

# User Guide

Sentrius™ BT510

*Version 1.3*

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## REVISION HISTORY

| Version | Date        | Notes                                                                      | Contributor                  | Approver      |
|---------|-------------|----------------------------------------------------------------------------|------------------------------|---------------|
| 1.0     | 03 Feb 2020 | Initial Release                                                            | Brent Mikkelsen<br>Ian Tracy | Jonathan Kaye |
| 1.1     | 04 Feb 2020 | Added Japan and AS/NZS Regulatory statements<br>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 2: Back of the Sentrius™ BT510 sensor**

**Figure 1: Top 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>

## 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.

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

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### 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.

## 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                     |

| 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: <a href="#">table 4</a> 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                             |

| 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: <a href="#">4.1.6 Flags</a>                             |
| 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: <a href="#">4.1.4 Record Event Types</a>                |
| 20   | Record Number LSB                    | This count matches the index in the NV log. It will rollover |
| 21   | Record Number MSB                    |                                                              |

| 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: <a href="#">table 4</a> 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: <a href="#">4.1.5 Magnet States</a>      |
| 3  | MOVEMENT           | -            | -                                             |
| 4  | ALARM HIGH TEMP 1  | TEMPERATURE  | Hundredths of degree C                        |
| 5  | ALARM HIGH TEMP 2  | TEMPERATURE  | Hundredths of degree C                        |

| 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: <a href="#">4.1.7 Reset Reason</a> |

## 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                 |

### 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<br>0 for read-only<br>1 for read-write   | Used to read all attributes. Configurable attributes are read-write.                                                   |
| reboot           | None or 0 for normal<br>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                                                                                                |

| Method (Command) | Parameters                     | Description                                                                                                                                                                                                                                                                                                       |
|------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ledTest          | integer, duration of each step | Both LEDs off for X milliseconds<br>Green LED on for X milliseconds<br>Red LED on for X milliseconds<br>Both LED on for X milliseconds.<br>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.

