

User Guide

Sentrius[™] BT710

Version 0.2

PRELIMINARY

REVISION HISTORY

Version	Date	Notes	Contributor	Approver
0.1	14 Aug 2020	Initial preliminary release	Scott Lederer	Chris Boorman
0.2	10 Sept 2020	Revised some functional definition and added further operational overview. PRELIMINARY	Scott Lederer	Chris Boorman

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1 ABOUT THIS GUIDE

This document provides a comprehensive guide on how to configure the Sentrius™ BT710 Tracker functionality, including Bluetooth parameters, alert parameters, and general use for proximity sensing applications.

2 INTRODUCTION

2.1 Product Overview

The Sentrius™ BT710 Tracker or “tag” is a battery powered, Bluetooth v5 integrated sensing and proximity tracking platform enabling tag-to-tag proximity sensing and logging along with tag-to-gateway communication for log upload. It contains several local alarm peripherals including four bright red LEDs, an RGB LED, an audible speaker, and a vibration motor. For applications where proximity sensing is desired with local alarm indication, the BT710 offers several user-configurable options to suit the use case. The BT710 is powered by Laird Connectivity’s field proven BL653 BLE module that integrates Nordic Semiconductor’s nRF52833 SoC silicon.



1. Clasp
2. Status LED
3. Speaker
4. Alarm LEDs
5. Pushbutton
6. Magnetic Switch

Figure 1: Top of the Sentrius™ BT710 Tracker

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

2.2 Specifications

See the BT710 product brief for detailed specifications. It's available from [BT710 series product page](https://www.lairdconnect.com/documentation/product-brief-bt7x0-tracker) or from the following link:
<https://www.lairdconnect.com/documentation/product-brief-bt7x0-tracker>

3 DEVICE OPERATION

3.1 Activating the Tracker

The Sentrius™ BT710 is shipped with the battery installed and operating in a low power state called **Shipment Mode**.

When it arrives from the factory, the tracker is in shipment mode. To wake the device, press the pushbutton for five seconds until the alarm LEDs turn on and a speaker tone is emitted (startup sequence). This puts the tracker into **Active mode**. The tracker blinks the status LED yellow waiting for its internal clock to be set, either by the BT710 mobile app or a nearby gateway. If a gateway is not available, connect the mobile app to automatically set the internal clock. Once in Active mode with its clock set, the BT710 scans for compatible nearby trackers and transmits BLE advertisements for other trackers to sense.

In Active mode, the BT710 tracker can be configured using the associated Laird Connectivity BT710 mobile application. The default configuration sets the tracker to periodically scan for and log other trackers. Additional parameters include BLE advertising interval, RSSI sense threshold, proximity alarm timers, and alarm indicator styles.

There are two low power modes: **Non-Active** and **Power-Save**. The tracker automatically enters these modes based on motion detection to extend battery life. User-configurable parameters control timing for this feature. Separate BLE scanning parameters can be set for each operating mode to scan less frequently in Non-Active mode and Power-Save mode.

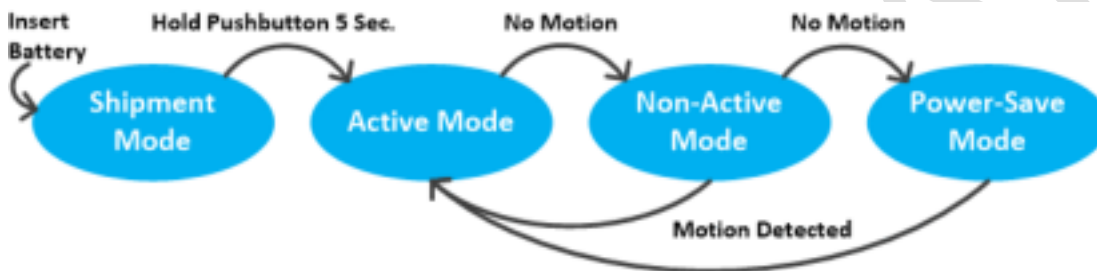


Figure 2 - Operating modes of the BT710 tracker

3.2 Battery Check

Press and hold the pushbutton for three seconds to perform a battery check. The BT710 lights up a number of its red alarm LEDs to indicate approximate voltage level of the battery.

