User Guide

Sentrius™ BT510

Version 1.3

REVISION HISTORY

Version	Date	Notes	Contributor	Approver
1.0	03 Feb 2020	Initial Release	Brent Mikkelsen Ian Tracy	Jonathan Kaye
1.1	04 Feb 2020	Added Japan and AS/NZS Regulatory statements Added ordering information	Dave Neperud	Jonathan Kaye
1.2	03 Mar 2020	Updated Record Event Types table information for clarity	Brent Mikkelsen	Jonathan Kaye
1.3	20 Mar 2020	Updated mobile App section and added more information to the Advertisement	Brent Mikkelsen	Jonathan Kaye

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1 About this Guide

This document provides a comprehensive guide on how to configure the Sentrius™ BT510 Sensor functionality, including Bluetooth settings and temperature readings, motion, and contact detection.

2 Introduction

2.1 Product Overview

The Sentrius™ BT510 Sensor is a battery powered, Bluetooth v5 long-range integrated sensor platform enabling robust, reliable sensor data transfer in the harshest of environments. It contains a temperature sensor, also seamlessly integrating open/close contact and motion/impact detection and BLE beaconing capabilities. The BT510 is powered by Laird Connectivity's field proven BL654 BLE module that integrates Nordic Semiconductor's nRF52840 SoC silicon.

1. Fixing holes
2. LED
3. Hidden button to wake device
4. Magnetic switch

Figure 1: Top of the Sentrius™ BT510 sensor

Figure 2: Back of the Sentrius™ BT510 sensor

Note: Laird Connectivity 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 BT510 product brief for detailed specifications. It's available from the documentation tab of the BT510 series product page: https://www.lairdconnect.com/iot-devices/iot-sensors/bt510-bluetooth-5-long-range-ip67-multi-sensor

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3 Device Operation

3.1 Activating the Sensor

The Sentrius™ BT510 doesn't have a power switch. It is shipped with an installed battery and is in a low power state called shelf mode.

To wake the device, firmly press the button in the center of the round face for at least three seconds until the green LED turns on.

When you release the button, the green LED blinks once a second.

The sensor is in sleep mode from the factory. Pressing the button for three seconds wakes the sensor and it starts to advertise. The sensor is now ready for normal operation configuration. This can be done using a phone or gateway. The LED blinks for 30 seconds or until a connection is made, the button is pressed again, or the sensor stops advertising. The default state of the sensor is to advertise indefinitely.

3.2 Battery Check

Quickly press the button to perform a battery good check. If the battery is good, the sensor briefly blinks the green LED and starts to advertise. If the battery is below the recommend operating voltage, then the LED does not blink but the sensor tries to advertise.

3.3 Factory Reset

If the button is held for more than ten seconds and released, the sensor performs a factory reset. A factory reset erases all logs, pairing information, and reset the configuration to its default state.

When the button as shown in Figure 1 is held for 10 seconds, the LED turns yellow or red. If the LED turns red, then factory reset is not allowed using the button. This is because the sensor is locked. The sensor can be locked by using one of the JSON properties. When locked, the factory reset can still be performed using Bluetooth. If the LED turns yellowish orange, then factory reset is allowed. The yellowish orange LED blinks when the button is released.

3.4 Replacing Batteries

The battery is a 3-volt lithium of CR2477 type.

Note: The battery door cover has a gasket inside to keep out liquids.

3.5 Care and Maintenance

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

The sensor does not require any calibration.

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4 Sensor Architecture

The Sentrius™ BT510 advertises events. An event can be a temperature measurement, an alarm, a battery measurement, a button press, a door opening/closing, or movement. The configuration of a sensor determines what kind of events it generates.

You can configure a sensor using a Bluetooth connection and the Laird virtual serial port(vSP) service. The protocol sent over the virtual serial port is JSON-RPC version 2. This allows you to add new commands and features without changing the Bluetooth interface. More details can be found at https://www.jsonrpc.org/specification.

4.1 Advertisements

Advertising each event once it becomes active is the default behavior of the sensor. This provides ample time for a gateway to detect an event, maximizes the lifetime of the battery, and allows the sensor to be a good RF citizen. Once a sensor is configured, it is possible that a gateway never needs to connect to a sensor. If multiple events occur at the same time, the sensor queues events and advertises each one for the configured advertising duration (default of indefinite).

If the sensor is configured to advertise indefinitely, then the advertisement queue is bypassed.

For each new event, the record number increments. You can use this value to filter out duplicate advertisements.

The TLV (type-length-value) fields are shown in the order that is broadcast by the sensor. However, this order is not guaranteed.

The sensor can be configured to transmit with an output power of +8 dBm. It can also be configured to use the LE coded PHY.

When using the coded PHY, the scan response isn't used.

4.1.1 1M PHY

Table 1: 1M PHY

Byte	Description	Value/Notes
0	0x02	Length (0x02)
1	GAP_ADTYPE_FLAGS	Type (0x01)
2	GAP_ADTYPE_FLAGS_BREDR_NOT_SUPPORTED	Data
3	0x1b (27)	Length (length is not included in overall length)
4	GAP_ADTYPE_MANUFACTURER_SPECIFIC	0xFF (Type)
5	Company ID 1	0x77 (Laird)
6	Company ID 2	0x00
7	Protocol ID LSB	0x01 (Identifies the advertisement format)
8	Protocol ID MSB	0x00
9	Network ID LSB	Assigned during configuration. Default is 0x000.
10	Network ID MSB	This can be used for filtering advertisements
11	Flags LSB	Indicate the current state of the system
12	Flags MSB	See: 4.1.6 Flags
13	BD_ADDR 1	Random static Bluetooth address
14	BD_ADDR 2	
15	BD_ADDR 3	
16	BD_ADDR 4	
17	BD_ADDR 5	
18	BD_ADDR 6	
19	Record Type	See: 4.1.4 Record Event Types

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Byte	Description	Value/Notes
20	Record Number LSB	This count matches the index in the NV log. It will rollover
21	Record Number MSB	
22	Epoch 0 LSB	This is a timestamp in seconds from Jan 1, 1970
23	Epoch 1	
24	Epoch 2	
25	Epoch 3 MSB	
26	Data byte 0 LSB	See: table 4 to match record type to data
27	Data byte 1	
28	Data byte 2	
29	Data byte 3 (MSB)	
30	Reset Count LSB	For testing purposes.

