



# Abeeway Trackers User Guide

Supporting: Micro Tracker, Smart Badge, Compact Tracker, and Industrial Tracker



**Firmware V2.1**

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# 1 INTRODUCTION

## 1.1 Document purpose

This document describes in detail the usage of Asset tracker MCU application Firmware 2.x that runs on Abeeway trackers: Micro tracker, Compact tracker, Industrial tracker and Smart badge. Chapters 2, 3 and 4 are related to the main functionalities of the device, and chapter 5 discusses the geolocation strategies. The next chapters 6 and 7 give more details for Uplink and Downlink messages. Chapters 9 and 10 conclude with safety and regulatory information

This document is reserved to support team, distributors and integrator teams to give a deeper knowledge of all the possible settings. We do reserve the right to modify the contents in future releases.

## 1.2 Products description

The Abeeway trackers employ multi-technology geolocation, combining GPS, Low power GPS, WIFI sniffer, BLE and LoRaWAN™ TDOA geolocation technologies, for accurate outdoor and indoor positioning.

### 1.2.1 Micro tracker

The Micro Tracker is versatile and multi-purpose. With its small size and long battery life, it is the ideal product for numerous tracking applications of things of value, people or pets.

### 1.2.2 Smart badge

The Abeeway Smart Badge is ideal for the monitoring of workforce safety and security. It is simple to use and a single button gives you access to several functionalities such as Panic/SOS Button. It has an industrialized rugged magnetic connector for recharging the battery.

### 1.2.3 Compact tracker, Industrial tracker

The Abeeway Compact and Industrial tracker have a robust form factor, designed to resist harsh surroundings enabling you to perform seamless asset tracking and management in any industrial environment – whether it's for heavy-duty assets or small equipment, taking advantage of its long battery autonomy.

## 1.3 Typical applications

### 1.3.1 Micro tracker

- Workforce optimization and safety: lone workers monitoring, tracking, SOS panic button alerts on construction sites, mines, oil & gas platforms, factories and other industrial indoor and outdoor facilities
- Tracking and monitoring of assets, vehicles, machines and equipment
- Antitheft applications, notification and location trigger when device is moving, at fixed frequency updates or on demand
- Personal tracking with help button: employees, elderly, children
- Personal assets protection: cars, motorbikes, bikes, keychains, luggage, handbags or pets.
- Contact back-tracking, proximity detection for sanitary policy enforcement.

### 1.3.2 Smart badge

- Personal multi-mode tracking: employees, workers, visitors
- SOS panic alarm for indoor and outdoor lone workers
- Safety evacuation monitoring
- Location heatmaps, e.g. for optimization of supervisor/worker ratio in large construction or industrial sites
- Contact back-tracking, proximity detection for sanitary policy enforcement.

### 1.3.3 Compact and Industrial tracker

- Real-time tracking, status monitoring of heavy and light assets, vehicles, machines and equipment, outdoors or in indoor industrial facilities.
- Activity monitoring based on motion for usage optimization, industrial control and asset management
- Livestock tracking in large farms
- Optimization of supply chain and production, delivery and inventory tracking
- Antitheft applications, notification and location trigger when device is moving, at fixed frequency updates or on demand

## 2 FEATURES

- **Multiple operating modes**
  - ✓ **Standby:** LoRaWAN™ heartbeat only
  - ✓ **Motion tracking:** Get the tracker position at a given cycle when motion is detected.
  - ✓ **Permanent tracking:** Get permanently a position of the tracker.
  - ✓ **Start/End motion tracking:** Get position messages during motion start and end events.
  - ✓ **Activity tracking:** Monitor activity rate with embedded sensors.
  - ✓ **OFF:** device stopped
- **Position on demand:** Receive the tracker position only when requested (very low power operating mode).
- Low frequency periodic position (I.e. once per hour to once a day)
- **Configurable motion detection**
- **SOS support**
- **Shock detection**
- **Proximity feature**
- **Supported geolocation technologies**
  - ✓ **GPS:** Precise outdoor position.
  - ✓ **Low power GPS (LPGPS):** Get quick position outdoors and daylight indoor conditions.
  - ✓ **WIFI:** Indoors positioning and urban area.
  - ✓ **BLE:** Indoors positioning
- **Buzzer and LEDs (micro trackers and smart badge)**
- **Reed-switch interface (compact tracker)**
- **GNSS constellation selection**
- **Temperature monitoring**
- **Battery monitoring**
- **Embedded antennas**
- **LoRaWAN™ Class A radio**
- **IP rating for enclosures:**
  - **Compact tracker: Waterproof enclosure (IP68); IK08**
  - **Smart badge and micro tracker: High Pressure Water-spray resistant enclosure (IP65)**
  - **Industrial tracker: Dust-proof and powerful water jets - (IP66)**
  - **Micro-tracker : IP64**

