Industrial Tracker User Guide

Industrial Tracker

Firmware V1.6

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1 Introduction

1.1 General Description

Designed to withstand harsh environment, the Industrial Tracker combines high performance GPS receiver, a Wi-Fi receiver and a Semtech Lora™ transceiver making it ideal for low-power industrial indoor and outdoor tracking applications.
An accelerometer detector associated with proprietary low power GPS technology extends significantly its battery life time.
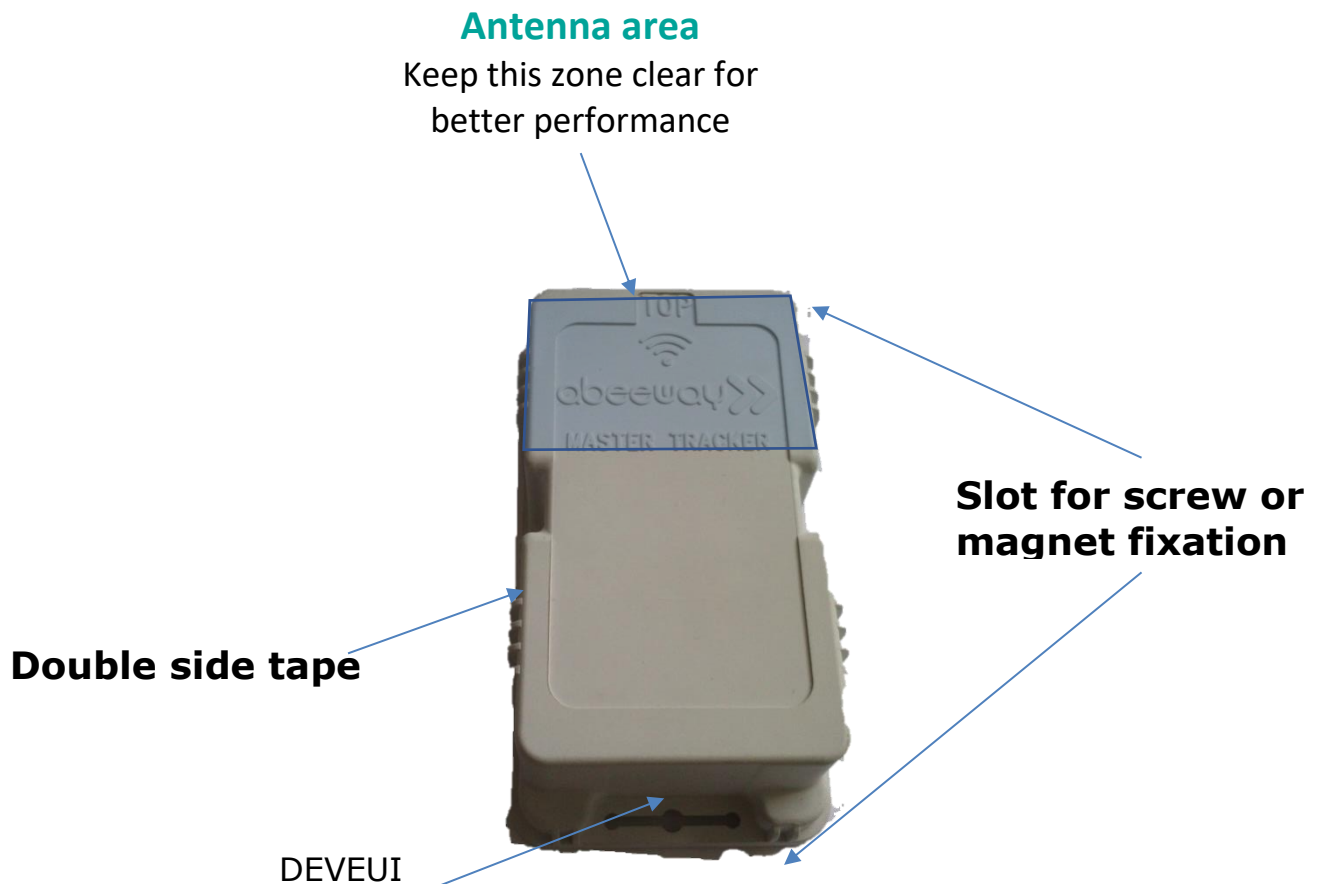
1.2 Applications

➢ Asset and vehicle tracking at fixed frequency updates or on demand
➢ Anti-theft systems
➢ Activity monitoring
➢ Geofencing applications

