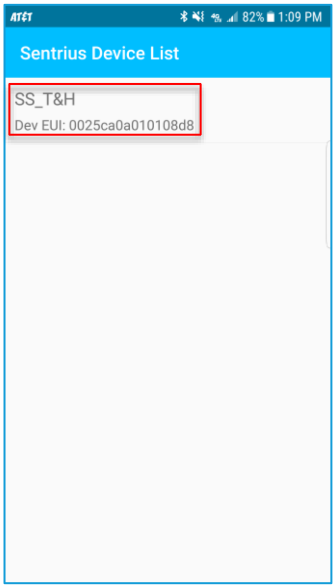


Figure 10: Select device to connect to

8.4 Main Screen

Figure 11 is the main screen of the mobile application.

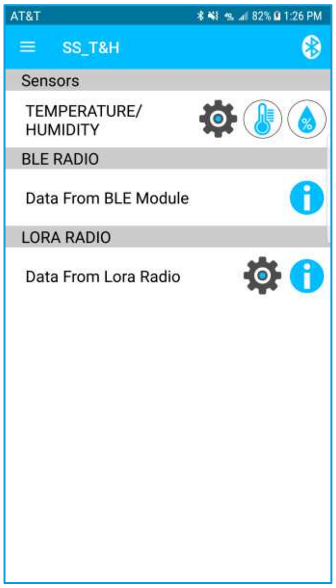
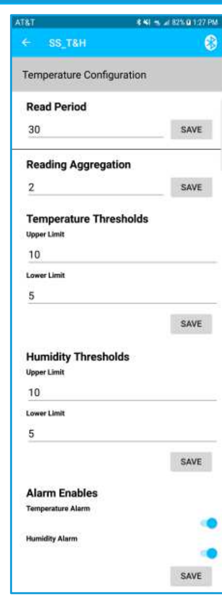
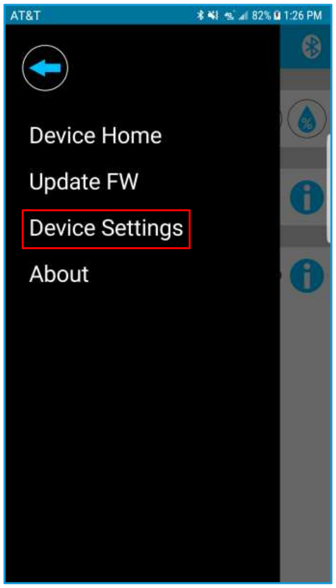
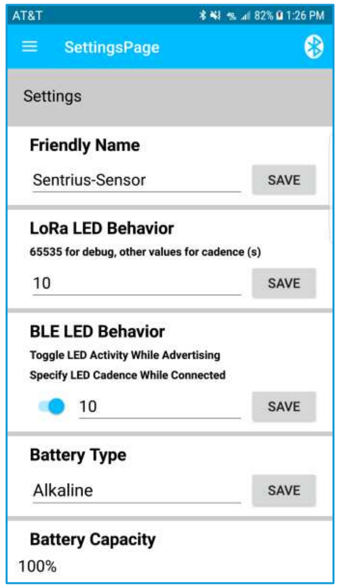


Figure 11: Mobile application main screen

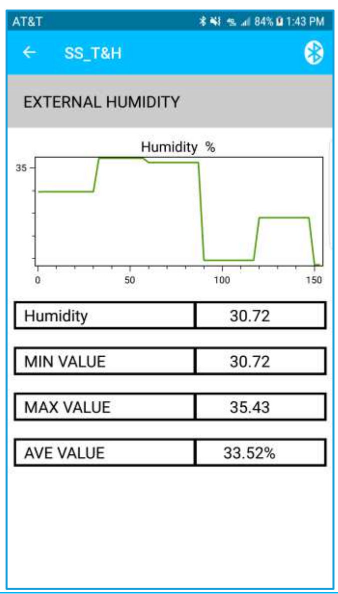
8.5 Configure Device

8.5.1 Sensor Configuration

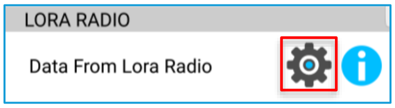
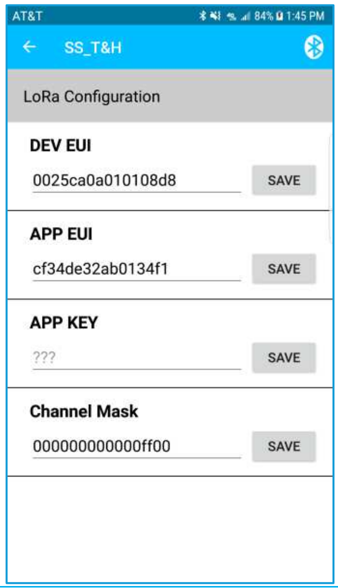
Navigation	Screen	Comments
		The read period, aggregate number, as well as temperature and relative humidity alarms can be configured. See Section 6.10 Setting up the Sensor for more information.