### 3 DEVICES CHARACTERISTICS

Function		Micro	Badge	Compact	Industrial	Required functionalities
Shipping mode		X	X	X	NA	Button or reed switch
Operating modes	OFF	X	X	(1)	NA	Button or reed switch acting like a button
	Standby	X	X	X	X	
	Motion tracking	X	X	X	X	
	Permanent tracking	X	X	X	X	
	Motion start/end	X	X	X	X	
	Activity mode	X	X	X	X	
Side operating modes	Periodic positions reporting	X	X	X	X	
	Position on demand	X	X	X	X	
	Alert position	X	X	(1)	NA	Button or reed switch acting like a button
	Periodic activity reporting	X	X	X	X	
	Collection payloads	X	X	X	X	
SOS mode	using a three short presses	X	X	(1)	NA	Button or reed switch acting like a button
	using downlink	X	X	X	X	
Low battery management		X	X	NA	NA	This functionality requires Rechargeable battery
Temperature monitoring		X	X	X	X	
shock detection		X	X	X	X	
Battery monitoring		X	X	X	X	
Motion sensitivity		X	X	X	X	

#### Note

(1) If the reed switch is configured to work like a button. See section 0 for reed switch interface explanation

#### Interface/ components embedded on the trackers:

Function		Micro	Badge	Compact	Industrial
User interface	Button	X	X		
	LEDs (white charging LED and bicolor LED)	X	X	(1)	(1)
	buzzer	X	X		
	Reed switch			X	
Geolocation chip	GPS	X	X	X	X
	LPGPS	X	X	X	X
	WIFI	X	X	X	X
	BLE	X	X	X	X
Rechargeable battery		450 mAh	1300 mAh		
Primary battery				8000 mAh	19000 mAh

#### Note

(1) LEDs inside the casing, can only be used for test

### 3.1 Getting started

Your Device needs to be registered on a LoRaWAN™ Network

- Your LoRaWAN™ network provider can use two activation modes<sup>1</sup>:
  - ✓ OTAA (Over The Air Activation): This mode requires the following keys to join the network: DEVEUI, APPEUI and APPKEY for each device. (It is the one mostly used)
  - ✓ ABP (Activation by personalization): This mode that requires the following keys to connect to the network: DEVEUI, DEVADDR, NWKSKEY and APPSKEY for each device
- Depending on your operator, some actions need to be done to activate the transfer of the data through Abeeway servers. Please refer to your LoRaWAN™ network provider for more information.

The application firmware will start as soon as a join is successfully done

### Note

The provided trackers are in OTA configuration only. It can't be changed by configuration. If you need trackers working in ABP please refer to your vendor.

## 3.2 Micro tracker device



### 3.2.1 Getting started

- Charge your device using a micro USB cable. While charging the white LED is ON. When the battery is fully charged, the white LED goes OFF.
- The micro tracker is shipped to the customer in “shipping” state to preserve battery lifetime. It can be brought back into “JOIN” state with a long button press. The tracker will then start the JOIN procedure which can be seen in LoRaWAN Network Server logs.
- A long press is needed to turn ON the device (After a join success it starting starts in motion tracking mode in the default configuration, (for more details on the default configuration of the smart badge tracker see here).

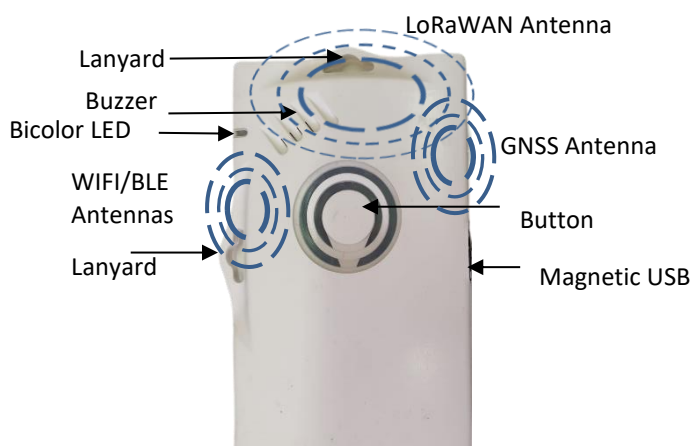
### 3.2.2 Tracker best placement

The device can be attached with the provided lanyard or placed in a bag, or inside an asset. It is recommended to place the tracker in a way that LoRaWAN/GPS antenna is pointing towards the sky for best LoRaWAN/GPS coverage.

**Note**

The close environment and orientation of the tracker can influence the radio performance. For optimum results keep the zone around the antenna area clear from any conducting material or magnetic fields.

### 3.3 Smart badge device



#### 3.3.1 Getting started

The smart badge is shipped to the customer in “shipping” state to preserve battery lifetime. It can be brought back into “JOIN” state with a long button press. The tracker will then start the JOIN procedure which can be seen in LoRaWAN Network Server logs.

After a join success it starts in motion tracking mode in the default configuration.