## 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 <tdb cross ref>                                                                                                                      |
| event data | 2             | The type of data depends on the event type.<br>Signed temperature in hundredths of degrees C, unsigned voltage in millivolts, or Magnet State. |
| type       | 1             | See Event Type <tdb 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/mXZIJQA5v+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"}
```

**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.

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

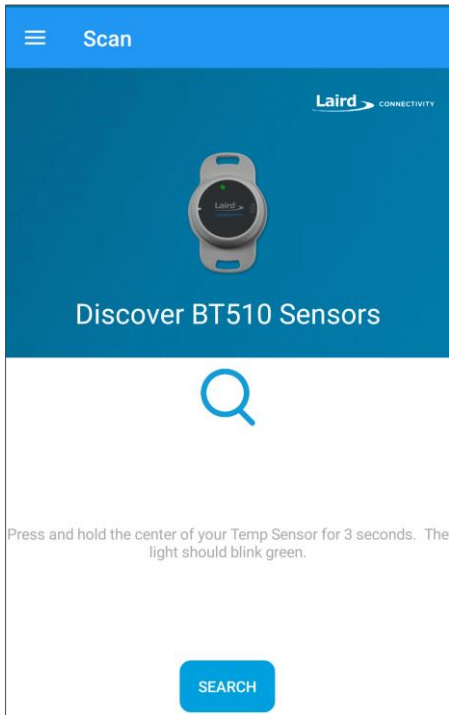


Figure 4: Scan for new sensors

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

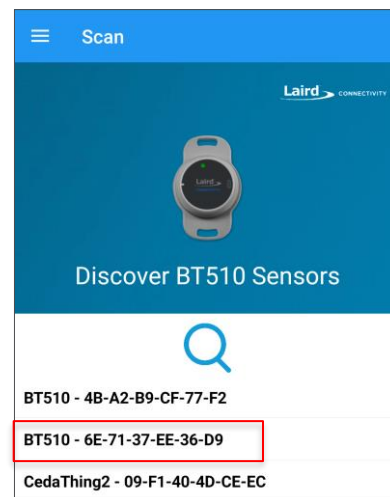


Figure 6: Device search results

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

- 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).

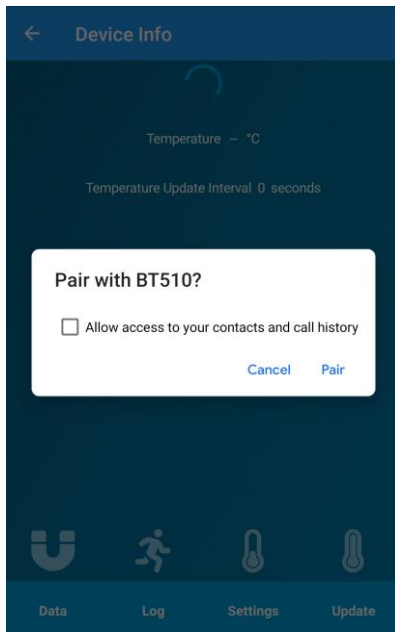


Figure 7: Pair window

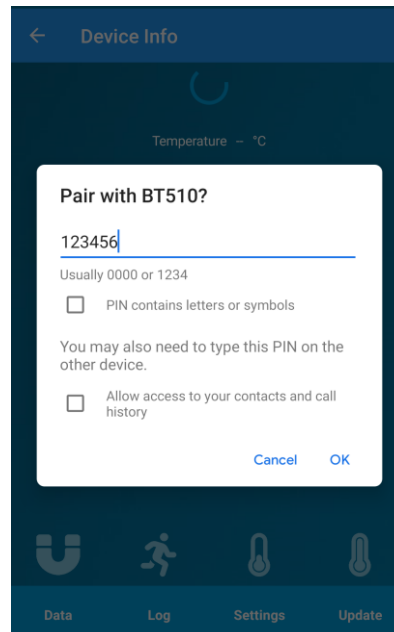


Figure 8: Pair key

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).

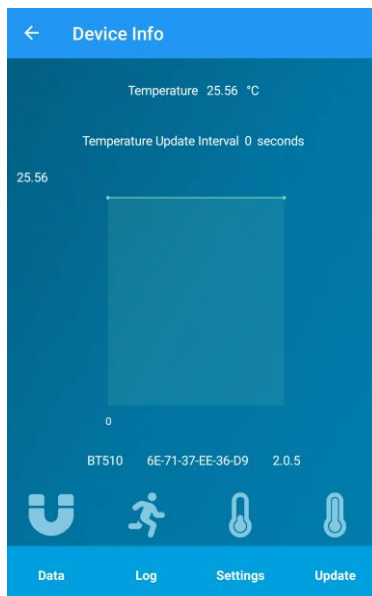


Figure 9: Main screen

|                                                                                     |                                                                                                     |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
|  | Lights up when there is change in the magnetic switch.                                              |
|  | Lights up when the configured <i>G Threshold</i> 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. |

## 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  | BT510                    | SET |
| Passkey      | 123456                   | SET |
| Location     |                          | SET |
| LE Coded PHY | <input type="checkbox"/> | SET |

**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 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

| INTERVALS                 |      |     |
|---------------------------|------|-----|
| Temp Sense (s)            | 0    | SET |
| Advertising Duration (ms) | 0    | SET |
| Advertising Interval (ms) | 1000 | SET |
| Connection Timeout (s)    | 60   | SET |
| Battery Sense (s)         | 0    | SET |

**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.

### 5.3.3 Alarm Configuration

| ALARMS            |          |
|-------------------|----------|
| G Threshold       | 3        |
| Temp Delta T (°C) | 255 SET  |
| Temp High T1 (°C) | 127 SET  |
| Temp High T2 (°C) | 127 SET  |
| Temp Low T1 (°C)  | -127 SET |
| Temp Low T2 (°C)  | -127 SET |

**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**

| ← Device Info |             |          |
|---------------|-------------|----------|