2 Features

➢ **Multiple operating modes**
  • **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 a position messages during motion start and end events.
  • **Activity tracking:** Monitor activity rate with embedded sensors.
➢ **Position on demand:**   Receive the tracker position only when needed (very low power operating mode).
➢ **Used geolocation technologies**
  • **GPS**: Precise outdoor position.
  • **Low power GPS:**   Get quick position outdoors and daylight indoor conditions.
  • **Wi-Fi:** Position indoors and urban area.
➢ **LED**
➢ **Temperature monitoring**
➢ **Embedded antennas**
➢ **LoRa™ Class A radio**
➢ **Dust-proof and powerful water jets - (IP66)**

Restricted distribution
11 July 2018

3 Installation

Antenna area
Keep this zone clear for
better performance

**Slot for screw or
magnet fixation**

Double side tape

DEVEUI

3.1 Getting started

➢ The tracker is provided with battery connected
➢ Your network can use two activation modes:
  o OTAA (Over The Air Activation) that requires the following keys to make the join: DEVEUI, APPEUI and APPKEY for each device. (the most used)
  o ABP (Activation by personalization) that requires the following keys to make the join: DEVEUI, DEVADDR and NWKSKEY 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 vendor for more information.

3.2 Fixation

For optimum radio performance the tracker has to be positioned vertically (as shown on the picture).
It can be fixed with a magnet, screws or a double-sided tape.
Note: the 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 field.

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4 Functioning

4.1 Main operating modes

This section describes the different operational modes supported by the trackers.

Standby mode: The tracker is sending periodically short LoRa messages, called heartbeat at the chosen period (*lora_period*). Device positions can be obtained in this mode by using the side operations features (see next section).

Motion tracking mode: The tracker provides positions when the device is moving. The reporting is done at the chosen period (*ul_period*). The positions are acquired based on the *geoloc_sensor* geolocation technology. If the device is not moving, heartbeat messages are sent regularly at the *lora_period* frequency. Additional positions can be obtained by using the on-demand side operations features.
Note: Whatever the chosen geolocation policy, the first position is always established via a Wi-Fi one sent immediately after the beginning of the motion.

Permanent tracking mode: The device reports its positions at *ul_period* frequency regardless the motion. It uses the *geoloc_sensor* geolocation technology. Heartbeat messages are sent if there are no uplink message during *lora_period* seconds.

Motion Start/End tracking mode: In this mode, position messages are sent twice at the start and at the end of a motion (one Wi-Fi and one using the *geoloc_sensor* geolocation technology). The end of the motion is detected when there is no movement detection for a period of 120 seconds.
Heartbeat messages are sent if there are no uplink message during *lora_period* seconds. Additional positions can be obtained by using the on-demand side operations features.

Activity mode: This mode sends activity reports instead of positions. The tracker focuses on detecting movements. Each shake detection increases a counter (after applying an integration period). The value of the counter is reported up the LoRa link at the *ul_period* frequency. Heartbeat messages are sent if there are no uplink message during *lora_period* seconds. Additional positions can be obtained by using the on-demand side operations features.

Note: **The accuracy of the different frequencies is not guaranteed as extra delay may be introduced by the LoRa network duty cycle.**

4.2 Side operations

Whatever the operating mode, optional messages can be sent according to the configuration. The side operations can be:
Periodic position message: The device sends periodically its position at *periodic_pos_period* frequency. Usually, this reporting frequency is very long. The position is sent three times (six if the device is moving).

Position on Demand: Position requests are done via LORA downlink message. The device answers with its current position. The position is sent three times (six if the device is moving)

Notes:
➢ The geolocation strategy used in these cases is *geoloc_method* one
➢ The side operations can be cumulated.

4.3 Geolocation strategies

4.3.1 Main operating modes

The following geolocation policies (*geoloc_sensor* parameter) are used when the operating mode is either motion-tracking, permanent-tracking, or start/end tracking.

➢ **Wi-Fi only** → Only Wi-Fi scans are used for position determination.
➢ **GPS only** →Only the GPS is used for position determination.
➢ **LP-GPS only**→ GPS and LP-GPS are used for position determination.
➢ **Multimode (Wi-Fi + AGPS + GPS**)→ Alternate Wi-Fi, LP-GPS and GPS technologies on failure, with timeout.
➢ **Wi-Fi-GPS only** → Wi-Fi then GPS if Wi-Fi fails in one geolocation cycle.
➢ **Wi-Fi-LPGPS only** → Wi-Fi then LP-GPS if Wi-Fi fails in one geolocation cycle.
➢ **Wi-Fi-LPGPS/ Wi-Fi-GPS** → Wi-Fi-LPGPS first, then Wi-Fi-GPS if Wi-Fi-LPGPS fails until timeout, then back to Wi-Fi-LGPS.

Note: The first position is always a Wi-Fi one whatever the chosen geolocation strategy.

4.3.2 Side operations

The following geolocation policies (*geoloc_method* parameter) are used for periodic-reporting or on-demand actions.