4.1.2 1M PHY Scan Response

Table 2: 1M PHY scan response

Byte	Description	Value/Notes
0	0x10 (16)	Length (length is not included in overall length)
1	GAP_ADTYPE_MANUFACTURER_SPECIFIC	0xFF (Type)
2	Company ID 1	0xE4 (Laird)
3	Company ID 2	0x00
4	Protocol ID LSB	0x03 (Identifies the advertisement format)
5	Protocol ID MSB	0x00
6	Product ID LSB	Identification of the device transmitting
7	Product ID MSB	
8	Firmware Version Major	Version of the main application installed
9	Firmware Version Minor	
10	Firmware Version Patch	
11	Firmware Type	Firmware type can be used to interleave versions for multiple devices
12	Configuration Version	Configuration version is updated when advertisement is built
13	Boot Loader Version Major	
14	Boot Loader Version Minor	
15	Boot Loader Version Patch	
16	Hardware Version	
17	Length (X)	(<=13)
18	DEVICE_NAME	0x08 or 0x09
19		Max Complete Name (0x09) is 12 characters

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Byte	Description	Value/Notes
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

4.1.3 LE Coded PHY

Table 3: LE Coded PHY

Byte	Description	Value/Notes
0	0x02	Length (0x02)
1	GAP_ADTYPE_FLAGS	Type (0x01)
2	GAP_ADTYPE_FLAGS_BREDR_NOT_SUPPORTED	Data
3	0x26 (38)	Length (length is not included in overall length)
4	GAP_ADTYPE_MANUFACTURER_SPECIFIC	0xFF (Type)
5	Company ID 1	0x77 (Laird)
6	Company ID 2	0x00
7	Protocol ID LSB	0x02 (Identifies the advertisement format)
8	Protocol ID MSB	0x00
9	Network ID LSB	Assigned during configuration. Default is 0x000.
10	Network ID MSB	This can be used for filtering advertisements
11	Flags LSB	Indicate the current state of the system
12	Flags MSB	See: 4.1.6 Flags
13	BD_ADDR 1	Random static Bluetooth address
14	BD_ADDR 2	
15	BD_ADDR 3	
16	BD_ADDR 4	
17	BD_ADDR 5	
18	BD_ADDR 6	
19	Record Type	See: 4.1.4 Record Event Types
20	Record Number LSB	This count matches the index in the NV log. It will rollover
21	Record Number MSB	

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Byte	Description	Value/Notes
22	Epoch 0 LSB	This is a timestamp in seconds from Jan 1, 1970
23	Epoch 1	
24	Epoch 2	
25	Epoch 3 MSB	
26	Data 0 LSB	See: table 4 to match record type to data
27	Data 1	
28	Data 2	
29	Data 3 (MSB)	
30	Reset Count LSB	For testing purposes.
31	Product ID LSB	Identification of the device transmitting
32	Product ID MSB	
33	Firmware Version Major	Version of the main application installed
34	Firmware Version Minor	
35	Firmware Version Patch	
36	Firmware Type	Firmware type can be used to interleave versions for multiple devices
37	Configuration Version	Configuration version is updated when advertisement is built
38	Boot Loader Version Major	
39	Boot Loader Version Minor	
40	Boot Loader Version Patch	
41	Hardware Version	
42	Length (X)	(<=24)
43	DEVICE_NAME	0x09
44		
…		
66		

4.1.4 Record Event Types

Table 4: Record event types

ID	Event	Data	Format
0	RESERVED	-	
1	TEMPERATURE	TEMPERATURE	Hundredths of degree C (signed 16-bit number)
2	MAGNET (PROXIMITY)	MAGNET STATE	See: 4.1.5 Magnet States
3	MOVEMENT	-	-
4	ALARM HIGH TEMP 1	TEMPERATURE	Hundredths of degree C
5	ALARM HIGH TEMP 2	TEMPERATURE	Hundredths of degree C

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ID	Event	Data	Format
6	ALARM HIGH TEMP CLEAR	TEMPERATURE	Hundredths of degree C
7	ALARM LOW TEMP 1	TEMPERATURE	Hundredths of degree C
8	ALARM LOW TEMP 2	TEMPERATURE	Hundredths of degree C
9	ALARM LOW TEMP CLEAR	TEMPERATURE	Hundredths of degree C
10	ALARM DELTA TEMP	TEMPERATURE	Hundredths of degree C
12	BATTERY GOOD	BATTERY VOLTAGE	Millivolts (unsigned 16-bit number)
13	ADVERTISE ON BUTTON	BATTERY VOLTAGE	Millivolts
14	RESERVED	-	-
15	RESERVED	-	-
16	BATTERY BAD	BATTERY VOLTAGE	Millivolts
17	RESET	RESET REASON	See: 4.1.7 Reset Reason

4.1.5 Magnet States

The magnet states are NEAR = 0 (door closed) and FAR = 1 (door open).

