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# 1. General Introduction

This tracker design is based on GNSS, Bluetooth Low Energy, and LoRa technology. With the advanced LoRa technology and built-in accelerometer, the tracker employs ultra-long standby time compared with the traditional GPRS-based solution. It supports indoor tracking with Bluetooth and outdoor tracking with GNSS technology. The LoRa work mode is adjustable according to your needs, the position report interval period, and the heartbeat report period.

It also supports asset management features and can receive nearby asset Bluetooth beacons (up to 105) and send the information to the LoRaWAN gateway.


# 2. Abbreviation

- **ABP**: Activation by Personalization
- **ADR**: Adaptive Data Rate
- **AS**: Application Server
- **BLEPRI**: Bluetooth Position Report Interval
- **CRC:** Cyclic Redundancy Check
- **DR:** Data Rate
- **GNSS**: Global Navigation Satellite System
- **GNSSPRI:** GNSS Position Report Interval
- **HB**: Heart Beat
- **NS:** Network Server
- **OTAA**: Over the Air Activation
- **RFU**: Reserved for Future Usage
- **RSSI**: Received Signal Strength Indicator
- **UTC**: Coordinated Universal Time

## 2.1 Features

- **Indoor & outdoor tracking**
  - Indoor tracking with Bluetooth and Outdoor tracking with GNSS

- Support GNSS on/off to save power
- Adjustable position and heartbeat report interval

- **Movement duration**
  - Time duration the tracker moves between two confirmed heartbeat messages.
- **Autonomous mode**
  - Only sends position information periodically after it has moved. It does not transmit any while stationary
  - It optimizes the battery life based on the balance between experience and maintenance
- **Asset management**
  - Report nearby asset Bluetooth beacon or tag's major, minor, and RSSI
- **Temperature**
  - Reports the interior temperature of the tracker
- **Bluetooth positioning division**
  - Break a long Bluetooth positioning interval into several sections in case the tracker is moved during a long positioning report period.
- **Tamper detection**
  - Sends an alert message to the server if the magnet is removed from the tracker
- **Offline cache position**
  - Container tracker caches the latest 40 positioning messages and sends them to the server when it is back online
- **Power switch enable/disable**
  - The power off can be disabled or enabled with a downlink command in case the user does not want anyone to turn off the tracker.
- **Battery life**
  - It can send about 40,000 GNSS coordinates
  - Longer than 6 years with a GNSS report per hour

# 3. Product Specifications

Table 1: Product Specifications

| LoRaWAN | |
|---|---|
| Protocol | Version 1.0.2B, Class A |
| Activation Mode | OTAA or ABP |
| LoRa Frequency | US915, AU915, EU868, EU433, AS923, RU864, KR920, IN865, CN470 |
| LoRa TX power | 0 to 20dBm |
| LoRa Sensitivity | -137dBm @ SF12, BW 125kHz, 868MHz/915MHz |
| LoRa Communication Distance | >1km in an urban area |
| Encryption | AES128 |

| Bluetooth | |
|---|---|
| Protocol | 5.0, iBeacon |
| TX Power | -20 to +4dBm TX power, configurable in 4dB steps |
| Sensitivity | -96dBm |

| GNSS | |
|---|---|
| GNSS | GPS, BDS, GALILEO, GLONASS, QZSS, SBAS(WAAS/EGNOS/GAGAN/MSAS) |
| Accuracy | <2.5m (CEP50) |
| Cold Start Time Duration | 30 ~ 120s |

| System | |
|---|---|
| Max. Current | 20μA |
| FOTA Over Bluetooth | Supported |

| Battery Life | Please refer to the battery life calculator spreadsheet for details. |
|---|---|
| GNSS (report interval - 10 minutes) | Approx. 40,000 times |
| Bluetooth positioning | Approx. 1 million times |

| Physical Parameters | |
|---|---|
| Dimension | 176 x 28 x 33mm (LxWxH, without the lugs)<br>200 x 28 x 33mm (LxWxH, with the lugs) |
| Housing Material | ABS+PC |
| Switch | Magnet type |
| Operating Temperature Range | -40°C ~ +70°C |
| Storage Temperature Range | -50°C ~ +80°C |

# 4. Application Information

## 4.1 Function

### 4.1.1 LoRa Mode

The tracker supports both OTAA and ABP modes and works in Class A mode. DevEUI, AppEUI, and AppKey, or DevAddr, NwkSKey, and AppSKey are stored in the tracker. DevEUI or DevAddr is labeled at the back of the device. Lansitec will help to configure these parameters before shipping if needed.

After powering on and joining the LoRa network, the tracker sends a registration message to the Application Server (AS). Configuration information of the tracker is included in this registration message for AS to validate.