- 4 LEDs on: 75-100% battery life remaining
- 3 LEDs on: 50-75% battery life remaining
- 2 LEDs on: 25-50% battery life remaining
- 1 LED on: 0-25% battery life remaining

When the BT710 senses a battery below the low battery threshold, it alternates a small beep sequence and blinks the status LED orange every 30 seconds as a reminder to change the battery.

3.3 Factory Reset

If the button is held for more than 10 seconds, the status LED begins to rapidly blink yellow. Releasing the button performs a factory reset. A factory reset erases all logs and resets all parameters to defaults. The BT710 goes through a reset cycle when finished and emits the startup sequence LED pattern and beeps, followed by entry into active mode.

3.4 Replacing Batteries

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

Note: The battery door cover is underneath the clasp on the backside of the tracker. A coin may be used to aid in removal.

3.5 Active Mode Operation



Figure 3 – BLE operations in Active mode

When in Active mode, the tracker sequences through a series of BLE operations continuously including Scan, Advertise, and Connected. The Scan Interval parameter determines how much time passes between scan events, at which point the tracker awakes from sleep and performs a BLE scan (discovery of other trackers) for a number of seconds defined by the Scan Duration parameter.

When not connected, the tracker advertises (transmits) data for other trackers to receive when scanning. The rate of transmit events when performing the Advertise operation is determined by the Ad Interval parameter.






The advertisement data contains identifiers to help filter out non-tracker devices, including device ID, TX power, and other status information. Flags in the advertisement can be used by gateway devices to determine when a tracker has log data ready for download.

3.6 LED Patterns

3.6.1 Pre-Production Hardware

The **pre-production tracker hardware** provides a multi-color status LED for detailed operating behavior to the user. The following table (Table 1) describes the LED patterns used to indicate status. Note the blue LED illuminates very weakly as battery level drops.



Table 1: Pre-production tracker hardware LEDs

LED	Status LED Behavior	Description
	Pulsing blue	BLE scanning in progress
	Pulsing cyan	Non-Active mode
	Pulsing white	Power-Save mode or Alarm Snooze
	Flashing yellow	Tracker clock is not set, connect to mobile app to set it
	Flashing orange	Low battery

3.6.2 Production Hardware

The **production tracker hardware** uses a red/green status LED to indicate operating behavior to the user. The following table (Table 2) describes the LED patterns used to indicate status.

Table 2: Production hardware LEDs

LED	Status LED Behavior	Description
	Flashing yellow	Tracker clock is not set, connect to mobile app to automatically set it
	Flashing orange	Low battery

3.7 Alarm Styles

Several indicator styles are available providing control over how alarm LEDs, audible tones, and vibration motor feedback are activated when an alarm is triggered. These styles are configurable using the Alarms tab of the BT710 mobile application. Indicator styles may be selected independently for Alarm 1 and Alarm 2 conditions. The following table (Table 3) describes the styles available for each alarm indicator.

Table 3: Alarm indicator styles

Indicator	Style	Description/Pattern
Red Alarm LEDs	Off	Red Alarm LEDs will remain off
	Style 1	LEDs are lit in a clockwise pattern
	Style 2	All red LEDs on, long blink 5 times
	Style 3	Top/Bottom fast blink, Left/Right fast blink 2 times
	Style 4	Left/Right fast sweep of red LEDs 10 times
Speaker Indicator	Off	No tones will be emitted by the speaker
	Style 1	3 fast chirps
	Style 2	5 buzz tones
	Style 3	3 double-beep tones
	Style 4	4 bright tones, repeated 3 times
Vibe Indicator	Off	No vibration will be triggered by the vibration motor
	Style 1	3 double-pulse vibrations, repeated 2 times
	Style 2	5 double-pulse vibrations
	Style 3	5 wave-pulse vibrations
	Style 4	4 pulse vibrations, repeated 4 times

3.8 Care and Maintenance

The tracker can be cleaned with a mild, non-abrasive detergent. The tracker is not IP-rated/waterproof, so do not immerse it in water or cleaning fluids.

The tracker does not require any calibration.