4.1.6 Flags

The flags are a bitmask of the current state of the sensor.

Table 5: Flags

Bit	Name
0	RTC was set (epoch)
1	Active Mode
2	Any flag was set
3	reserved
4	reserved
5	reserved
6	reserved
7	Low Battery Alarm
8	high temperature alarm bit 0
9	high temperature alarm bit 1
10	low temperature alarm bit 0
11	low temperature alarm bit 1
12	Delta Temperature Alarm
14	Movement Alarm
15	Magnet State

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4.1.7 Reset Reason

The reset reasons come from the RESETREAS register in the Nordic nRF52840. Reserved values do not apply to the sensor.

Table 6: Reset reasons

Value	Reason
0	Power Up
1	Reset Pin
2	Watchdog
3	Software Request
4	CPU Lock-up detected
5	Reserved
6	Low Power Comparator
7	Reserved
8	Reserved
9	Reserved
10	Unknown

4.2 Laird vSP (Virtual Serial Port)

Details can be found at https://www.lairdconnect.com/documentation/application-note-using-vsp-smartbasicpdf.

The sensor doesn't use the optional Modem In/Out characteristics.

4.3 JSON-RPC

The sensor supports version 2.0 of the specification. The sensor does not support batch commands.

More details can be found at https://www.jsonrpc.org/specification.

4.3.1 Methods

Table 7: JSON-RPC methods

Method (Command)	Parameters	Description
get	<properties>	The get command is used to get the value of an attribute.
set	<properties>	The set command is used to set attributes.
dump	None for all 0 for read-only 1 for read-write	Used to read all attributes. Configurable attributes are read-write.
reboot	None or 0 for normal Non-zero for enter bootloader	Restart the sensor immediately after sending acknowledgement.
factoryReset	NA	Reset the device to factory settings
prepareLog	integer, positional	0 = FIFO mode, 1 = LIFO mode
readLog	integer, positional	Number of events to read
ackLog	integer, positional	Number of events to invalidate
setEpoch	integer, positional	Seconds since client's reference point; used to timestamp data; tested with reference of January 1, 1970 midnight UTC.
getEpoch	none	Returns epoch in result

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Method (Command)	Parameters	Description
ledTest	integer, duration of each step	Both LEDs off for X milliseconds Green LED on for X milliseconds Red LED on for X milliseconds Both LED on for X milliseconds. Processor remains running (doesn't enter low power mode) for duration of test. The minimum duration is 10 milliseconds. This command is primarily for production test.

4.4 Sensor Configuration

The sensor has multiple properties (attributes) that can be used to configure it for a particular use case.

The read only parameters reflect the current state of the sensor. Issuing a JSON-RPC command to get the temperature does not cause the sensor to take a temperature measurement. It returns the value of the last temperature measurement taken.

As indicated in the table, some parameters require the sensor to be reset before they take effect.

Note: The sensor contains more parameters than those that are listed in the table. They are used during production and reliability testing by Laird Connectivity. They may not exist in future software versions.

4.4.1 Example

In this example system, the device name is changed during configuration so that unconfigured devices are the only devices that advertise with the name *BT510*.

1. Start Scan for *BT510*.

```
Found Device E235431D1F8E with RSSI -47 and advertisement data
"0201061BFF770001000000000808E1F1D4335E20C030008B1D55DB80B00000210FFE4000300000001030A000000000008
06094254353130"
```

2. Stop Scan.
3. Connect to E235431D1F8E.
4. Set time in sensor.

```
>> {"jsonrpc": "2.0", "method": "setEpoch", "params": [1574285874], "id": 2}

<< {"jsonrpc": "2.0", "id": 2, "result": "ok"}
```

5. Configure sensor to take a temperature measurement every 15 minutes, a battery measurement every hour, and enable motion detection.

```
>> {"jsonrpc": "2.0", "method": "set", "params": {"sensorName": "Test-02", "location": "desk",
"advertisingDuration": 15000, "batterySenseInterval": 3600, "temperatureSenseInterval": 900,
"odr": 5}, "id": 3}

<< {"jsonrpc": "2.0", "id": 3, "result": "ok"}
```

6. Reset the sensor because name and advertising duration were changed.

```
>> {"jsonrpc": "2.0", "method": "reboot", "id": 4}

<< {"jsonrpc": "2.0", "id": 4, "result": "ok"}
```

7. Request Disconnect.

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4.5 Event Log

All sensor events are recorded in a non-volatile log. The log can store seven days of measurements with a temperature sample rate of 15 minutes. Each event has a timestamp and a sample ID. These values are the same as those found in the advertisements.

The log can be read in FIFO mode or LIFO mode. In FIFO mode, the oldest event is retrieved first. In LIFO mode, the last event is retrieved first.

Many systems do not require the traceability that the event log provides. When the log is full, the oldest event is overwritten.

4.5.1 Event Structure

The JSON format used for sensor configuration has too much overhead for large amounts of data. Therefore, the event log data is transferred with a size in bytes and a Base64 encoded array of event structures.

Table 8: Event structure

Name	Size in Bytes	Description
timestamp	4	See epoch <tbd cross ref>
event data	2	The type of data depends on the event type. Signed temperature in hundredths of degrees C, unsigned voltage in millivolts, or Magnet State.
type	1	See Event Type <tbd cross ref>
salt	1	A counter used by sensor to differentiate events with the same timestamp (simultaneous events).