### 4.1.2 Tracking Feature

The tracker supports both Bluetooth and GNSS positioning. Bluetooth positioning beacons must be deployed around the tracker to use Bluetooth tracking. The Bluetooth receiving duration is 3 seconds, and it cannot be configured. The tracker sends nearby beacons' information (major, minor, and RSSI) to the server. It only reports the 3 beacons with the highest RSSI value, no matter how many beacons are received. The RSSI reported is an average of all messages received within 3 seconds. Since the beacons' positions are already known, the server calculates the distance to the three beacons nearby. Then the coordinates can be acquired according to the triangulation algorithm.

Please refer to:

930-01232 "LoRaWAN Tracker Positioning Service API Document" for detailed information on the triangulation.
990-00170 "B-Fixed® PERSONNEL& ASSET TRACKING SOLUTION" to find out how to design and develop your tracking system.

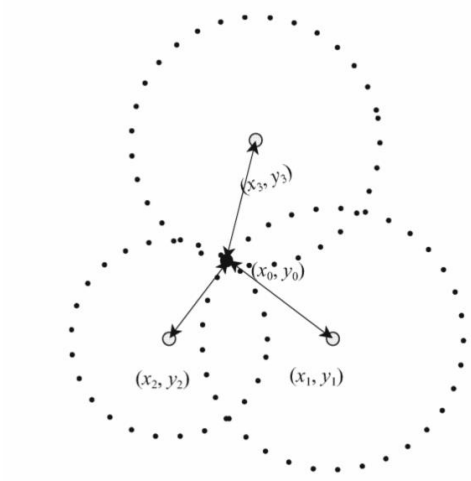



Figure 1: Triangulation method

The tracker turns on Bluetooth receiving for 3 seconds before tracking (at the beginning of each interval). The tracker turns on the GNSS module if it can't receive any beacons. Vice versa, GNSS will not be turned on if the beacon signal is received. GNSS timeout duration is 3 minutes. It stops acquiring satellites when timeout and will restart in the next cycle.

According to LoRaWAN specification, an uplink duty cycle decides the downlink response time in the Class A mode. The tracker uses a heartbeat message to control the downlink response time and avoid relying on the position message for the downlink configuration. The heartbeat message report period can be configured as multiples of 30 seconds. The heartbeat message also contains the status information of the tracker. AS can use it to monitor the tracker.

### 4.1.3 Asset Management

The tracker can report the nearby asset Bluetooth beacons' major, minor, and RSSI to the LoRa gateway. A maximum of 105 beacons are supported. The tracker reports a maximum of 15 asset beacons at one time. Asset beacon's UUID can be configured with a downlink command.

### 4.1.4 Movement Duration

The tracker records how long it moves or vibrates between two confirmed heartbeats and reports it in the second one. It can be used for recording how long a blender works in a day.

### 4.1.5 Temperature

It reports an estimated temperature inside the tracker.

## 4.2 Positioning Report Mode

- Periodic reporting mode
  The tracker starts the positioning process and reports the positioning results at fixed intervals as configured.

  ***Note**: The satellite acquisition time could be longer than the positioning process, so the actual positioning report interval received by the Application Server may be longer than the configured position period.*
- Autonomous reporting mode
  The tracker decides whether to start the positioning process and reports the positioning result based on the motion state perceived by the accelerated speed in the last positioning cycle.
- On-Demand reporting mode
  The tracker starts the positioning process and reports the positioning results only when it receives a LoRa downlink message deployed by the AS.

The positioning beacon and GNSS share the same report interval described in the Position Report Interval field in the ***6.2 Tracker Configuration***.

## 4.3 Positioning Process

1) When the positioning process starts, the tracker turns on the Bluetooth receiver for 3 seconds at the beginning of the cycle.

   If beacons with the UUID "F2-A5-2D-43-E0-AB-48-9C-B6-4C-4A-83-00-14-67-20" are received, the tracker reports the Major, Minor, and RSSI of 3 of the beacons which have the strongest RSSI.
   Then the positioning process terminates. The UUID can be configured with a downlink command.

2) If no beacon is received, the tracker turns on the GNSS module.

   Generally, the tracker can obtain the coordinates in about 25 ~ 60 seconds under the condition of a good GNSS satellite signal in the outdoor environment. After successful GNSS positioning, it reports the longitude, latitude, and UTC, and then the positioning process terminates.
   If the GNSS module cannot obtain the coordinates due to the weak satellite signal, the GNSS timeout is 3 minutes. Then the positioning process terminates, and it reports 0 longitude and latitude.