4 TRACKER ARCHITECTURE

The Sentrius™ BT710 advertises an identifying beacon used by other nearby BT710 compatible Bluetooth tracking devices and gateways to log proximity to the tracker. This advertisement includes information such as a user configurable device identifier, a hardware identifier, and current status of the Bluetooth tracking device.

You can configure a tracker using a Bluetooth connection and the Laird Connectivity 'Sentrius™ BT710 – Bluetooth Tracker' mobile application.

4.1 Advertisements

The following tables describe the data available in the advertisements of the BT710 tracker. Once a tracker is configured, it is possible for a mobile app or gateway to connect to the Bluetooth tracking device for configuration of parameters and/or data log download.

The Bluetooth tracking device can be configured to transmit with an output power of -20 to +8 dBm.

4.1.1 1M PHY

Table 4: 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	0x81 (Identifies the advertisement format)
8	Protocol ID MSB	0xFF
9	Network ID LSB	Assigned during configuration. Default is 0xFFFF
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: 4.1.4 Flags
13-18	Device ID	Random static Bluetooth address (0 is LSB)
19	Ad Record Type	See: 4.1.3 Ad Record Types
20-30	Ad Record Data	Determined by value of Ad Record Type above

4.1.2 1M PHY Scan Response

Table 5: 1M PHY scan response

Byte	Description	Value/Notes
0	DEVICE_NAME	0x08 or 0x09
1-11		Max Complete Name (0x09) is 12 characters

4.1.3 Ad Record Types

Table 6: Advertisement record types

ID	Event	Data	Format
0x00	Tracking Ad		

4.1.4 Flags

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

Table 7: Flags

Flag Bit	Name	Description
Bit 0 (0x0001)	HAS_EPOCH_TIME	0 Clock time not set
		1 Clock time set
Bit 1 (0x0002)	HAS_LOG_DATA	0 Data log not ready
		1 Data log ready for download
Bit 2 (0x0004)	HAS_MOTION	0 No motion
		1 Motion detected
Bit 3 (0x0008)	LOW_BATTERY	0 Battery good
		1 Battery low

4.2 Tracker Configuration

The tracker has several parameters that can be used to tailor it for each use case.

The table below lists the common parameters that can be adjusted by the user based on the use case the tracker is being applied. These parameters can be updated using the BT710 mobile application.

Parameter Name	Default Value	Description
SCAN SETTINGS		
RSSI Threshold	- 48 dBm	Trackers with RSSI value less than this threshold will be ignored
Tx Power	+8 dBm	Transmit power of BLE radio (-20dBm to +8dBm)
Distance Filter	1	RSSI filter selection (0: none, 1: average)
Antenna Option	Ant 1 TX, Both RX	Select how antennas are used for transmit (TX) and receive (RX)
Active Scan Interval	10 sec	Seconds between scan/discovery events (Active Mode)
Active Scan Duration	2 sec	How long to scan for/discover nearby trackers (Active Mode)
Active Ad Interval	250 ms	Milliseconds between advertisement TX events (Active Mode)
Active Motion Timeout	300000 ms	Milliseconds of no motion to trigger "Non-Active Mode" from "Active Mode"
Non-Active Scan Interval	120 sec	Seconds between scan/discovery events (Non-Active Mode)
Non-Active Scan Duration	2 sec	How long to scan for/discover nearby trackers (Non-Active Mode)
Non-Active Ad Interval	500 ms	Milliseconds between advertisement TX events (Non-Active Mode)
Non-Active Motion Timeout	600000 ms	Milliseconds of no motion to trigger "Power-Save Mode" from "Non-Active Mode"
Non-Active Motion Detect	500 ms	Milliseconds of motion to wake from "Non-Active Mode"
Power Save Scan Interval	3600 sec	Seconds between scan/discovery events (Power-Save Mode)
Power Save Scan Duration	1 sec	How long to scan for/discover nearby trackers (Power-Save Mode)
Power Save Ad Interval	1000 ms	Milliseconds between advertisement TX events (Power-Save Mode)
Power Save Motion Detect	500 ms	Milliseconds of motion to wake from "Power-Save Mode"