#### 3.3.2 Tracker best placement

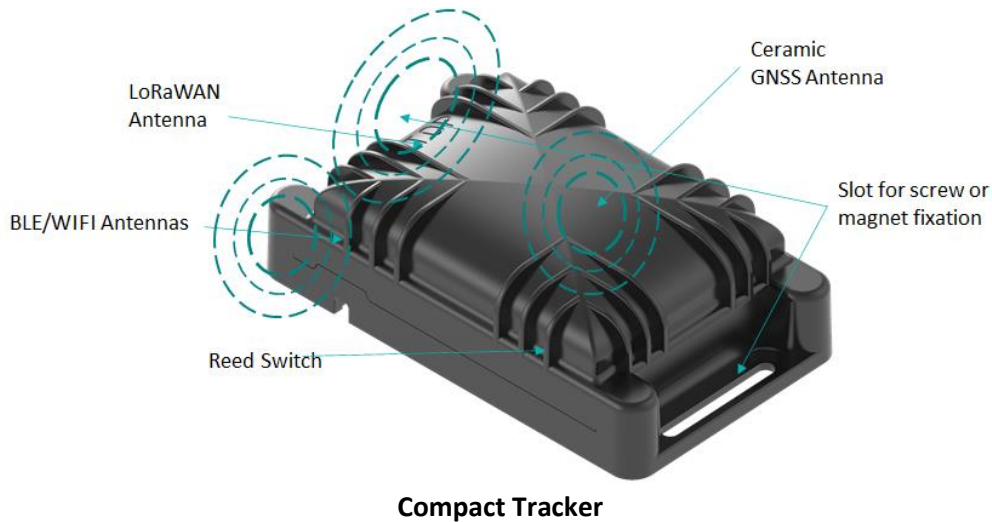
The device can be attached with the provided lanyard or placed in a bag, or inside an asset. It is recommended to place the tracker in a way that LoRaWAN/GPS antenna is pointing towards the sky for best LoRaWAN/GPS coverage.

**Note**

The close environment and orientation of the tracker can influence the radio performance. For optimum results, keep the zone around the antenna area clear from any conducting material or magnetic fields.



### 3.4 Compact tracker and Industrial tracker device



**Compact Tracker**



**Industrial Tracker**

#### 3.4.1 Getting started

The compact tracker is shipped to the customer in “shipping” state to preserve battery lifetime. It can be brought back into “JOIN” state by bringing the magnet close to the tracker for at least 5 seconds. The tracker will then start the JOIN procedure which can be seen in LoRaWAN Network Server logs.

The industrial tracker is set directly in the join step.

The compact tracker and the industrial tracker start immediately in the configured mode as soon as the join is done.

#### 3.4.2 Tracker best placement

For optimum radio performance the tracker should be laid flat (as shown on the picture). Designed for harsh industrial environments or outdoor applications, device can be mounted using 2 magnets on a metal frame or screws. The fast and easy installation is possible by using the two mounting flanges.

#### **Note**

The close environment and orientation of the tracker can influence the radio performance. For optimum results keep the zone around the antennas area clear from any conducting material or magnetic fields.

## 4 FUNCTIONING

### 4.1 Startup process

This new firmware version significantly modifies the startup process of Abeeway devices. A process called shipping has been introduced to allow the shipping of the trackers to the final customer. This process put the tracker in a deep low power state. Once the tracker arrives on the final customer site, it leaves the shipping state and starts the LoRaWAN™ join process. The shipping process can be disabled during the manufacturing.

This process, including the shipping, is described as follow:

- 1- The device is in the shipping state and wait for a long button press or a long reed switch contact. <sup>(4)</sup>
- 2- Then LoRaWAN™ join attempts are done:
  - If the LoRaWAN™ join succeeds, the application starts (go to step 3)
  - If the LoRaWAN™ join fails, the number of attempts is checked against a fixed limit <sup>(1)</sup>
    - If the limit is not reached, a new LoRaWAN™ join attempt is done
    - otherwise, the tracker goes back to shipping state (back to step 1).
    - There is a delay between different join attempts which range from 15 minutes to 1 hour.
- 3- The device starts. <sup>(2)</sup>

Once the join successes the tracker doesn't redo a shipping process, even after the device resets

#### Notes:

- (1) The number of attempts is limited to 15 in EU region and 27 for other regions for micro trackers and smart badge, it is infinite for compact trackers and Industrial trackers
- (2) If the autostart feature is enabled (via *config\_flags* parameter) the tracker starts in its configured mode. Otherwise another long press on the button is required.
- (3) The long reed switch contact will work to get out of shipping mode regardless the value of *reed\_switch\_configuration* parameter
- (4) The Industrial tracker does not have reed switch and is directly in the join state. The shipping mode is not activated for the Industrial tracker

This feature is supported by all Abeeway trackers. Ask you vendor if you need more explanation on that subject.

### 4.2 Main operating modes

Operating mode	trackers	User Interface needed
OFF <sup>(1)</sup>	All	button or reed switch acting like a button
Standby	All	
Motion tracking	All	
Permanent tracking	All	
Motion start/end	All	
Activity mode	All	

#### Note

- (1) Can be forbidden using *config\_flags* parameter bit 1 and bit 15

### 4.2.1 Overview

The tracker supports up to six different operational modes: Off, Standby, Motion tracking, Permanent tracking, Start/End tracking and Activity tracking.

The mode is configurable using configurations parameters

### 4.2.2 OFF mode

The tracker is in deep low power mode. No LoRaWAN™ uplinks are sent.