## 4.4 On/Off and LED Status

1) Turn on: Attach a magnet to the SWITCH spot for over 3 seconds and then remove the magnet. The red LED flashes four times while the green LED is on and the buzzer beeps when the tracker is on.

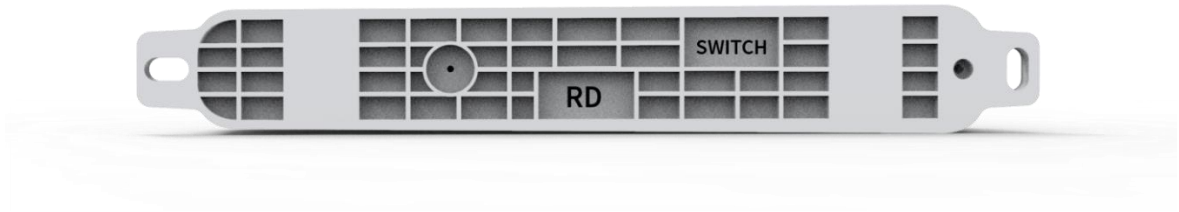



Figure 2: Switch Position

2) Turn off: Attach a magnet to the SWITCH spot again for over 3 seconds and then remove the magnet. The red LED flashes four times and the buzzer beeps when the tracker is off.
3) The power-off can be disabled or enabled with a downlink command in case the user does not want anyone to turn off the tracker.
4) When it joins the LoRa network, the green LED is on until the end of the joining process.
5) The magnet briefly attaches to the SWITCH spot:
   a) The green LED flashes once: LoRa network successfully joined.
   b) The red LED flashes once: LoRa network lost connection.
   c) No LED flashes: The device is powered off.

## 4.5 Confirmed and Unconfirmed Uplink Message Configuration

To reduce the number of downlink messages, all GNSS positions and beacon uplink messages are unconfirmed. The number of confirmed heartbeat messages is configurable. Refer to the CFMMSG field in section ***5.1 Registration*** for details.

## 4.6 LoRa Network Connectivity

The device determines LoRa network connectivity by counting the number of confirmed uplink heartbeat messages that are lost.

The default settings are: CFMMSG field is 2, and HBCOUNT field is 5 as described in section ***5.1 Registration***. It means that 5 confirmed and 5 unconfirmed heartbeat messages are lost, and the device considers LoRa is disconnected. It will not send the position report anymore. Instead, it will try to join the network once every 5 minutes for 3 times. If unsuccessful, it will try to join once at the beginning of each hour. The position report resumes once the network is reconnected.

## 4.7 Tamper Detection

Attach a magnet to the TD (Tamper Detection) spot. When the magnet is removed, the tracker beeps 3 times and sends an alarm (0x9 command) to the LoRa gateway.

# 4.8 Offline Cache Position Report

When LoRa is disconnected, the device enters the offline state. It continues to do positioning during this state, but does not report the position data and only saves the most recent 40 positions in the RAM. When the device is back online, it reports the position data saved during the offline status at an interval of 10 seconds before all other position data.

# 4.9 Battery

The container tracker uses two ER18505 lithium thionyl chloride batteries + a Lithium Ion capacitor. The voltage drops while it is operating, and recovers to around 3.5V when idle. The voltage stays at 3.5V until power is almost consumed. Due to the discharge characteristics of the battery, the voltage may drop sharply to 3.0V or even lower. If the voltage is seen lower than 3.3V in continuous 3 heartbeat messages, the battery should be replaced. For more information, please refer to the battery life calculator spreadsheet (PN: 511-00120).

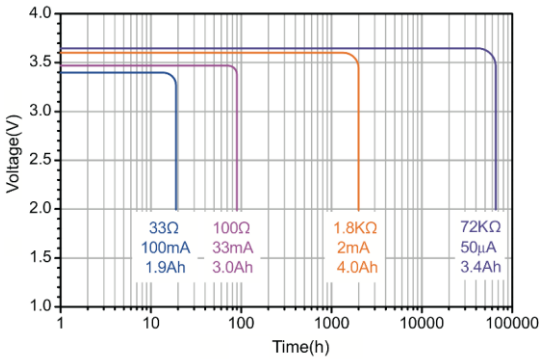



Figure 3: Battery Discharge Characteristics

It is recommended to replace the capacitor when replacing the battery. Capacitor replacement steps:

1) Turn off the switch
2) Remove the capacitor
3) Remove the batteries
4) Install the batteries making sure the +/- direction is right
5) Plugin the capacitor
6) Turn on the switch