4.5.2 Example

1. Connect to sensor.
2. Tell the sensor to get ready to send logs in FIFO mode.

```
>> {"jsonrpc": "2.0", "method": "prepareLog", "params": [0], "id": 1}
<< {"jsonrpc": "2.0", "id": 1, "result": 9}
```

3. Ask for 500 events. Sensor returns nine events (72/8). The sensor does not return more than 128 events per read.

```
>> {"jsonrpc": "2.0", "method": "readLog", "params": [500], "id": 2}
<< {"jsonrpc": "2.0", "id": 2, "result": [72,
"Ob/mXZIJAQA5v+ZdLgsMAXDA5l0BAAMAdsDmXXELDACRweZdLAkBAJHB5l1HCwwB0MLmXQEAAwDowuZdAQADAOjC5l0BAAMB
"]}
```

4. Acknowledge events.

```
>> {"jsonrpc": "2.0", "method": "ackLog", "params": [9], "id": 3}
<< {"jsonrpc": "2.0", "id": 3, "result": 9}
```

Note: The sensor allows any number of events to be acknowledged even if they haven't been read. If more events are acknowledged than were read and another read is issued, then blank entries are returned.

5. Update the time (after all events have been read).

```
>> {"jsonrpc": "2.0", "method": "setEpoch", "params": [1575404269], "id": 4}
<< {"jsonrpc": "2.0", "id": 4, "result": "ok"}
```


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Table 9: Decoded log

Index	Epoch	Salt	Local time	Data	Event Type
1	1575403321	0	03 Dec 19 14:02:01	24.5	TEMPERATURE
2	1575403321	1	03 Dec 19 14:02:01	28.62	BATTERY_GOOD
3	1575403632	0	03 Dec 19 14:07:12	-	MOVEMENT
4	1575403638	0	03 Dec 19 14:07:18	29.29	BATTERY_GOOD
5	1575403921	0	03 Dec 19 14:12:01	23.48	TEMPERATURE
6	1575403921	1	03 Dec 19 14:12:01	28.87	BATTERY_GOOD
7	1575404240	0	03 Dec 19 14:17:20	-	MOVEMENT
8	1575404264	0	03 Dec 19 14:17:44	-	MOVEMENT
9	1575404264	1	03 Dec 19 14:17:44	-	MOVEMENT

5 Mobile Application

5.1 Overview

The Sentrius™ BT510 mobile application allows a user to configure a device, troubleshoot a device, see real-time sensor data, and update firmware.

5.2 Using the Sentrius™ BT510 Sensor Mobile App on Device

To use the Sentrius™ BT510 mobile application, follow these steps:

1. From the applicable app store (Apple or Android) search for and install the Sentrius™ BT510 Sensor mobile application on your device.
2. To connect to the Sentrius BT510 sensor, press and hold the button in the center of the Laird Connectivity logo for three seconds (#3 on Figure 3).

Figure 3: Front side of the Sentrius™ BT510 sensor

The sensor blinks the green LED, begins advertising, and becomes connectable.

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3. Tap the search icon to discover the sensor(s) within range of the mobile device (Figure 4).

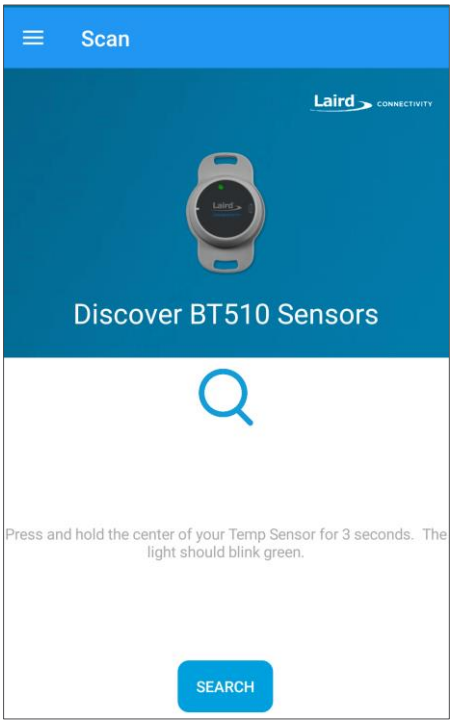

Figure 4: Scan for new sensors

4. Select the applicable device. The sensor name defaults to BT510 when searching for the sensor. The BLE ID is printed on the label located on the back of the sensor (Figure 5). The BLE ID matches the number of the applicable sensor located in the search results Discover screen (Figure 6).

Note: The number displayed in the search results is the *inverse* order as shown on the device label. For example, from the following, the BLE ID **D936EE37716E** on the label matches **BT510 - 6E-71-37-EE-36-D9** in the search results.

Figure 5: BLE ID location

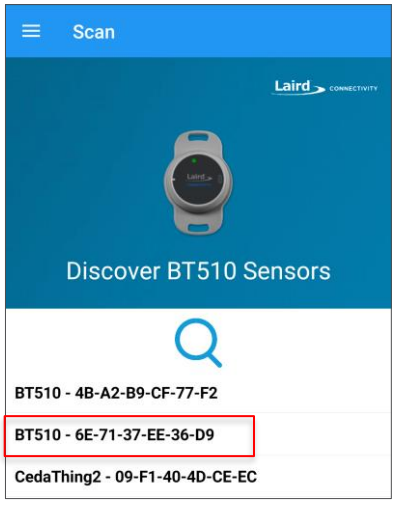

Figure 6: Device search results

Once you select the desired sensor and if this is the first time connecting to it, you need to pair the selected device.

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5. When prompted *Pair with BT510?*, select **Pair**. If you select **Cancel**, the application disconnects from the sensor (Figure 7).

   The default pairing key is *123456* (Figure 8).