A long button press is required to wake up the device. There are three different ways to enter this mode:

- User action (long button press, if the device is allowed for by setting bit 1 and clearing bit 15 of the *config\_flags* parameter, and if the tracker is not in SOS mode).
- Low battery level.
- LoRaWAN™ downlink request.

In each case, a shutdown message is sent via LoRaWAN™ uplink, with the cause. See section Shutdown message for more details.

### 4.2.3 Standby mode

The tracker sends periodically short LoRaWAN™ messages, called heartbeat, at the configured frequency (*lora\_period*). The device positions can be obtained in this mode by using the side operations features (see the side operations section).

### 4.2.4 Motion tracking mode

The tracker provides positions at the *ul\_period* frequency only when the device is moving. The positions are given by the geolocation strategy defined by *geoloc\_sensor* parameter.

When the device is not moving, the position message is replaced by the heartbeat message transmitted at the *lora\_period* frequency.

The end of motion is detected when the device has not moved during a *motion\_duration* delay.

### 4.2.5 Permanent tracking mode

The device reports its positions at the *ul\_period* frequency regardless of the motion. It uses the *geoloc\_sensor* parameter for the geolocation technology.

Heartbeat messages are sent if there are no uplink messages during *lora\_period* seconds.

### 4.2.6 Motion Start/End tracking mode

This mode is used when only the beginning and the end of a motion is the point of the interest. The tracker provides its position when it starts and stops moving. The technology used is defined by the *geoloc\_sensor parameter*.

In this mode, (*motion\_nb\_pos+1*) positions messages (due to a start or an end) are reported and are spaced in time by the parameter *ul\_period*.

The end of the motion is detected when there is no movement during *motion\_duration* seconds.

Heartbeat messages are sent if there are no uplink message during *lora\_period* seconds.

### 4.2.7 Activity mode

This mode sends an activity reports instead of positions by counting the amount of motions with the accelerometer. Each motion detection increases a counter (if 3 motion events are detected during a 2 seconds period interval) and the counter value is reported at the *ul\_period* frequency.

### 4.3 Side operations

Whatever the operating mode (except OFF mode), the trackers support **side operations in the table below**:

Side operations	Trackers	User interface needed
Periodic positions reporting	All	-
Positions on demand	All	-
Alert position	Smart Badge, Micro and compact tracker	button or reed switch acting like a button
Periodic activity reporting	All	-
Collection payloads	All	-
Proximity detection	Smart Badge, and Micro tracker	Button

### 4.4 SOS mode

Activation mode	trackers	User Interface needed
Using a button (three short presses)	Micro tracker	Button
	Smart badge	
	Compact tracker	Reed switch acting like a button
Using a downlink	All	

This capability forces the device in a specific tracking mode tagged as SOS, for instance when the tracker's carrier needs help.

Once this feature is activated, the behavior is the following:

- The tracker sends a **start SOS mode** event payload
- The tracker sends continuously its position at a fixed period of 120 seconds.
- The tracker uses the geolocation strategy: *geoloc\_sensor*, with a GPS timeout fixed to 120 seconds.
- The LoRaWAN™ position messages are tagged with an alert flag.
- The tracker's blue LED is blinking

The tracker can enter this mode by either making three short presses on the button or receiving a **SOS start** LoRaWAN™ downlink.

This mode is disabled by either another three short presses, a **SOS stop** LoRaWAN™ downlink or an operating mode change request

When it is deactivated, a **stop SOS mode** event payload is sent, the tracker stops blinking and plays a melody.

### 4.5 Motion detection

This feature is supported by all Abeeway trackers

#### 4.5.1 Overview

The tracker embeds a three axis accelerometer, which detects accelerations and triggers a motion event. It is configurable with two parameters:

- *motion\_sensitivity*: Allows a fine tuning of the acceleration intensity to trigger a motion event.
- *motion\_duration*: Defines the delay needed without any motion detection to generate a **motion end** event.

The accelerometer is always active except in OFF mode

#### 4.5.2 Motion sensitivity

The accelerometer sensitivity can be fine-tuned by configuration via the parameter *motion\_sensitivity* as follows:

- The zero value is used for the default sensitivity:
- The range [1 .. 100] gives the sensitivity (in percentage).

#### 4.5.3 Motion duration

The end of a motion is triggered by the absence of movement using a configuration parameter called *motion\_duration*.

This parameter is expressed in seconds and ranges from [60 .. 3600]. The factory default value is 120 seconds.

#### 4.5.4 Device orientation

The acceleration values from the three axes are available with the **motion end** event messages or by sending a specific downlink. This allows the application to determine the tracker orientation.

### 4.6 Event Messages

Events message are supported by all Abeeway trackers

These messages are notifications sent by the tracker informing the server about specific events

Based on the configuration, events can be:

- Geolocation start: Sent when the tracker begins a geolocation
- Motion start: Sent when the trackers begins a motion
- Motion end: Sent when the end of a motion is detected. (after *motion\_duration* delay)
- Temperature information: Sent if the measured temperature is below or above the configured thresholds
- Start SOS mode: Sent when the trackers enters the SOS mode
- Stop SOS mode: Sent when the trackers leaves the SOS mode

The sending of Geolocation start, Motion start, and Motion end event messages depend on the operational mode as well as of the *config\_flags* (bits 6, 8 and 9). See subsections below for more data

### 4.7 Shock detection

This feature is supported by all Abeeway trackers

#### 4.7.1 Overview

This feature enables the reporting of the shocks detected by the tracker.