# 5. Uplink Message

Table 2: Uplink Message Table

| Message Type | Name | Description |
|---|---|---|
| **0x1** | Registration | Once the LoRa network is successfully connected or a specific downlink message (***6.3 Command Request***) is received, the tracker will send this message once. |
| **0x2** | Heartbeat | The tracker periodically sends this message to confirm the status of the LoRa network connection. |
| **0x3** | GNSS position | The tracker sends this message according to the report policy when GNSS location information is acquired. |
| **0x7** | Positioning Beacon | According to the report policy, the tracker sends this message when specific beacons are received. |
| **0x8** | Asset Beacon | The tracker sends this message to a LoRa gateway when asset beacons are received. |
| **0x9** | Alarm | The tracker sends an alarm message when a magnet is removed from the tracker. |
| **0xA** | Vibration Shock Detection | The tracker reports the number of vibration shocks that exceed the set threshold. |
| **0xB** | Offline Cache Report | The tracker reports the position data cached during offline. |

## 5.1 Registration

| **Bytes** | **1** | **1** | **1** | **1** | **2** | **2** | **1** | **1** | **16** | **1** | **2** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Item** | Type | SMODE | Power | Config | HB | BLEPRI | DIV | BLEEN | Positioning Beacon UUID | Accelerometer Threshold | VER |

| **1** | **1** | **1** | **1** | **1** | **16** | **1** | **1** | **2** | **2** |
|---|---|---|---|---|---|---|---|---|---|
| CFMMSG | HBCOUNT | Bluetooth Receive Period | Bluetooth Receiving Duration | Extra Asset Beacon Report Interval | Asset Beacon UUID | Shock Detection Threshold | Shock Detection Report Period | GNSSPRI | RFU |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0x1 | Message type<br>Bit7 is the most significant bit. |
| **3** | ADR | **0**: OFF<br>**1**: ON | LoRa ADR enable status<br>The default value is OFF.<br>***Note:*** As the tracker is a mobile device, we suggest turning off ADR and setting proper DR according to the distance between the tracker and the gateway. |
| **2 ~ 0** | MODE | 0x0 | Current working LoRaWAN Channel plan<br>Reserved for future usage. |

SMODE Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | SMODE | 0x0 | Supported LoRa frequency band plan. Reserved for future usage. |

Power Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 3** | Power | 0 ~ 31 | LoRa TX power (dBm)<br>The default value depends on the tracker work mode. It is always the largest TX power allowed by the LoRaWAN protocol. For example, the default value is 20 dBm in EU868.<br>***Note:*** For the available TX power value for each LoRaWAN channel plan, please refer to ***Table 3: LoRa TX Power Table.*** |
| **2** | Offline cache enable | 0x0 ~ 0x1 | 0: disable 1: enable, the default value is 0. |
| **1** | Alarm enable | 0x0 ~ 0x1 | 0: disable 1: enable, the default value is 0. |
| **0** | Single key enable | 0x0 ~ 0x1 | 0: disable 1: enable, the default value is 0. |

Table 3: LoRa TX Power Table

| | EU868 | US915 | EU433 | AU915 | CN470 | AS923 | KR920 | IN865 |
|---|---|---|---|---|---|---|---|---|
| **TX Power (dBm)** | 16 | 20 | 12 | 20 | 20 | 16 | 14 | 20 |
| | 14 | 18 | 10 | 18 | 18 | 14 | 12 | 18 |
| | 12 | 16 | 8 | 16 | 16 | 12 | 10 | 16 |
| | 10 | 14 | 6 | 14 | 14 | 10 | 8 | 14 |
| | 8 | 12 | 4 | 12 | 12 | 8 | 6 | 12 |
| | 6 | 10 | 2 | 10 | 10 | 6 | 4 | 10 |
| | 4 | 8 | - | 8 | 8 | 4 | 2 | |
| | 2 | 6 | - | 6 | 6 | 2 | 0 | |
| | - | 4 | - | 4 | - | - | - | |
| | - | 2 | - | 2 | - | - | - | |

Config Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | DR | 0 ~ 5 | LoRa Data Rate (DR3 ~ DR5)<br>If ADR is disabled, the tracker works at this data rate.<br>The default value is DR3 (0x3).<br>***Note****: For each LoRa frequency band plan, the available DR value, please refer to* ***Table 4: LoRa Data Rate and Payload Length Limitation Map (bytes)***<br>***Note****: The data Rate in US915 is DR2 by default.* |
| **3** | GNSSEN | **0**: Disable<br>**1**: Enable | This field indicates whether the GNSS feature is enabled or not.<br>If GNSSEN is 0 (disabled), only Bluetooth positioning is effective. When indoor positioning is needed only, this feature saves power.<br>The default value is Enable (0x1). |
| **2 ~ 1** | Position Report Mode | **0**: Period mode<br>**1**: Autonomous mode<br>**2**: On-Demand mode | The default value is the autonomous mode (0x1). |
| **0** | SWITCHEN | **1**: Enable<br>**0**: Disable | Switch enable status<br>If SWITCHEN is disabled, the switch cannot be used to shut down the device. The default value is disabled (0x0). |