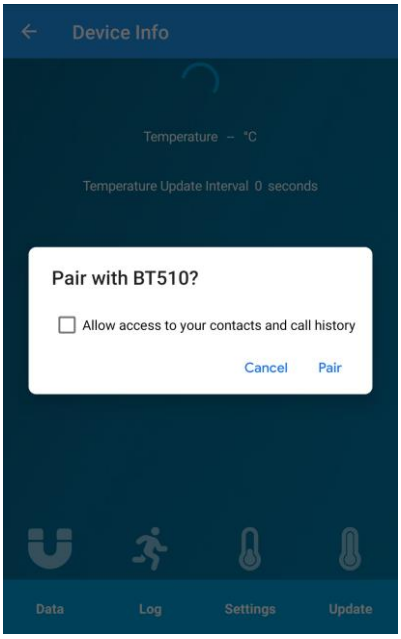

Figure 7: Pair window

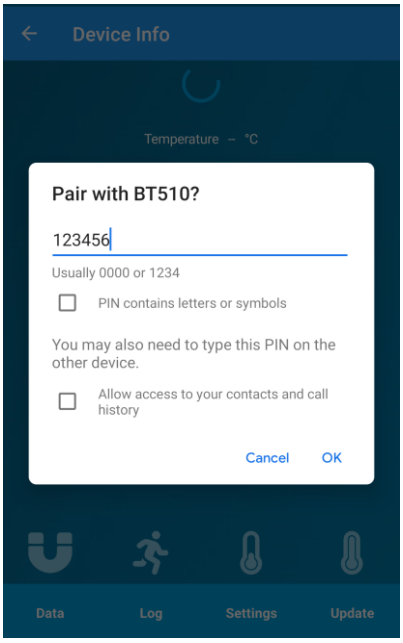

Figure 8: Pair key

Once paired, the Main screen of the mobile application displays. This screen contains a graph of the temperature over time. It also indicates at what interval the temperature value is updated by the sensor (Figure 9).

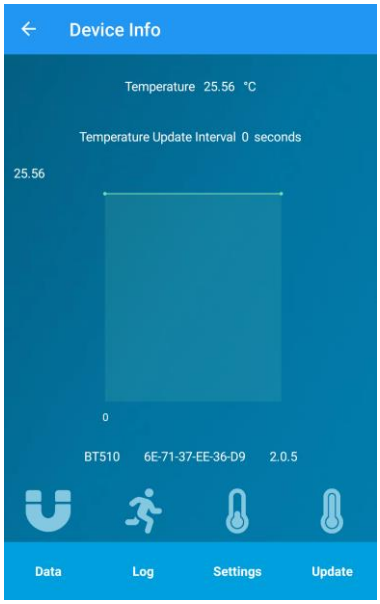

Figure 9: Main screen

	Lights up when there is change in the magnetic switch.
	Lights up when the configured *G Threshold* alarm value is reached.
	Lights up when the temperature of the sensor reaches one of the configured low temperature alarms.
	Lights up when the temperature of the sensor reaches one of the configured high temperature alarms.

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5.3 Device Configuration

The following section describes how to configure various aspects of the device. To access the configuration option, select **Settings** located near the bottom of the main screen (Figure 10).

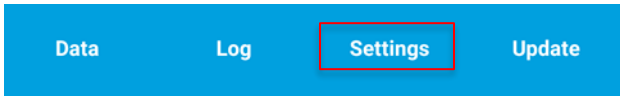
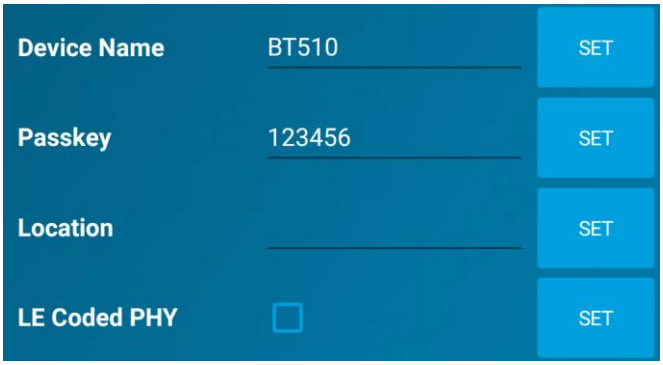


Figure 10: Access Settings

5.3.1 Sensor Configuration



Device Name – Used to assign a user-friendly name to the sensor

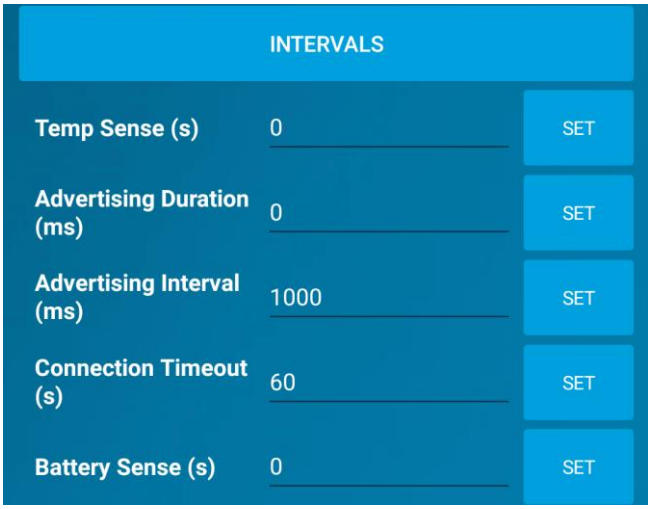
Passkey – A unique number assigned to the device to help protect the configuration values from being changed without permission. This passkey is used when pairing a sensor to a new mobile device

Location - Can be a given a name to help identify the area where the sensor is being stored.