The configuration is flexible enough to detect a shock either globally or belonging to a given direction.

#### 4.7.2 Configuration

The configuration of the shock detection is based on a single parameter called *shock\_detection*. This parameter gives the accelerometer sensitivity used to trigger the shock events.

The threshold can range from 0 to 100%. Value 0 means no detection.

#### Notes

- 1- The *motion\_sensitivity* parameter must be configured (nonzero value)
- 2- The *shock\_detection* parameter must be lower than the *motion\_sensitivity*, otherwise all motions events are considered as shocks

### 4.7.3 Shock detection message

Upon the detection of a shock event, the tracker triggers a LoRaWAN™ message as follows:

The first message is sent immediately with the actual acceleration values.

The next ones are delayed by two minutes. In this case the reported value will be the highest shock that occurred during this fixed period. If no shock is detected during the two minutes period, no more payload is sent.

## 4.8 Temperature monitoring

This feature is supported by all Abeeway trackers

This feature is designed to report temperature events when the temperature measured by the device is above or below the configured thresholds, *temperature\_high* and *temperature\_low* parameters.

Each threshold is used independently.

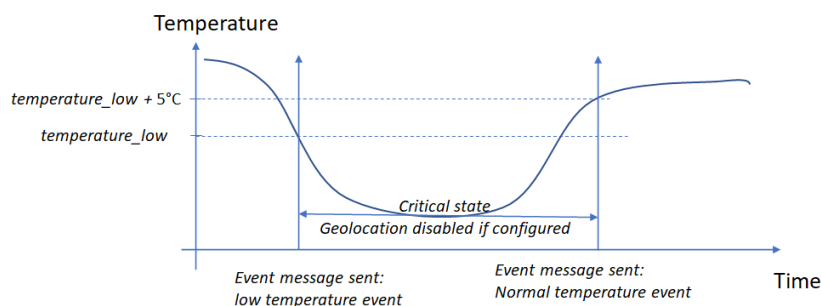
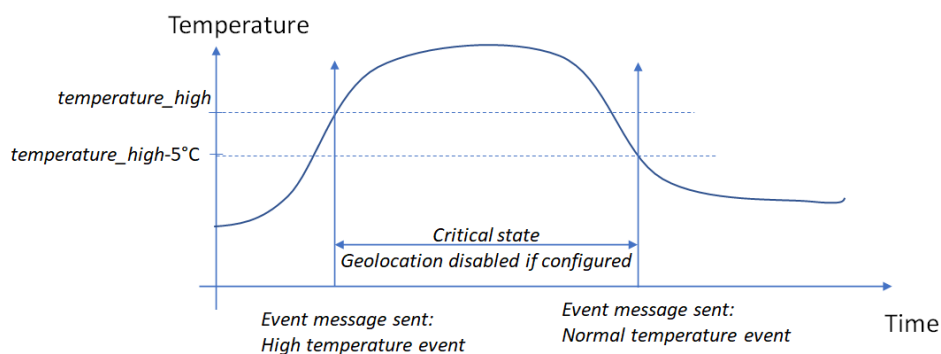
The value 255 is used to **disable** the threshold and the temperature monitoring.

A specific action can be taken if the temperature exceeds one of the configured thresholds. Example: The geolocation can be deactivated.

This action is configured via the parameter *temperature\_action* which is using the threshold of *temperature\_high* and *temperature\_low* parameters.

The temperature monitoring is enabled if one of the two thresholds is not set to the **disable** value.

The temperature measurement is done periodically. If one of the configured thresholds is reached, a matching event is sent, and a critical state is entered until the temperature comes back to an acceptable value



## 4.9 Low battery management for trackers with rechargeable battery

trackers	Type of battery
Micro tracker	rechargeable battery
Smart badge	

The battery level monitoring is done as follows:

- Every 5 minutes
- On a single button short press

When the battery level goes to 1%, the device sends a shutdown message with the reason **low battery** then moves to the **OFF** mode (no more LoRaWAN™ payloads are sent).

The tracker remains in this state until the battery is recharged and restarted with a long button press.

Before moving to the OFF state, a low battery melody is played.

On restarted the tracker goes back to its previous operational mode.

#### Note

- 1- If the battery is not recharged and stays at 1% during a long time it will take much longer than the regular two hours to fully recharge the tracker.

## 4.10 Network timeout monitoring

This feature is supported by all Abeeway trackers

This feature monitors the LoRaWAN™ network and resets the device in case of trouble.

The monitoring consists of two periods:

- *network\_timeout\_check*: once this duration elapses the tracker prepends a Link Check Request in all LoRaWAN™ uplinks (to force the network to answer). The associated timer is restarted each time a LoRaWAN™ downlink is received.
- *network\_timeout\_reset*: this duration covers the link check request period. Once elapsed, the tracker resets.