LOGGING		
Profile	0	User assignable value for categorizing tracker types
Network ID	65535	Network identifier for grouping trackers and gateways
Log Interval	2 min	How often data log is available for download (if present)
Contact Period	86400 sec	Period being monitored for a contact event
Discovery Duration	300 sec	Time a tracker must be observed before logging to storage
Tracking Duration	1800 sec	Maximum log time for each tracker per contact period
ALARMS		
Proximity Alarm 1	3 sec	Seconds of proximity to a remote tracker before triggering alarm 1
Alarm 1 Red LED Indicator	Style 1	Selects style for the red LED indicators when alarm 1 is triggered
Alarm 1 Speaker Indicator	Style 4	Selects style for the speaker indicator when alarm 1 is triggered
Alarm 1 Vibe Indicator	Off	Selects style for the vibration motor indicator when alarm 1 is triggered
Proximity Alarm 2	600 sec	Seconds of proximity to a remote tracker before triggering alarm 2
Alarm 2 Red LED Indicator	Style 1	Selects style for the red LED indicators when alarm 2 is triggered
Alarm 2 Speaker Indicator	Style 1	Selects style for the speaker indicator when alarm 2 is triggered
Alarm 2 Indicator Styles	Style 4	Selects style for the vibration motor indicator when alarm 2 is triggered

4.3 Parameter Selection Considerations

The parameters provide flexibility in configuration of timing and operation of the tracker for different use cases. For example, a fixed location asset tracker may be suited to scanning less often than a mobile tracker.

The configuration parameters affect how often the tracker operates in each mode and therefore has a direct impact on responsiveness/latency of the log entries and battery life of the device. These parameters must be considered carefully for the log data to serve the purpose of a specific tracking application.

The highest power usage occurs during the time the tracker is scanning/discovering other trackers. In this mode, the device is both transmitting its BLE advertisements and has the radio receiver turned on to discover nearby trackers for logging. The defaults target use cases where batteries are changed about once a month. If more time is necessary, the scan interval can be increased (scan less frequently), the scan duration can be decreased (scan for a shorter time period), or the advertising interval can be adjusted to keep the radio in sleep mode more often, thus extending useful battery life. TX power is also a consideration as higher power settings reduce battery life.

Note: Scan interval, scan duration, and ad interval can be set separately for Active mode, Non-Active mode, and Power-Save mode. By increasing the scan interval and reducing the scan duration and ad interval during Non-Active mode and Power-Save mode, the tracker can conserve battery life when motion is not detected. For best power savings, set Power-Save mode scan duration to a value of zero to keep from scanning altogether when the tracker has been idle (no motion) for an extended period.

4.4 Firmware Updates

The BT710 tracker supports over-the-air (OTA) firmware updates when paired with an appropriate Laird Connectivity mobile application or gateway product. The process uses a standard DFU mechanism that can be incorporated into customer apps/products for compatibility.

4.5 Proximity Alarms

The tracker implements two programmable alarms that can be used to trigger local audio, visual, and haptic indicators when a remote tracker is detected for a configured amount of time. Each alarm has a parameter indicating the number of seconds a remote tracker must be detected before triggering the alarm indicators.

Each scan interval, the tracker determines which trackers are within proximity and meet the configured RSSI threshold to begin recording. A counter increases each time that same tracker is observed in a scan. Once **[the number of scan intervals a tracker is detected] x [Scan Interval parameter]** is equal or greater than the configured alarm time, the alarm indicators are triggered for each subsequent scan that tracker is detected until the configured contact period expires.

The following diagram (Figure 4) shows the proximity alarm timeline given default parameter values.