LE Coded PHY – When selected the device will switch to transmitting a Coded PHY extended advertisement.

NOTE: When selecting this option, the only way to return to 1M PHY (normal operation) is to perform a factory reset.

5.3.2 Interval Configuration



Temp Sense – The time in seconds when the sensor takes a temperature measurement.

Advertising Duration – Specifies how long the sensor should advertise each event. When sent to 0, it advertises indefinitely.

Advertising Interval – The time between advertising packets.

Connection Timeout – The time in seconds that the mobile device is connected to the sensor. When set to 0, there is no timeout.

Battery Sense – The time in seconds when the sensor takes battery measurement.

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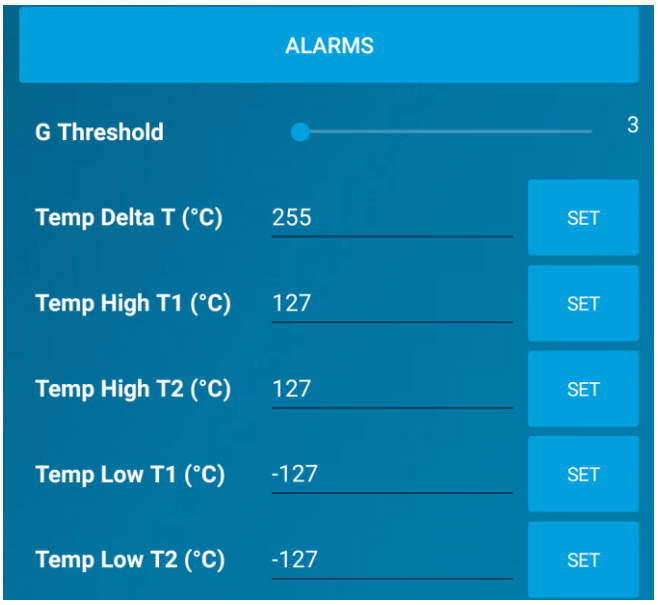
5.3.3 Alarm Configuration



G Threshold – Sets the acceleration threshold on the sensor. The lower the number, the lower amount acceleration acted on the device is required to trigger the alarm.

Temp Delta – The alarm is triggered when the temperature change between intervals is greater than value written here.

Temp High T1 – Alarm that triggers when the sensor temperature is higher than this value. It is also logged when triggered and has the high temp icon light up on the data screen.

Temp High T2 – Behaves the same as *Temp High T1*. This is just another alarm that can be triggered if the temperature is high than this value.

Temp Low T1 – Alarm that triggers when the sensor temperature is lower than this value. It is also logged when triggered and has low temp icon light up on the data screen.

Temp Low T2: This behaves the same as *Temp Low T1*. This is just another alarm that can be triggered if the temperature is lower than this value.

5.4 View Log

Select the Log icon located near the bottom of the screen (Figure 11). Figure 12 displays an example of log data over time.

Figure 11: Log icon

Figure 12: Log data

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5.5 Update Firmware

Select the Update icon located near the bottom of the screen (Figure 13).

Figure 13: Update button

If the current firmware on the sensor is out of date, it is shown to have update package available as seen in Figure 14. Select the UPDATE button to begin the update process. It updates the bootloader first if it is out of date and then updates the firmware. Once the update is complete, a window appears that indicates success or failure (Figure 15**)**.

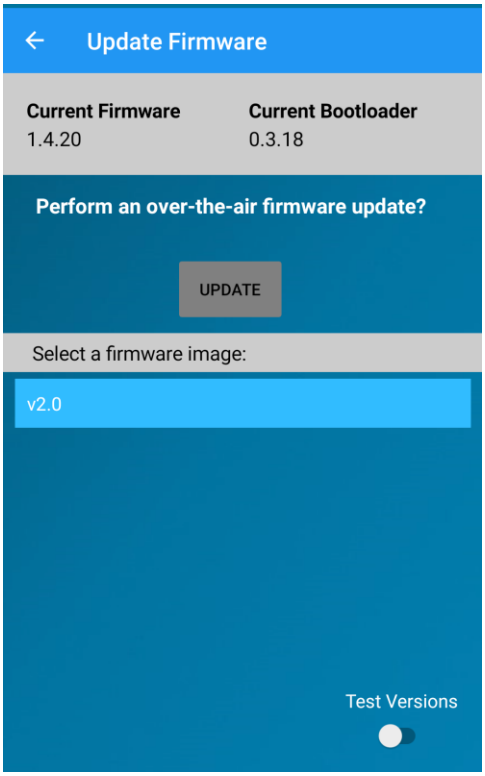

Figure 14: Available update

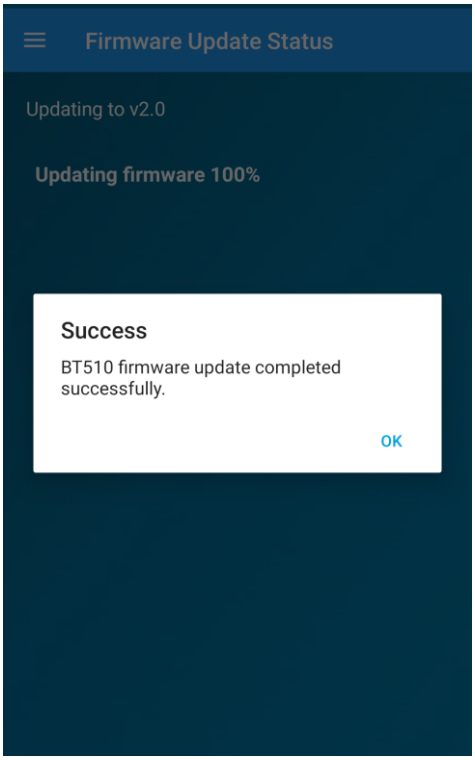

Figure 15: Update complete

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6 BLUETOOTH SIG

The Sentrius™ Sensor is certified by the Bluetooth® SIG as a Bluetooth v5.0, End Product. The Declaration ID (DID) is D041400.