Table 4: LoRa Data Rate and Payload Length Limitation Map (bytes)

| DR | EU868 | US915 | EU433 | AU915 | CN470 | AS923 | KR920 | IN865 |
|---|---|---|---|---|---|---|---|---|
| **0** | 51 | 11 | 51 | 51 | 51 | 51 | 65 | 51 |
| **1** | 51 | 53 | 51 | 51 | 51 | 51 | 151 | 51 |
| **2** | 51 | 126 | 51 | 51 | 51 | 51 | 242 | 51 |
| **3** | 115 | 242 | 115 | 115 | 115 | 115 | 242 | 115 |
| **4** | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 242 |
| **5** | 242 | - | 242 | 242 | 242 | 242 | 242 | 242 |

HB Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Heartbeat Report Interval | 0 ~ 65535 | The period of heartbeat message, unit 30secs, big-endian<br>**Heartbeat can't be disabled.**<br>The default is 1 hour (0x78). |

BLEPRI Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Bluetooth Position Report Interval | 0 ~ 65535 | The period of position report, unit: 5sec, big-endian<br>It can't be disabled, the value must be bigger than 0.<br>The default is 5 minutes (0x3C). |

DIV Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | DIV | 0 ~ 255 | This feature allows the tracker to use Bluetooth tracking multiple times during a long PRI.<br><br>DIV divides PRI period into DIV+1 sections. The tracker turns on Bluetooth receiving for 3 seconds at the end of each section. It does not turn on GNSS even if no beacon is received. Example:<br>PRI = 0x10E0, 6 hours.<br>DIV = 5<br>In autonomous mode, if it is moved between 0 ~ 1 hour (1:00:00), it turns on Bluetooth receiving at 1:00:00. If it receives beacons, it reports them and the 6 hours PRI period recounts. If not, it does this again at 2:00:00 if it is moved again. It does not turn on Bluetooth receiving if it is not moved during each section.<br>The PRI period ends till it reports the GNSS coordinates.<br><br>This feature works in periodic mode too. It turns on Bluetooth receiving 3secs at the end of each section (1:00:00, 2:00:00, ……).<br><br>The default value is 0. The tracker only does Bluetooth receiving for 3s at the end of the PRI period.<br><br>Refer to ***Figure 4: Bluetooth and GNSS Position*** for a detailed explanation. |

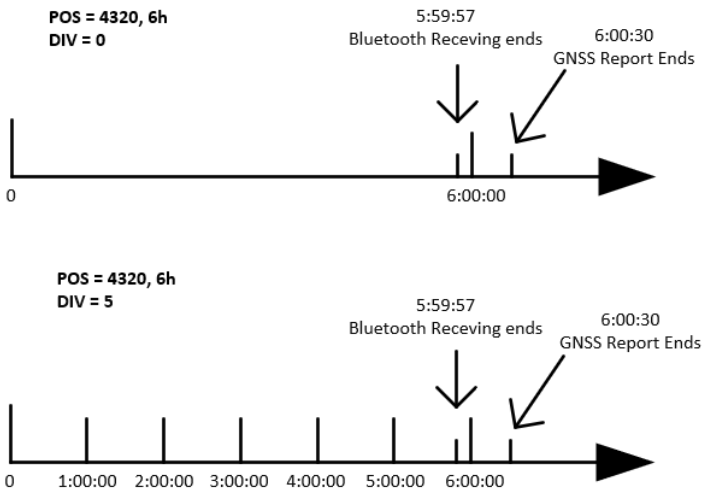



Figure 4: Bluetooth and GNSS Position

BLEEN Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 1** | RFU | 0x0 | Reserved for future usage. |
| **0** | BLEEN | **0**: Disable<br>**1**: Enable | BLE enable status<br>If BLEEN is disabled, only GNSS positioning is effective. When outdoor positioning is needed only, turning off this option saves Power.<br>The default is Enable (0x1).<br>***Note:*** *Either GNSSEN or BLEEN must be enabled.* |

Bluetooth Positioning Beacon UUID

| Bit | Name | Value | Description |
|---|---|---|---|
| **127 ~ 0** | Positioning UUID | 128-bit hex | Bluetooth position UUID filter<br>Default UUID: F2-A5-2D-43-E0-AB-48-9C-B6-4C-4A-83-00-14-67-20. |