➢ **Wi-Fi only** → Only Wi-Fi scans are used for position determination
➢ **GPS only** →Only the GPS is used for position determination
➢ **LP-GPS only**→ GPS and LP-GPS are used for position determination
➢ **Wi-Fi-GPS only** → Wi-Fi then GPS if Wi-Fi fails in one geolocation cycle
➢ **Wi-Fi-LPGPS only** → Wi-Fi then LP-GPS if Wi-Fi fails in one geolocation cycle

5 Uplink messages

Type of message	Content
Heartbeat message	Notify the server the tracker is operational and under LoRa coverage
Position message	GPS, low power GPS or Wi-Fi position data
Energy status message	Used by the server to estimate the battery level. Contain information related to the power consumption
Activity Status message	Reports the activity counter. Used only by the activity tracking operating mode
Debug message	Internal used only
Frame pending	When additional downlink messages are available on gateway, this uplink message is sent to trigger the sending. (and speed up the configuration of the tracker)

6 Remote configuration using ADA

All following parameters are configurable in Abeeway Data Analyzer (ADA) application

6.1 Operating Mode Configuration

All modes can be set using ADA application:
- ➢ Standby
- ➢ Motion tracking
- ➢ Permanent tracking
- ➢ Motion start/end tracking
- ➢ Activity tracking

6.2 Position on demand

Position of the tracker can be requested

6.3 Parameters configuration

Following parameters are configurable:
- ➢ Parameters used in operating modes:
  - ✓ LoRa Heartbeat: period of Lora Heartbeat messages
  - ✓ Position report: period of LoRa position messages
  - ✓ Geolocation methodology (geoloc sensor)

- ➢ Parameters used in side operating modes:
  - ✓ Periodic position: activation, and period of LoRa position messages
  - ✓ Geolocation methodology (geoloc method)

7 Downlink messages

These messages are sent from the server to the tracker through the LoRa network. They are used to configure the tracker or request a position. Each message contains a header including:
- ➢ A message type
- ➢ An acknowledgement token

The remaining of the message depends on the message type. The tracker accepts three types of downlink messages, listed in the following table:

Message type	ID	Description
POD	0x01	Position on demand
Set Mode	0x02	Change the tracker mode
Set Param	0x0B	Modify a parameter

Notes
1. Any unexpected message (unknown message type, bad length, ...) is discarded. However, the ack token is updated even if the message is discarded (if the payload is at least 2 bytes long).
2. The LoRa port to be used for downlink is 2.

7.1 Ack Token

It provides a way to indicate to the application that a given message has been received and processed by the tracker.

The ack token is transmitted in every uplink message, and it is updated when the tracker receives a LoRa message. This way, each time the server receives a LoRa uplink, it knows whether the previous message has been received.

The ack token is four bits size. Its value ranges from 0 to 15(0x0F).

Notes
1. The ack token value must be updated for each downlink to be used by the application.
2. It's up to the application to process or not the ack tokens.
3. It's up to the application to manage the confirmations. It can either wait for the matching ack token in the uplink message before sending another downlink or send multiple downlink and later waits for the acks.

7.2 Mode Configuration

The operating mode can be remotely configured with a downlink LoRa message built as follow:

Byte 0	Byte 1	Byte 2
0x02	ACK	Mode

ACK: Ack token. Refer to the associated section.
Mode: operating modes. Acceptable values are:
- ➢ 0- Standby
- ➢ 1- Motion tracking
- ➢ 2- Permanent tracking
- ➢ 3- Motion start/end tracking
- ➢ 4- Activity tracking

Example:
Changing the operating mode to "motion track" (01) with an ack token of 3: **0x020301**.

7.3 Position on demand

Whatever the state, a position can be requested from the tracker by the message:

Byte 0	Byte 1
0x01	ACK

Example:
Position on demand message with ack token of 2: **0x0102**.

7.4 Parameters configuration

Any parameter can be remotely modified with a downlink LoRa message.
Such messages are built according to the following format:

Byte 0	Byte 1	Byte 2	Byte 3-6
0x0B	ACK	Parameter ID	New value [31-00]