7 FCC AND ISED CANADA REGULATORY STATEMENTS

This product contains the BL654 from Laird Connectivity.

Model	US/FCC	CANADA/IC
BL654	SQGBL654	3147A-BL654

Power Exposure Information

This EUT complies with SAR for general population/uncontrolled exposure limits in FCC Part 1.1307, Part. 1310 and FCC KDB 447498 – RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices.

This transceiver must not be co-located or operating in conjunction with any other antenna, transmitter, or external amplifiers. 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 product (including the transmitter) and obtaining a separate FCC and Industry Canada authorization.

OEM Responsibilities

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

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 into 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.

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.

Industry Canada (IC) Warning

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(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.

Cet appareil contient des émetteurs / récepteurs exempts de licence qui sont conformes au (x) RSS (s) exemptés de licence d'Innovation, Sciences et Développement économique Canada. L'opération est soumise aux deux conditions suivantes:

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(1) Cet appareil ne doit pas causer d'interférences

(2) Cet appareil doit accepter toute interférence, y compris les interférences pouvant provoquer un fonctionnement indésirable de l'appareil.

ISED Radiation Exposure Statement

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. The module meets the SAR exclusion limit when installed and operated with a minimum distance of 12mm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements définies par le Canada pour un environnement non contrôlé. Le module respecte la limite d'exclusion SAR lorsqu'il est installé et utilisé avec une distance minimale de 12 mm entre le radiateur et votre corps.

8 CE Regulatory

The BT510 has been tested for compliance with relevant standards for the EU market. The BL654 module has been tested with the Printed PCB antenna.

Reference the Declarations of Conformity listed below for a full list of the standards that the BT510 were tested to. Test reports are available upon request.

8.1 EU Declarations of Conformity

Manufacturer Laird Connectivity
Product Sentrius™ BT510 Sensor
Product Description Bluetooth v5 IP67 Multi Sensor

EU Directives 2014/53/EU - Radio Equipment Directive (RED)

Reference standards used for presumption of conformity:

Article Number	Requirement	Reference Standard(s)
3.1(a)	Health	EN 62311:2008 EN 50665:2017 EN 50385:2017
	Safety	EN 62368-1:2014
3.1(b)	Protection requirements – EMC compatibility	EN 301 489-1 V2.2.0 (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 300 328 V2.1.1 (2016-11)

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 Connectivity
W66N220 Commerce Court, Cedarburg, WI 53012 USA
tel: +1-262-375-4400 fax: +1-262-364-2649

Date of Issue: 12/11/19
Name of Authorized Person: Ryan Urness, Director of Test Services

Signature of Authorized Person:

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9 Japan (MIC) Regulatory

The BT510 is approved for use in the Japanese market. The BL654 has been tested with the PCB trace antenna and the part number listed below holds WW type certification. Refer to **ARIB-STD-T66** for further guidance on OEM's responsibilities.

Model	Certificate Number	Antenna
451-00001	201-180112	PCB Trace

10 ACMA (Australia/NZ) Certification

The BT510 is approved for use in the Australia and New Zealand markets regarding the following standards:

- AS/NZS 4268:2017
- AS/NZS 2772:2011
- AS/NZS CISPR 32:2015, Class B

11 Ordering Information

Part Number	Description	Packaging
455-00083	Sentrius™ BT510 Sensor, Single	Single (1)
450-00048B	Sentrius™ BT510 Sensor, Bulk Packaged	Bulk (100)
455-00058	Magnet Kit (Open/Close) for Sentrius™ BT510, Single	Single (1)

12 Label Info

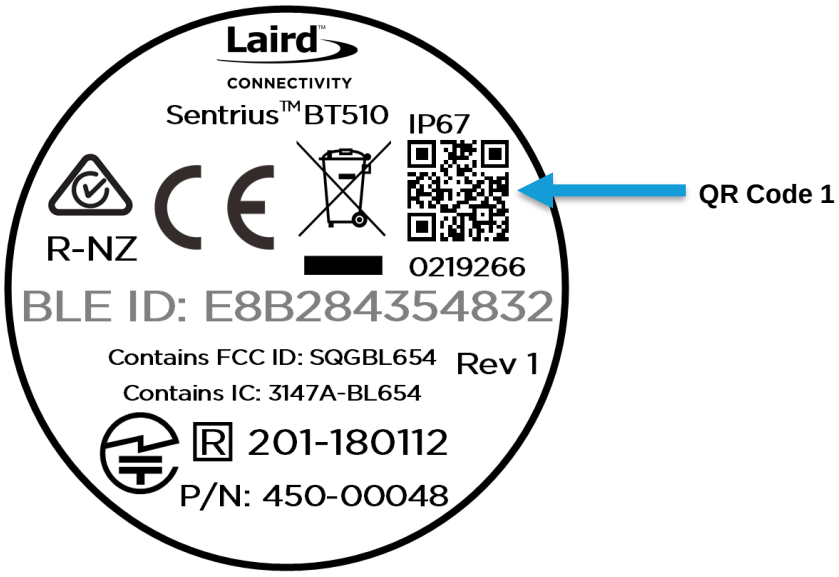

Figure 16: BT510 back sensor label

The QR Code contains the part number, hardware revision, date code, and BLE ID (All CAPS).