Accelerometer Threshold

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Accelerometer Threshold | 0 ~ 10 | The accelerometer threshold of the autonomous mode.<br>The tracker is considered moved when the accelerated speed is larger than the set threshold number.<br>The default value is 10 (0x0A, 0.1g).<br>Accelerometer Threshold = (50 + Value x 5)x 0.001g. |

VER Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | VER | 16-bit hex | Firmware version |

CFMMSG Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | CFMMSG | 0 ~ 255 | The interval of messages that need to be acknowledged.<br>The default value is 2, meaning the server must acknowledge the first one for every two heartbeat messages. |
| **7 ~ 0** | HBCOUNT | 0 ~ 255 | The number of heartbeat ACK that the tracker misses. When it |

| | | | |
|---|---|---|---|
| | | | reaches this number, the tracker considers itself disconnected from the network.<br>The default value is 5.<br>If 5 consecutive confirmed heartbeat messages are missed, the device is disconnected from LoRaWAN and will rejoin the network. |

Asset Beacon Report Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Asset Beacon Report Period | 0 ~ 255 | The period of asset beacon report, unit: 1min<br>0 means OFF and it is 30min by default.<br>A maximum of 105 beacons are supported. |
| **7 ~ 0** | Bluetooth Receiving Duration | 0 ~ 10 | Unit: 1sec. The duration of Bluetooth receiving from asset beacons.<br>The default value is 3 seconds. |
| **7 ~ 0** | Extra Asset Beacon Report Interval | 0 ~ 255 | The interval of asset beacon report, unit: 10secs,<br>The default is 20 seconds.<br>When more than 15 beacons are received in one asset beacon report period, the tracker sends the rest every 10s. Refer to ***Figure 5: Asset Beacon Report***. |
| **127 ~ 0** | Asset Beacon UUID | 128-bit hex | Asset beacon UUID |

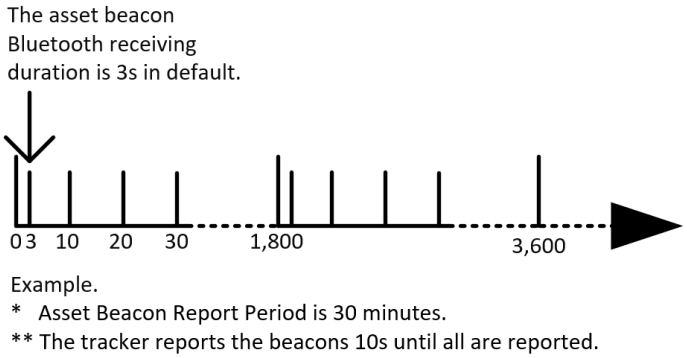



Figure 5: Asset Beacon Report

Vibration Shock Detection Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Vibration Shock Detection Threshold | 0 ~ 100 | The threshold of Vibration Shock Detection.<br>The tracker checks the accelerometer once every 2secs.<br>The vibration shock is valid only when the accelerated speed of the tracker is larger than the set threshold.<br>The default value is 10 (0x0A, 0.1g).<br>Vibration Shock Detection Threshold = (50 + value x 5)x0.001g. |
| **7 ~ 0** | Vibration Shock Detection Report Period | 0 ~ 255 | The period of shock detection report, unit 30s, big-endian<br>0 means OFF.<br>The default is 0 (0x00). |

GNSSPRI Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | GNSS Position Report Interval | 0 ~ 65535 | The period of GNSS position report, unit 5s, big-endian.<br>0 means OFF.<br>The default is 30 minutes (0x0168). |

RFU Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | RFU | 0x0 | Reserved for future usage. |

# 5.2 Heartbeat

| **Bytes** | **1** | **1** | **1** | **2** | **1** | **2** | **2** | **4** |
|---|---|---|---|---|---|---|---|---|
| **Item** | Type | VOL | RSSI | SNR | GNSSSTAT | Temperature | Movement | RFU |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0x2 | Message type<br>Bit7 is the most significant bit. |
| **3 ~ 0** | SNREN | 0: No SNR field<br>1: The SNR field is enabled | The field indicates whether the SNR field is enabled or not. The default value is SNR field enabled (0x1). |

VOL Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Voltage | 0 ~ 250 | Battery voltage, unit 0.01 V<br>Battery voltage is VOL x 0.01+1.5.<br>Example: when the value is 209, the voltage is 3.59V. |

RSSI Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | RSSI | 0 ~ 127 | LoRa Received Signal Strength Indication, unit -1 dBm<br>LoRa signal strength received from LoRa gateway. |

SNR Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | SNR | -3000 ~ 3000 | LoRa Signal Noise Ratio, unit 0.01 dB<br>Signal noise ratio received from LoRa gateway.<br>***Note**: If the SNRINC field is 0, the Application Server should ignore this field.* |