The parameters identifier and the values are given in the following table

Parameter	ID	Unit	Range	Description
Position period *ul_period*	0x00	second	60 - 86400	Period of position or activity messages in motion tracking, start end tracking, activity mode or permanent operating mode
Heartbeat period *lora_period*	0x01	second	300 - 86400	Period of heartbeat messages (sent only in idle state)
Periodic position report period * *periodic_pos_period*	0x03	second	0, 900 - 604800	Period of the periodic position report. When 0, no periodic position report is transmitted.
Geolocation sensor profile *Geoloc_sensor*	0x05	none	0 - 9	Geolocation policy used in motion, start end or permanent tracking operating mode 0- Wi-Fi only 1- GPS only 2- LP-GPS (AGPS/GPS) 3- Reserved (do not use) 4- Reserved (do not use) 5- Multimode (Wi-Fi + LP-GPS + GPS) (with reset to Wi-Fi on timeout) 6-Wi-Fi-GPS only (Wi-Fi then GPS if Wi-Fi fails in one geolocation cycle) 7- Wi-Fi-LPGPS only (Wi-Fi then LP-GPS if Wi-Fi fails in one geolocation cycle) 8- Reserved (do not use) 9- Wi-Fi-LPGPS first, the Wi-Fi-GPS until timeout, then back to Wi-Fi-LGPS
Oneshot geolocation method *Geoloc_method*	0x06	none	0-4	Geolocation policy used for periodic or on demand positions: 0- Wi-Fi 1- GPS 2- XGPS (Low power GPS/GPS) 3- Wi-Fi-GPS only (Wi-Fi then GPS if Wi-Fi fails in one geolocation cycle) 4- Wi-Fi-LPGPS only (Wi-Fi then LP-GPS if Wi-Fi fails in one geolocation cycle)

Example:

To modify the heartbeat period to 1 hour, the command **0x0B020100000E10** should be sent.

Description:

- ➢ (0x0B) : set the parameter
- ➢ (0x02) : with an ack token of 2
- ➢ (0x01) : heartbeat message period
- ➢ (0x 00 00 0E 10) : to a value of 3600s = 1 hour

It is possible to modify two parameters in the same message by using the following format:

		Parameter 1		Parameter 2	
Byte 0	**Byte 1**	**Byte 2**	**Byte 3-6**	**Byte 2**	**Byte 3-6**
0x0B	ACK	ID	New value1 [31-00]	ID	New value2 [31-00]

8   Specifications

8.1   Physical configuration

Size	145mm x 76 mm x 42 mm (L x l x h)
Weight	240g
Waterproof capability	IP66
Operating temperature	-15°C to 65 °C [1]
Storage temperature (recommended)	10°C to 30 °C
Time storage max	6 months (recommended)
Humidity	<95% non-condensing

(1) Operation at temperature different from ambient may lead to reduce capacity and battery life time

8.2   Estimated lifetime

Use Case	Battery Life (Approx.)
Standby mode	>10 years at 20°C
Movement detection (120 positions per day)	Up to 3 years[2]

(2) Using Wi-Fi modes

8.3   Data communication support

LoRa™ Modem	Semtech transceiver SX1272
Protocol	LoRaWAN v1.0.2 Class A
Frequencies bands	EU 868MHz ISM band US 902-928MHz
Configuration supported	OTA or ABP
RF power	14 dBm (EU) 18.5 dBm (max)
Min sensitivity of LoRa receiver	-132 dBm in SF10
Wi-Fi Frequency band	2412 – 2472MHz
Wi-Fi sniffer max emission	3 dBm
GNSS band	1559 – 1610MHz

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8.4 Position accuracy

GPS[3]	Position Accuracy (50%-90%)	10 to 18 meters	
	Time to have a position	Cold start	50-210 seconds
		Hot start	15 seconds
	Acquisition sensitivity	-140 dBm	
Low power GPS[3]	Position Accuracy (50%-90%)	15 - 30 meters	
	Time to have a position	10-30 seconds	
	Acquisition sensitivity	-160 dBm	
Wi-Fi	Indoor Position accuracy	20-50 meters	
	Time to have a position	3 seconds	
	Sensitivity	-86 dBm	

(3) In static, >5 satellites at -130 dBm

8.5 Power management

Non-rechargeable Battery	3.6V	19 Ah
Battery type	Lithium Thionyl Chloride Type D	
Power consumption	Stand-by: 0,01mA/h	
	GPS tracking in cold start[1]: 1,5mAh (per position)	
	Low power GPS tracking[1]: 0,3mAh (per position)	
	WiFi tracking: 0,1mAh (per position)	

(1) In static, 6 satellites or more at -130 dBm

9 Instructions / Warnings

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.

Any changes or modifications to this equipment not expressly approved by ABEEWAY may cause, harmful interference and void the FCC authorization to operate this equipment.

This equipment complies with FCC's radiation exposure limits set forth for an uncontrolled environment under the following conditions :
1. *This equipment should be installed and operated such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and user's/nearby person's body at all times.*
2. *This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.*

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*

10   Products References

Product definition	SKU
ABE INDUSTRIAL TRACKER EU868 with Single GPS antenna and Wi-Fi - include tropicalization option	DEABE202-152EU
ABE INDUSTRIAL TRACKER US915 with Single GPS antenna and Wi-Fi - include tropicalization option	DEABE203-162US
ABE INDUSTRIAL TRACKER AS923 with Single GPS antenna and Wi-Fi - include tropicalization option	DEABE203-163AS

Optional tropicalization protect electronic from very humid environments.