Example Readout: 450-00048,1,0919452,CB09AE5B8D7F

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13 JSON PROPERTIES

Category	Name	Type	Min	Max	Default	Units	Reset Req.	Description/ Notes
rw	sensorName	s	0	23	BT510	NA	1	The sensor name is part of the advertisement.
rw	location	s	0	32	""	NA	0	User configurable string that is unused by sensor.
rw	advertisingInterval	u	20	10000	1000	ms	1	The interval between advertising packets.
rw	advertisingDuration	u	0	0	0	ms	1	0 = indefinite This specifies how long the sensor should advertise each event. 15000 is often used for normal operation.
rw	connectionTimeout	u	0	10000	60	s	0	0 = none
rw	passkey	s	6	6	123456	NA	1	6 digits 0 to 9
rw	lock	u	0	1	0	NA	0	Reserved for future use.
rw	batterySenseInterval	u	0	86400	0	s	0	
rw	temperatureAggregationCount	u	1	32	1	samples	0	When greater than 1, the temperature samples are averaged.
rw	temperatureSenseInterval	u	0	86400	0	seconds	0	
rw	highTemperatureAlarmThreshold1	i	-128	127	127	°C	0	Range is larger than actual operating range.
rw	highTemperatureAlarmThreshold2	i	-128	127	127	°C	0	threhold2 > threshold 1, threshold 1 checked first
rw	lowTemperatureAlarmThreshold1	i	-128	127	-127	°C	0	
rw	lowTemperatureAlarmThreshold2	i	-128	127	-127	°C	0	threshold 2 < threshold 1
rw	deltaTemperatureAlarmTheshold	u	0	255	255	°C	0	
rw	odr	u	0	9	5	NA	0	LIS2DH12_ODR_POWERDOWN 0 LIS2DH12_ODR_1HZ 1 LIS2DH12_ODR_10HZ 2 LIS2DH12_ODR_25HZ 3 LIS2DH12_ODR_50HZ 4 LIS2DH12_ODR_100HZ 5 (default/tested value) LIS2DH12_ODR_200HZ 6 LIS2DH12_ODR_400HZ 7 LIS2DH12_ODR_1620HZ 8 LIS2DH12_ODR_1344_5376HZ 9
rw	scale	u	0	3	2	NA	0	LIS2DH12_SCALE_2G 0 LIS2DH12_SCALE_4G 1 LIS2DH12_SCALE_8G 2 LIS2DH12_SCALE_16G 3
rw	activationThreshold	u	0	255	8	NA	0	With odr 5 and scale 2
rw	returnToSleepDuration	u	0	255	6	NA	0	
ro	tempCc	i	-128000	127000	NA	Hundredths of a °C	0	
ro	batteryVoltageMv	u	0	0	NA	Milli-volts	0	

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Category	Name	Type	Min	Max	Default	Units	Reset Req.	Description/ Notes
ro	hwVersion	s	1	1	NA	NA	0	*major*
ro	firmwareVersion	s	0	11	NA	NA	0	*major.minor.revision*
ro	resetReason	s	0	8	NA	NA	0	For development
rw	scratchpad1	u	0	0	NA	NA	0	For development. This can be used to test read/write operation without affecting sensor operation.
rw	scratchpad2	u	0	0	NA	NA	0	For development
rw	scratchpad3	u	0	0	NA	NA	0	For development
ro	bluetoothAddress	s	12	12	NA	NA	0	
ro	mtu	u	20	244	20	bytes	0	For development. Maximum Transmission Unit for Bluetooth Notifications and Write without response
ro	accelerometerSelfTestStatus	u	0	4	NA	NA	0	0 Reserved 1 Unable to communicate with sensor (possible I2C issue) 2 Self-test pass 3 Self-test fail
ro	flags	u	0	0	NA	NA	0	Bitmask is the same as what is found in the advertisement.
ro	resetCount	u	0	0	NA	NA	0	
rw	useCodedPhy	u	0	1	NA	NA	1	When 1 the coded PHY is used as the primary and secondary PHY to send connectable but non-scannable extended advertisements.
rw	txPower	i	-40	8	0	dBm	0	-40 dBm, -20 dBm, -16 dBm, -12 dBm, -8 dBm, -4 dBm, 0 dBm, +2 dBm, +3 dBm, +4 dBm, +5 dBm, +6 dBm, +7 dBm, +8 dBm
rw	networkId	u	0	65535	0	NA	0	The Network ID is part of the advertisement. It can be used to put sensors in a group that is then filtered by Network ID on a gateway.
rw	configVersion	u	0	255	0	NA	0	The version can be used to help synchronize changes made by a phone application and a gateway. This value is unused by the sensor.
ro	bootloaderVersion	s	0	11	NA	NA	0	*major.minor.revision*

14 Frequently Asked Questions

https://www.lairdconnect.com/support/faqs

What is the command to enter the bootloader (Nordic Secure DFU)?

```
{"jsonrpc": "2.0", "method": "reboot", "params": [1], "id": 1}
```


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15 Additional Assistance

Please contact your local sales representative or our support team for further assistance:

Laird Connectivity
Support Centre: https://www.lairdconnect.com/resources/support
Email: wireless.support@lairdconnect.com
Phone: Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610
Web: https://www.lairdconnect.com/iot-devices/iot-sensors/bt510-bluetooth-5-long-range-ip67-multi-sensor

Note: This is a first production release version of this BT510 user guide. Information contained in this document is subject to change.