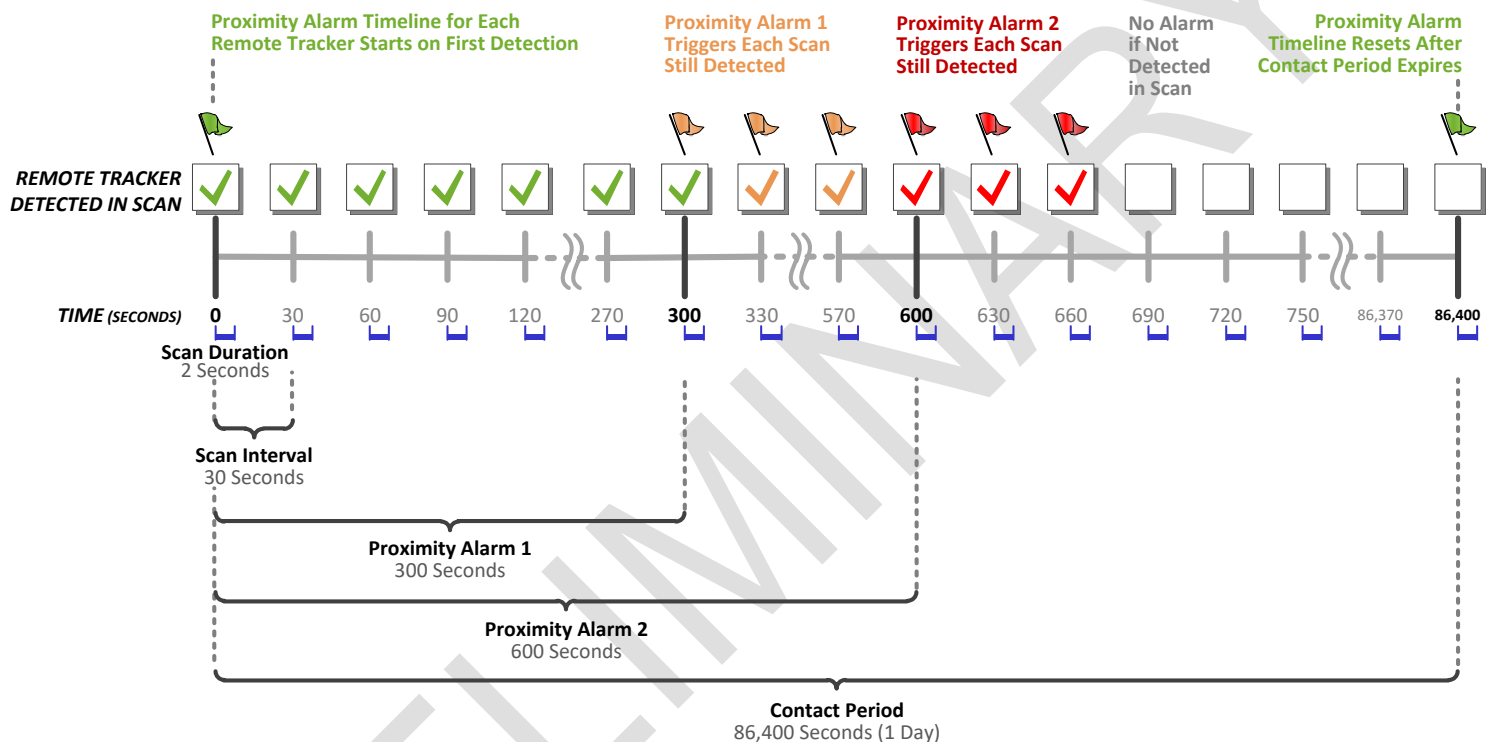


Figure 4 - Proximity alarm timeline

As a tracker detects other remote trackers ("remotes") in a BLE scan, each remote enters into a RAM-based discovery database in order to track the number of scan intervals each is seen for alarming purposes. Each remote is on its own timeline from the perspective of the sensing tracker.

Each time a remote is detected in a BLE scan, a count of seconds is added to that remote's total detection time in the database. This number of seconds is equal to the **Active Scan Interval** parameter. If a remote is not detected in a scan, the total detection time in its database entry is not incremented for that scan interval. For example, with default parameters, each scan interval a remote is detected adds 30 seconds to its total detection time in the database.

After any remote is detected in enough scans such that the total detection time crosses a configured alarm threshold, the configured alarm indicators are triggered to alert the user. The alarm continues to trigger each scan interval until no remotes having total detection time longer than the alarm time setting are within range.

Once "Contact Period" seconds passes since the first time a remote is detected, its total detection time is reset to zero in the database, starting a new proximity alarm timeline for that device once it is detected in a future scan.

4.6 Data Logging

The BT710 tracker is designed to log data from other compatible tracker devices it observes during its BLE scan operations. The following diagram (Figure 5) shows the data logging timeline and how various parameters affect each logging phase.