GNSSSTAT Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | GNSSSTATE | **0x00**: off<br>**0x01**: Boot GNSS<br>**0x02**: Locating<br>**0x03**: Located<br>**0x09**: No signal | Status of GNSS module |
| **3 ~ 0** | VIBSTATE | 0 ~ 9 | Moving state of the tracker.<br>0 means no moving.<br>9 means it moves with high accelerated speed. |

Temperature Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | TEMP | -20000 ~ 20000 | It is the temperature inside the housing and is a signed number. The default is 0x0000, and the unit is 1°C.<br>Example:<br>0x000A = 10 (decibel) = 10°C<br>0xFFFB = 111 1111 1111 1011<br>111 1111 1111 1011 - 1 = 1111 1111 1111 1010<br>Invert 1111 1111 1111 1010 = 0101 = 5, -5°C |

Movement Duration Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Movement | 0 ~ 65565 | Default:0x0000<br>The duration the tracker moves between confirmed heartbeats. (unit: 5sec)<br>The tracker checks the accelerometer once every 1 sec. If the tracker is moved once every 5 seconds, it is considered moved for 5 seconds. The parameter "Movement" is the number of 5-second blocks. |

RFU Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **31 ~ 0** | RFU | 0x0 | Reserved for future usage. |

# 5.3 GNSS Position

| **Bytes** | **1** | **4** | **4** | **4** |
|---|---|---|---|---|
| **Item** | Type | Longitude | Latitude | Time |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0x3 | Message type; Bit7 is the most significant bit. |
| **3 ~ 0** | Flag | 0x0 ~ 0x1 | 0x0: GNSS positioning succeeded.<br>0x1: GNSS positioning failed. |

Longitude Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **31 ~ 0** | Longitude | Float | Longitude IEEE 754 format, the positive value represents east longitude, and the negative value represents west longitude.<br>GNSS timeout is 10 minutes. The tracker reports 0 longitudes while time out. |

Latitude Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **31 ~ 0** | Latitude | Float | Latitude IEEE 754 format, the positive value represents north latitude, and the negative value represents south longitude.<br>GNSS timeout is 10 minutes. The tracker reports 0 latitudes while time out. |

TIME Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **31 ~ 0** | Time | Integer | UTC time, seconds since 1970/1/1 00:00:00 |

## 5.4 Positioning Beacon

| Bytes | 1 | 5 | 2 | 2 | 1 | 2 | 2 | … |
|---|---|---|---|---|---|---|---|---|
| Item | Type | RFU | Major | Minor | RSSI | Major | Minor | … |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0x7 | Message type<br>Bit7 is the most significant bit. |
| **3 ~ 0** | Length | 1 ~ 3 | The number of beacons received |

RFU Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **39 ~ 0** | RFU | 0x0 | Reserved for future usage. |

Major Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | MAJOR | 16-bit hex | Major of the Bluetooth beacon |

Minor Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | MINOR | 16-bit hex | Minor of the Bluetooth beacon |

RSSI Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | RSSI | -128 ~ 0 | Bluetooth Received Signal Strength Indication, unit dBm<br>Signal strength received from beacon - application server utilizes this to calculate the indoor position.<br>***NOTE**: For compatibility with the legacy version, this field is represented by a negative 8-bit number.*<br>Example: the value is 170, the real RSSI =170 - 256 = -86 dBm |

## 5.5 Asset Beacon

| Bytes | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | … |
|---|---|---|---|---|---|---|---|---|---|
| Item | Type | QTY | Major | Minor | RSSI | Major | Minor | RSSI | … |

Type Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0x8 | Message type, CS uses it to identify different uplink messages. |
| **3 ~ 0** | RFU | 0x0 | Reserved for future usage. |

Beacon Quantity Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | QTY | Short | The quantity of beacons transmitted in this message.<br>The tracker supports a maximum of 105 asset beacons. It transmits a maximum of 15 beacons in one message. It transmits 15 in the next interval if there are more until all are transmitted. Refer to the asset beacon report period field in section ***6.2 Tracker Configuration*** on how the beacons are sent. |

Major Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Major | Short | Major of Bluetooth beacon. |

Minor Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Minor | Short | Minor of Bluetooth beacon. |

RSSI Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | RSSI | Integer | Received Signal Strength Indication of the beacon. The server utilizes it to calculate the distance. This value -256 = the real RSSI<br>Example: the value is 170, the real RSSI =170 - 256 = -86 dBm |

# 5.6 Alarm

| **Bytes** | **1** | **1** |
|---|---|---|
| **Item** | Type | Alarm |

Type Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0x9 | Message type, CS uses it to identify different uplink messages. |
| **3 ~ 0** | RFU | 0x0 | Reserved for future usage. |