## 4.11 User interfaces

Depending on the trackers, some user interfaces can be unmounted

User interfaces	trackers
Button	Micro tracker Smart badge
LEDs	Micro tracker Smart badge
buzzer	Micro tracker Smart badge
Reed switch	Compact tracker

### 4.11.1 Button management

The interface from the user to the tracker is performed via a button.

Sequence	Action	Output
One short press	Battery level is shown with the LEDs	LED pattern (See next section)
Three short presses	Trigger an alert position or start/ end the SOS mode	LED pattern (see next section) <a href="https://youtu.be/HgsMfytTue4">https://youtu.be/HgsMfytTue4</a> (SoS) <a href="https://youtu.be/7BAg7XF2jyk">https://youtu.be/7BAg7XF2jyk</a> (Alert)
Double short press	Add a tracker in the whitelist contact (proximity feature) <sup>(4)</sup>	
Any press when battery low (short or long press) <sup>(1)</sup>	Go to OFF mode, except if mode disabled	Buzzer melody fast LED blinking
One long press when device OFF and good battery	Switch ON the tracker	LED pattern (See next section) <a href="https://youtu.be/T9dfVbptpsM">https://youtu.be/T9dfVbptpsM</a>
One long press when device ON.	Go to the OFF mode, except if mode disabled or if the tracker is in SOS mode	Buzzer melody <a href="https://youtu.be/gNtn3KRgIrU">https://youtu.be/gNtn3KRgIrU</a>
While the button is pressed when the device is ON		Blue LED ON <a href="https://youtu.be/0b3yLGs_4Gw">https://youtu.be/0b3yLGs_4Gw</a>
4 short press, 1 long press, 1 short press, 2 long press <sup>(2)[3]</sup>	Enters in BLE bootloader	BLE firmware can be updated. <a href="https://youtu.be/XILHAbWMKZs">https://youtu.be/XILHAbWMKZs</a> (Part 1) <a href="https://youtu.be/QG58rI-mQwM">https://youtu.be/QG58rI-mQwM</a> (Part 2)
4 short press, 1 long press, 2 short press, 1 long press until the end of the melody <sup>(2)[3]</sup>	Enters in MCU bootloader	MCU firmware can be updated <a href="https://youtu.be/etZ0FA_sso">https://youtu.be/etZ0FA_sso</a>

#### 4.11.2 LED interface

The end user can observe the behavior of tracker via the LED interface. Several patterns have been defined for different outputs.

##### LED blinking patterns

Action	Status	Pattern	LED Color
Device switched on		Fade in effect	Blue
Device switched off		Fade out effect	Red
Battery check with button	the battery level is >75%	3 long blinks	Blue
	the battery level is between 50% and 75%	2 long blinks	Blue
	the battery level is between 25% and 50%	1 long blink	Blue
	the battery level is <25%	1 long blink	Red
Low battery detected: Go to the OFF mode		3 short blinks	Red
LoRaWAN™ join operation failed		6 short blinks	Red
Device starting for the first time after the join success		Three long blinks	Blue
SOS mode. Blinking remains until the mode is left <sup>(1)</sup>		Permanent long blinks	Red
Device acknowledges the alert position request <sup>(1)</sup>		8 short blinks	Red
GPS fix done <sup>(1)</sup>		(2 short blinks, one long blink) x 3 times	Blue
Device is reset		short blinks	Pink



Alarm or Warning is triggered <sup>(2)</sup>	Permanent short blinks	Red
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#### 4.11.3 Buzzer melodies

The second interface from the tracker to the user is done via a buzzer. The volume can be managed using *buzzer\_volume* parameter. Different melodies have been defined:

Meaning		Melody
Device is resetting/ going to bootloader		Device reset
Device is starting		Major rising scale
Device is going to OFF mode		Major falling scale
Low battery detected		Low battery
SOS mode is left		SOS stop
Join failed		2 short beeps
Join success		Join success melody
Proximity	Warning alert is triggered	Proximity warning
	Alarm alert state is triggered	Proximity alert
	A warning reminder is triggered	proximity reminder 1 beep
	An alert reminder is triggered	proximity reminder 2 beeps

#### 4.11.4 Reed switch interface

A Reed switch is an electrical switch operated by an applied magnetic field. It is used when no button is mounted on the tracker. It can be configured with *reed\_switch\_configuration* parameter:

- **In button configuration**, the Reed switch will act as described in section Button management. A short magnetic field input is recognized as a short press, and a long input, as a long press.
- **In specific behavior configuration**, the reed switch will behave as follows:
  - ✓ A short input triggers on demand position.
  - ✓ A long input (more than 5s) triggers a device reset.

## 5 GEOLOCATION STRATEGY MODES

All geolocation strategies are supported by Abeeway trackers

### 5.1 Main operating modes and SOS mode

The following geolocation technology settings (*geoloc\_sensor* parameter) are used by the main operating modes: motion-tracking, permanent-tracking, start/end tracking and SOS. Note that in standby mode, only side operations can report positions.