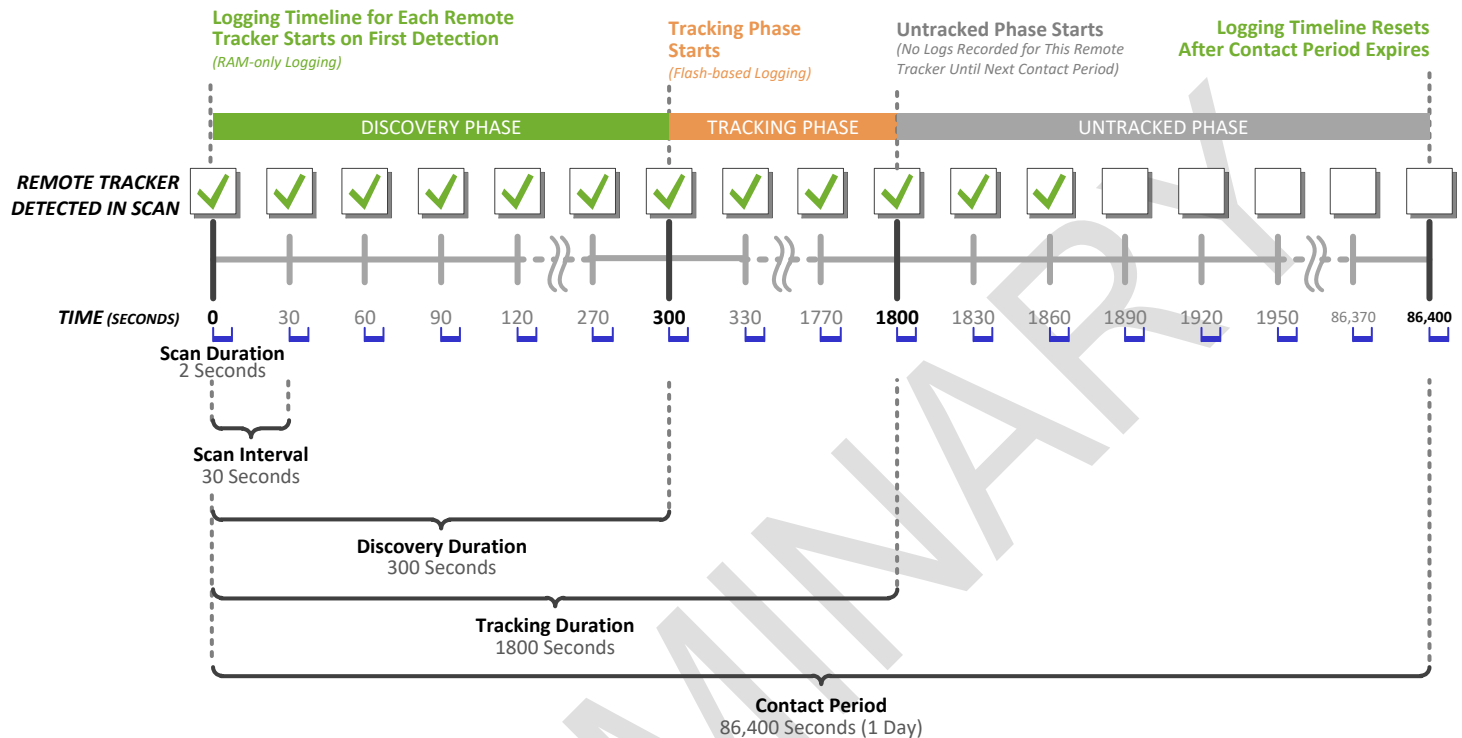


Figure 5 - Data logging timeline

As a tracker detects remote trackers ("remotes") in each BLE scan, the discovery database is updated and the remote steps through three phases throughout a single Contact Period.