Navigation	Screen	Comments
		**Friendly Name –** Used to assign a user-friendly name to the device, such as it location. **LoRa LED Behavior** – Used to control the cadence of the heartbeat LED (time in seconds). For example, a setting of 10 flashes the appropriate LED every ten seconds. A setting of 0 turns off the LED. With a setting of 65535, the device flashes the green LED during LoRa transmit and the orange LED during LoRa receive. See the LED Behavior section of this guide for additional information. **Note:** The LED flash has an impact on battery life.

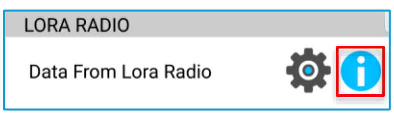
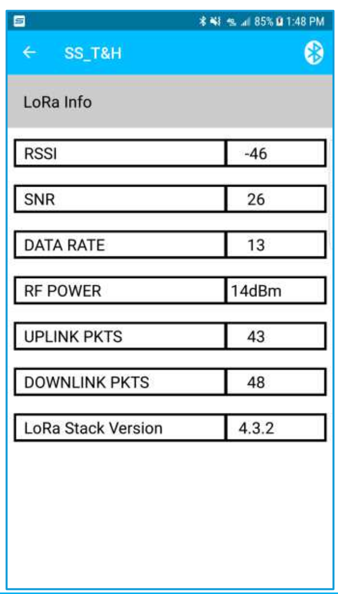
8.6 View Sensor Data

Navigation	Screen	Comments
		Temperature graph is similar, only the humidity graph is displayed in this example.

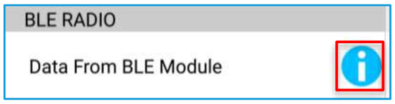
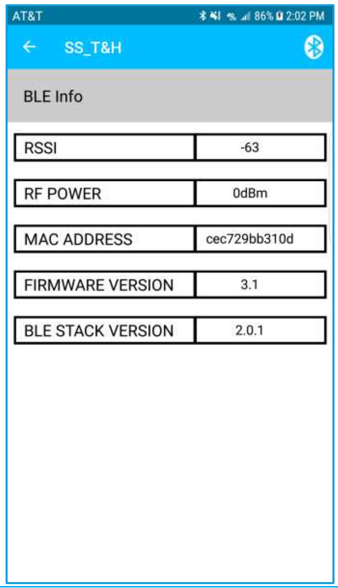
8.7 LoRa Configuration

<table>
<tr><th>Navigation</th><th>Screen</th><th>Comments</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>Use to update LoRa Keys.
Note: AppKey is write-only for security reasons.</td>
</tr>
</table>

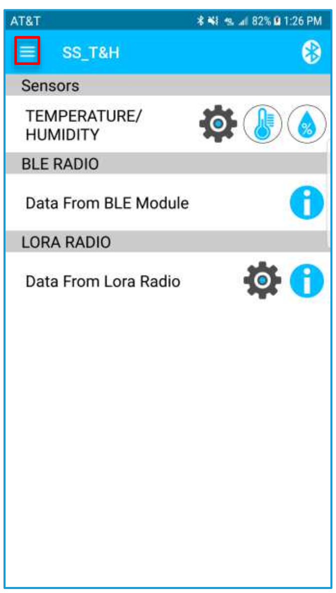
8.8 LoRa Network

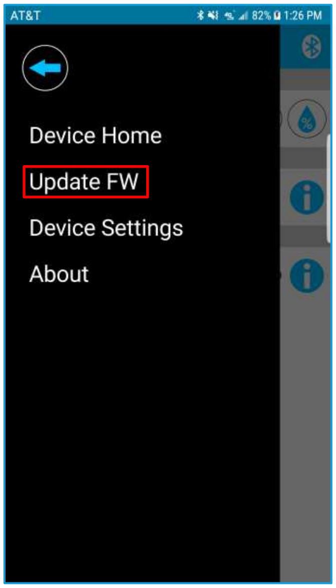
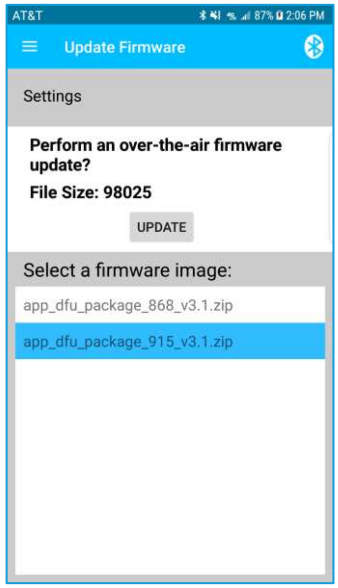
<table>
<tr><th>Navigation</th><th>Screen</th><th>Comments</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>Use the LoRa Info page to view data on the LoRa Network.</td>
</tr>
</table>

8.9 BLE Info

Navigation	Screen	Comments
		Use the BLE Info page to view information on the BLE connection.