| 02:00:32      | TEMPERATURE | 24.01 °C |
| 02:00:31      | BATTERYGOOD | 3.10 V   |
| 02:00:30      | BATTERYGOOD | 3.10 V   |
| 02:00:30      | TEMPERATURE | 23.99 °C |
| 02:00:29      | BATTERYGOOD | 3.10 V   |
| 01:51:14      | BATTERYGOOD | 3.10 V   |
| 01:51:13      | BATTERYGOOD | 3.10 V   |
| 01:51:13      | TEMPERATURE | 25.42 °C |
| 01:51:12      | BATTERYGOOD | 3.10 V   |
| 01:51:11      | BATTERYGOOD | 3.10 V   |
| 01:51:11      | TEMPERATURE | 25.50 °C |
| 01:51:10      | BATTERYGOOD | 3.10 V   |

**Figure 12: Log data**

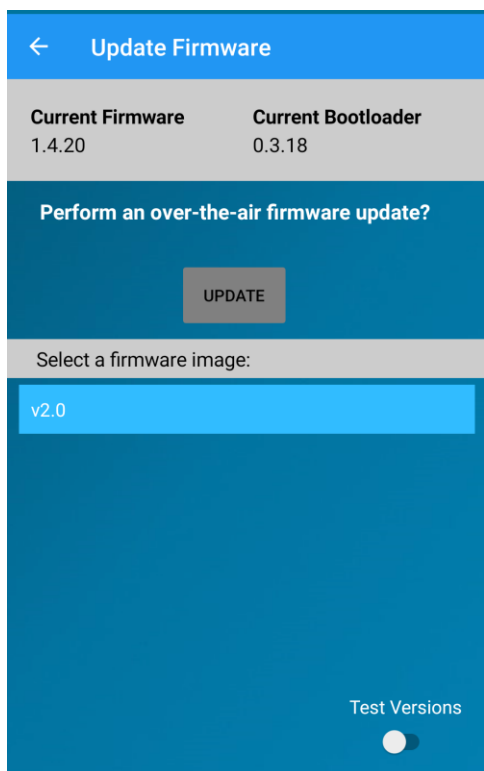
## 5.5 Update Firmware

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

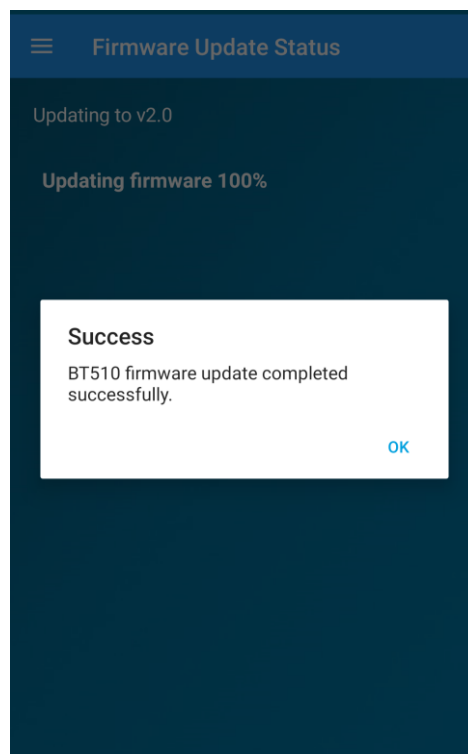


**Figure 13: Update button**

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**

## 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 ISCED 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:

(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

|                            |                                              |
|----------------------------|----------------------------------------------|
| <b>Manufacturer</b>        | Laird Connectivity                           |
| <b>Product</b>             | Sentrius™ BT510 Sensor                       |
| <b>Product Description</b> | Bluetooth v5 IP67 Multi Sensor               |
| <b>EU Directives</b>       | 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<br>EN 50665:2017<br>EN 50385:2017                 |
|                | Safety                                                           | EN 62368-1:2014                                                 |
| 3.1(b)         | Protection requirements – EMC compatibility                      | EN 301 489-1 V2.2.0 (2017-03)<br>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:



## 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

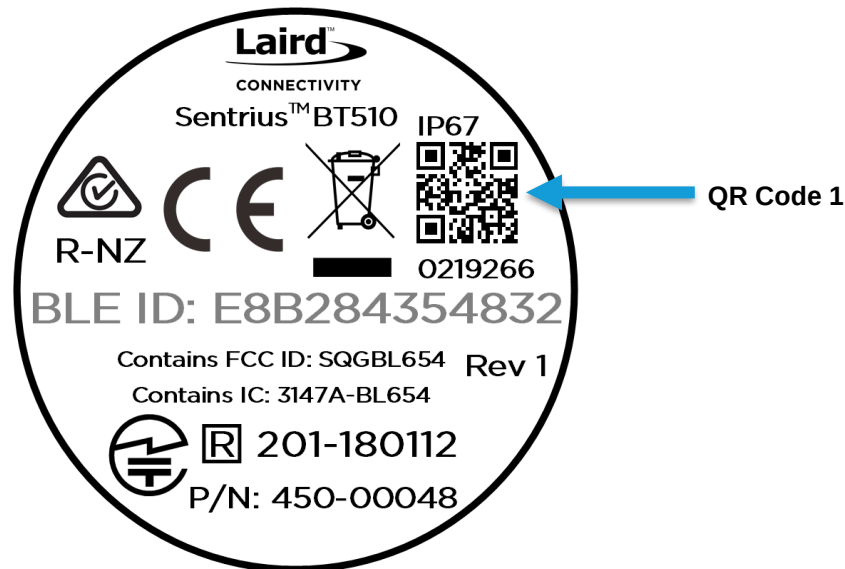
The BT510 is approved for use in the Australia and New Zealand markets regarding the following standards:

- 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

## 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<br>This specifies how long the sensor should advertise each event.<br>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          | threshold2 > 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<br>(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          |                                                                                                                                |

| 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}
```

## 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](mailto: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>

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

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