- **Discovery Phase** – Remote trackers are tracked in a RAM-only discovery database for each scan they are detected. Once the total detection time is greater than the configured Discovery Duration, the records for the remote are committed to a Flash-based log and the remote enters tracking phase. If a remote is only detected fewer scan intervals than the configured Discovery Duration within a given contact period, they are cleared and not logged to Flash. This is useful for situations where trackers are in proximity for very brief periods of time and do not warrant storage to the Flash-based log.
- **Tracking Phase** – Remote trackers in the tracking phase get an additional record in the Flash-based log for every scan interval they are detected, up to the maximum records that can be recorded for the duration of the tracking phase (set by the Tracking Duration parameter).
- **Untracked Phase** – If a remote tracker has been detected for the entirety of the Tracking Phase, no more records are made for that remote until the Contact Period expires. This way, a single remote only takes up a maximum number of Flash log records determined by the Tracking Duration each Contact Period, allowing remaining Flash space to be used for detection and logging of other remote devices during that Contact Period.

4.6.1 Data Log Entries

The BT710 tracker can store up to 350 log entries within a 24-hour contact period. Each log entry can store 15 records for a remote tracker, one per scan interval. The number of unique remote trackers that can be logged is a function of the Scan Interval and Tracking Period parameters. For example, with tracking period of 15 minutes, up to 350 unique remote devices can be tracked if scan interval is set to 30 seconds. The following data is logged from the remote tracker's advertisement data:

Device ID	Timestamp	Status	RSSI	Motion Status	TX Power
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Figure 6 - Data logged for each remote tracker detected in BLE scans

5 MOBILE APPLICATION

5.1 Overview

The Sentrius™ BT710 mobile application allows a user to configure tracker parameters and update firmware.

5.2 Using the Sentrius™ BT710 Mobile App

To use the Sentrius™ BT710 mobile application, follow these steps:

1. From the applicable app store (Apple or Android) search for and install the Sentrius™ BT710 mobile application on your mobile device.
2. To connect to the BT710 tracker, make sure it is in Active mode.
3. Tap **FIND BT7 DEVICE** to discover the tracker(s) within range of the mobile device.

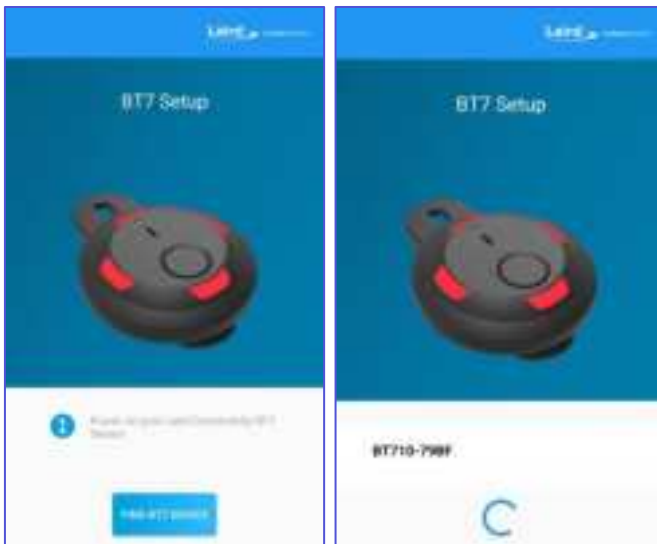


Figure 7 - Scan for BT710 trackers

4. Select the tracker to connect. Tracker names start with BT710 and end with the last four digits of the BLE ID as printed on the back of the Bluetooth tracking device. Once connected, the app displays the current parameter values configured for the tracker. Parameters are grouped using tabs near the bottom of the page.



6 FCC AND ISED CANADA REGULATORY STATEMENTS

Pending

7 CE REGULATORY

Pending

8 ORDERING INFORMATION

Part Number	Description	Packaging
450-00122-K1	Sentrius™ BT710 Bluetooth tracking device, with Clip, Single	Single (1)
450-00122B	Sentrius™ BT710 Bluetooth tracking device, with Clip, BULK	Bulk (100)
450-00059B	Sentrius™ BT710 Bluetooth tracking device, BULK	Bulk (100)

9 LABEL INFO

TBD

10 FREQUENTLY ASKED QUESTIONS

Please refer to the support FAQs online which can be found here:- <https://www.lairdconnect.com/support/faqs>

11 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/sentrius-bt7x0-tracker-multi-sensor>

Note: This is a first production release version of this BT710 user guide.
Information contained in this document is subject to change.

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