8.10 Update Firmware

Navigation	Screen	Comments
		Click the Hamburger Menu to bring up a navigation pane.

Navigation	Screen	Comments
		Click the **Update FW** link. Select **Update** on the page that is displayed. The released firmware builds from Laird are stored in the cloud. The Sentrius App will look in this location and display available versions of the firmware. Select the appropriate file to start the update process.

8.11 Integrating **Sentrius™** Sensor into a Third Party Application

The GATT tables used on the Sentrius™ Sensor are documented in the Bluetooth Developer Studio, a PC tool available from the Bluetooth SIG. These files are bundled together with the Mobile Application Source code which can be downloaded from the Software Download section of the RS1xx Product Page.

Note: The mobile application is written in Xamarin (C#), a product by Microsoft designed for cross-platform (Android + iOS) development. The source code for the project is available from Laird as mentioned above.

9 BLUETOOTH SIG

The Sentrius™ Sensor is certified by the Bluetooth® SIG as a Bluetooth v4.2, End Product. The Qualified Design ID (QDID) is 100178.

10 FCC AND ISED CANADA REGULATORY STATEMENTS

This product contains the RM191 from Laird.

Model	US/FCC	CANADA/IC
RS191	SQG-RM191	3147A-RM191

10.1 Power Exposure Information

To comply with FCC RF exposure limits for general population/uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and operating in conjunction with any other antenna or transmitter.

IMPORTANT NOTE: If these conditions cannot be met (for certain configurations or co-location with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID and IC Certification Number cannot be used on the final product. In these circumstances, the OEM integrator is responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC and Industry Canada authorization.

10.2 OEM Responsibilities

To comply with FCC and Industry Canada RF exposure limits for general population/uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

WARNING: Changes or modifications not expressly approved by Laird could void the user's authority to operate the equipment.

10.2.1 FCC Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in an installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

10.2.2 FCC Warning

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.

10.2.3 Industry Canada (IC) Warning

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.

French equivalent is:

Le présent appareil est conforme aux CNR d'Industrie Canada applicable aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

10.2.4 ISED Radiation Exposure Statement

To comply with ISED Canada RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be operating in conjunction with any other antenna or transmitter.

French equivalent is:

Déclaration IC d'exposition aux radiations
Pour se conformer à Industrie Canada RF limites d'exposition pour la population générale / exposition non contrôlée, l'antenne utilisée pour ce transmetteur doit être installée pour fournir une distance d'au moins 20 cm de toutes les personnes et ne doit pas fonctionner en conjonction avec toute autre antenne ou transmetteur.

11 CE Regulatory

The RS186 has been tested for compliance with relevant standards for the EU market. The RM186 module has been tested with custom internal slot antenna.

Reference the Declaration of Conformities listed below for a full list of the standards that the modules were tested to. Test reports are available upon request.

12 EU Declarations of Conformity

Manufacturer	Laird
Products	Sentrius™ RS186 Sensor
Product Description	IP65 Integrated Temperature/Humidity Sensor with LoRa & BLE connectivity
EU Directives	2014/53/EU – Radio Equipment Directive (RED)

Reference standards used for presumption of conformity:

Article Number	Requirement	Reference standard(s)
3.1a	Health	EN62311:2008
	Safety	EN60950-1:2006+A11+A1:2010+A12:2011+ A2:2013
3.1b	Protection requirements – Electromagnetic compatibility	EN 301 489-1 v2.2.0 (2017-03) EN 301 489-3 v2.1.1 (2017-03) EN 301 489-17 v3.2.0 (2017-03)
3.2	Means of the efficient use of the radio frequency spectrum (ERM)	EN 300 220-1 v3.1.1 (2017-02) EN 300 220-2 v3.1.1 (2017-02) EN 300 328 v2.1.1 (2017-03)

Declaration:

We, Laird, declare under our sole responsibility that the essential radio test suites have been carried out and that the above product to which this declaration relates is in conformity with all the applicable essential requirements of Article 3 of the EU Radio Equipment Directive 2014/53/EU, when used for its intended purpose.

Place of Issue:	Laird W66N220 Commerce Court, Cedarburg, WI 53012 USA tel: +1-262-375-4400 fax: +1-262-364-2649
Date of Issue:	30 November 2017
Name of Authorized Person:	Thomas T Smith, Director of EMC Compliance
Signature of Authorized Person:	Thomas T Smith

13 Ordering Information

455-0001	Sentrius™ Sensor, Temp & Humidity, Eval Kit, 915 MHz
455-0002	Sentrius™ Sensor, Temp & Humidity, Eval Kit, 868 MHz
455-0003	Sentrius™ Sensor, Temp & Humidity, Bulk Packaging, 915 MHz
455-0004	Sentrius™ Sensor, Temp & Humidity, Bulk Packaging, 868 MHz

13.1 Evaluation Kit Details (Applies to Both 455-0001 & 450-0002)