- **WIFI only** → Only WIFI scans are used for position determination.
- **GPS only** → Only the GPS is used for position determination.
- **LPGPS only** → GPS and low power-GPS are used for position determination.
- **BLE beacon scan only** → Provide data formatted as a list of “MAC address/RSSI” couple that can be used to compute a position
- **Multi-technologies modes**
  - **WIFI-GPS only** → WIFI then GPS if WIFI fails in one geolocation cycle.
  - **WIFI-LPGPS only** → WIFI then Low power-GPS if WIFI fails in one geolocation cycle.
  - **BLE-GPS only** → BLE then GPS if BLE fails in one geolocation cycle.
  - **WIFI-LPGPS/ WIFI-GPS** → WIFI-low power GPS first, then WIFI-GPS if WIFI-low power GPS fails until timeout, then back to WIFI-low power GPS.

### 5.2 Side operations

The following geolocation technology setting (*geoloc\_method* parameter) are used for periodic-reporting, on-demand or alert operations.

- **WIFI only** → Only WIFI scans are used for position determination.
- **GPS only** → Only the GPS is used for position determination.
- **LPGPS only** → GPS and low power-GPS are used for position determination.
- **BLE beacon scan only** → Provide data formatted as a list of “MAC address/RSSI” couple that can be used to compute a position
- **Multi-technologies modes**
  - **WIFI-GPS only** → WIFI then GPS if WIFI fails in one geolocation cycle.
  - **WIFI-LPGPS only** → WIFI then Low power-GPS if WIFI fails in one geolocation cycle.
  - **BLE-GPS only** → BLE then GPS if BLE fails in one geolocation cycle.

## 6 UPLINK MESSAGES

This section describes the payload messages supported by the tracker.

Unless otherwise specified, all values are transmitted in network byte order (MSB first).

Each message is composed of two parts:

- A common header
- A specific data parts

The LoRaWAN™ port used for the uplinks is the 18.

The tracker supports different types of uplink messages, that are described in the following sections:

Message type		Content
<b>Frame pending</b>	<b>0x00</b>	This uplink message is sent to trigger the sending. (and speed up the configuration of the tracker) if downlink messages are available on gateway and no other uplink message is on the queue
<b>Position</b>	<b>0x03</b>	GPS, low power GPS, WIFI or BLE position data
<b>Energy status</b>	<b>0x04</b>	No more used
<b>Heartbeat</b>	<b>0x05</b>	Notify the server that the tracker is operational and under LoRaWAN™ coverage
<b>Activity Status <sup>(1)</sup></b>	<b>0x07</b>	Reports the activity counter. Used only by the activity tracking operating mode
<b>Configuration <sup>(1)</sup></b>	<b>0x07</b>	Reports the partial or whole configuration of the trackers,
<b>Shock detection <sup>(1)</sup></b>	<b>0x07</b>	Reports the accelerometer vector (X, Y, Z) of the detected shock
<b>Shutdown</b>	<b>0x09</b>	Sent when the tracker is set off
<b>Event <sup>(2)</sup></b>	<b>0x0A</b>	Sent event information about tracker.
<b>Collection scan</b>	<b>0x0B</b>	WIFI or BLE collection scan data
<b>Proximity</b>	<b>0x0C</b>	Proximity feature messages (detailed in the application note AN-007_proximity feature)
<b>Debug</b>	<b>0x0F</b>	Internal use only

## 7 DOWNLINK MESSAGES

These messages are sent from the server to the tracker through the LoRaWAN™ network. They are used to either configure or manage the tracker. Each message contains a header including:

- A message type
- An acknowledgement token

The remaining of the message depends on the message type described in the following table.

Message type	ID	Description
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POD	0x01	Position on demand
Set Mode	0x02	Change the tracker operational mode
Request configuration	0x03	Request the actual configuration of the tracker
Start SOS mode	0x04	Turn on SOS mode
Stop SOS mode	0x05	Turn off SOS mode
Proximity command	0x07	Control and monitor proximity feature <sup>(3)</sup>
Set Param	0x0B	Modify parameter(s)
Debug command	0xFF	Reset the tracker Plays a melody Trigger a heartbeat message Entering in BLE bootloader

## 8 APPLICATION NOTES REFERENCES

	Name	Version	Description
1	AN-001_ble-update	V1.3	It describes how to update the BLE firmware
2	AN-002_LoRa_Transmission_strategy	V1.2	It is provided to: <ul style="list-style-type: none"> <li>Remind the basics of the LoRa network</li> <li>Remind the tracker configuration parameters.</li> <li>Provide the network capability of each supported region</li> </ul> Suggest the best setting for each region based on the application needs.
3	AN-003_ScanCollection	v1.0	It describes the functioning of the scan collection feature
4	AN-005_device_orientation	v1.0	It describes how to calculate the device orientation
5	AN-006_Position_BLE_filtering	TBD	It describes how works the filtering of BLE beacons for position payloads
6	AN-007_proximity feature	TBD	It describes the proximity detection behavior and configuration

## 9 HANDLING AND SAFETY

If there is any reason to suspect that the safety of a device has been compromised such as broken casing, battery leakage, anormal temperature, the device must be withdrawn from use and for ATEX product removed from any ex-hazardous area immediately.

### 9.1 Micro Tracker and Smart Badge

Those products use an internal and built-in rechargeable lithium-polymer battery that should last the lifetime of

the device. To ensure optimum performance and long battery lifetime, keep the device between -10°C to 60°C.

The tracker should be charged with an adequate DC 5V – 500mA USB charge power adapter. For the micro tracker, a standard USB cable with micro USB connector is required. The smart badge requires a specific USB cable with magnetic 4-pin connector provided by Abeeway or can be charged with the smart badge docking station.

Do not leave a fully charged battery connected to a charger, since overcharging may shorten its lifespan. Similarly, never leave your device fully discharge. It is recommended that you charge the device when battery reaches 20% capacity or at least once a month.

**CAUTION:**

Rechargeable batteries have a limited number of charge cycles. Battery life and number of charge cycles vary by use and settings. If you suspect your battery may be dead, try charging it several times. Do not attempt to open the casing or repair the device, if the battery does not recharge, please contact customer service for repair information.

For ATEX products, the battery must be charged outside ex-hazardous area. Do not charge the phone near any flammable or explosive substances.

The tracker must not be exposed to abrasive acids or bases and be kept away from extreme cold or heat, exposition to excessive heat such as fire, heating equipment.

Do not leave the tracker submerged in water for prolonged period or place it under the influence of high-pressure water jet

## 9.2 Compact and Industrial tracker

Those products are using Li-SOCl<sub>2</sub> 3.6V battery as primary power source with high energy content. To ensure optimum performance, the device should not be used above or below the permitted temperature and not expose to excessive heat such as fire, heating equipment. The tracker should be stored in rooms with generally low temperature below 35°C and low humidity levels. Storage temperatures above 75°C must be avoided.

### Caution

The battery inside the enclosure contains dangerous (Lithium) and deleterious (Thionyl Chloride) materials. For this reason, improper handling of the battery could lead to overheating, explosion, generation of irritating gases. The opening of the casing to change battery must be done by appropriately qualified personnel who should observe the following instruction to prevent accident.

- For ATEX products, batteries are not allowed to be connected or disconnected under the load in risk atmosphere. The replacement of the battery must be down outside a hazardous area
- Those batteries are not rechargeable batteries, they cannot be short circuit nor connected in reverse. Do check the polarity indicated on the battery holder for the compact tracker. The battery pack used for the industrial tracker has a special connector with a misleading to prevent misconnection.
- Damage batteries are prohibited to be operated
- Never use different batteries together
- Batteries should be stored away from any flammable material in a storage area

After replacement of the battery, the tracker must be operational immediately. If any defect, heat is observed, disconnect the battery, and contact the customer service.

## 10 CERTIFICATION AND REGULATORY

### 10.1 Radio certification

#### CE

This device may be operated in all member states of the EU with a LoRa network. The CE mark is affixed to this product. The Smart Badge Type E310 are in compliance with all the relevant provisions of Directive 2014/53/UE.

#### FCC

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 a particular 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 try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and 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. complies with part 15 of the FCC rules.

#### IC

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.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

#### Specific Absorption Rate (SAR)

The SAR limit of USA (FCC) is 1.6 W/kg averaged over one gram of tissue. This model (FCC ID: 2AOSP-U310) has also been tested against this SAR limited. The highest reported SAR value under this standard during product certification for near body use is 1.41 W/kg

### 10.2 ATEX certification

The smart Badge device is intrinsically safe in areas with an increased risk of explosion in zone 2 and zone 22 in

accordance to 2014/34/EU (ATEX) standard

The EC-Type Examination Certificate: SGS20ATEX0150X

Ex-Marking: Ⓜ II 3G Ex ic IIB T4 Gc Ta -20 °C ... +40 °C

Ⓜ II 3D Ex ic IIIB T135°C Dc Ta -20 °C ... +40 °C

Approved for zone 2 device group II, explosion group IIB (explosive gases, vapors or mist), temperature class T4. Approved for zone 22, device group II, explosion group IIIB (combustible flying, non-conductive dust and conductive dust), maximum Temperature 135°C.

### 10.3 REACH and WEEE compliance

The product is compliant with the REACH regulation (Regulation EC No 1907/2006) and RoHS directive 2011/65/UE.



Waste Electrical and Electronic Equipment (WEEE): This symbol on the device indicates that the device complies with European directive 2013/56/UE and it should not be disposed of as household waste.

This product should be disposed at an appropriate facility to enable recovery and recycling. For more detailed information, contact your local city office, household waste disposal service or retail store.

## 11 GLOSSARY

Acronyms	Description
BLE	Bluetooth Low Energy
DR	Data Rate
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
TBD	To Be Defined
ADR	Adaptive Data Rate
MCU	Micro Controller Unit

## 12 REVISION

Revision	Date	Author	Description of Change
1.0	November 3 <sup>rd</sup> , 2020	Anne Denis	Initial release
1.1	November 10 <sup>h</sup> , 2020	Anne Denis	add section 12 revision Add section to describe the downlink to play a melody section 4.11.3 add warning and alert reminder melody update the value of gps_standby_timeout to 28800 (max possible value)