Alarm Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Alarm | 0x01 | Tamper detection alarm.<br>The tracker only reports 0x01 once when the magnet is removed from the TD spot. It does not report anything when the magnet is attached.<br>This feature is not suitable for situations with strong magnetic fields. |

# 5.7 Offline Cache Position

| **Bytes** | **1** | **1** | **…** | **2** | **2** | **1** | **…** | **4** | **4** | **4** | **…** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Item** | Type | Cached Data Type Flag | … | Major | Minor | RSSI | … | Longitude | Latitude | Time | … |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0xB | Message type<br>Bit7 is the most significant bit. |
| **3 ~ 0** | Length | 1 ~ 8 | The length of cached location data. |

Cached Data Type Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Cache Data Type | 255 ~ 0 | The flag bit of the cached data type.<br>**0**: Bluetooth position data<br>**1**: GNSS position data<br>Example: Flag=0100 1110<br>The first, third, fourth, and eighth are Bluetooth position data. |

| | | | |
|---|---|---|---|
| | | | The second, fifth, sixth, and seventh are GNSS position data. |

Major Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Major | Short | Major of Bluetooth beacon. |

Minor Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Minor | Short | Minor of Bluetooth beacon. |

RSSI Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | RSSI | Integer | Received Signal Strength Indication of the beacon. The server utilizes it to calculate the distance.<br>This value -256 = the real RSSI<br>Example: the value is 170, the real RSSI =170 - 256 = -86 dBm |

Longitude Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **31 ~ 0** | Longitude | Float | Longitude IEEE 754 format, the positive value represents east longitude, and the negative value represents west longitude. |

Latitude Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **31 ~ 0** | Latitude | Float | Latitude IEEE 754 format, the positive value represents north latitude, and the negative value represents south longitude. |

TIME Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **31 ~ 0** | Time | Integer | UTC time, seconds since 1970/1/1 00:00:00 |

## 5.8 Vibration Shock Detection Report

| **Bytes** | **1** | **2** |
|---|---|---|
| **Item** | Type | Vibration Shock Count |

Type Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0xA | Message type, CS uses it to identify different uplink messages. |
| **3 ~ 0** | RFU | 0x0 | Reserved for future usage. |

Alarm Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | Vibration Shock Count | 0 ~ 65535 | The number of vibration shocks detected between two report cycles. |

# 6. Downlink Message

Table 5: Downlink Message Table

| Message Type | Name | Description |
|---|---|---|
| **0x8** | LoRa Configuration | The application server can deploy this message to configure LoRa parameters. |
| **0x9** | Tracker Configuration | The application server can deploy this message to configure tracker parameters. |
| **0xA** | Command request | The application server can deploy this message to request the tracker to execute instructions. |
| **0xB** | Offline Configuration | The application server can deploy this message to configure offline parameters. |
| **0xC** | Asset Beacon Configuration | The application server can deploy this message to configure asset beacon parameters. |
| **0xD** | Vibration Shock Detection Report Configuration | The application server can deploy this message to configure vibration shock detection Report parameters. |

## 6.1 LoRa Configuration

| **Bytes** | **1** | **1** | **1** |
|---|---|---|---|
| **Item** | Type | DR | MODE |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0x8 | Message type<br>Bit7 is the most significant bit. |
| **3** | ADR | 0: OFF | ADR (Adaptive Data Rate) status<br>ADR is not supported and is OFF in default.<br>At present, this bit can't be configured. |
| **2 ~ 0** | RFU | 0x0 | Reserved for future usage. |

DR Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | DR | 0 ~ 5 | LoRa Data Rate (DR0 ~ DR5)<br>The default value is DR2 (0x2) in US915 and DR3 in all other frequencies.<br>If Asset Beacon is disabled, this field can be configured.<br>***Note**: For the available DR value in each LoRa frequency band, please refer to **Table 4: LoRa Data Rate and Payload Length Limitation Map (bytes)***<br>***Note**: US915 DR0 is not supported, because the payload length limitation of DR0 in US915 is 11 Bytes.* |
| **3 ~ 0** | RFU | 0x0 | Reserved for future usage. |

Mode Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 5** | RFU | 0x0 | Reserved for future usage. |
| **4 ~ 0** | Power | 0 ~ 31 | LoRa TX power (dBm)<br>The default value depends on the tracker work mode. It is always the highest one of the allowed TX powers. For example, the |

| | | | |
|---|---|---|---|
| | | | default value is 16 dBm if MODE is EU868.<br>***Note**: For the available TX Power value in each LoRa frequency band plan, please refer to **Table 3: LoRa TX Power Table**.* |

# 6.2 Tracker Configuration

| **Bytes** | **1** | **2** | **2** | **1** | **1** | **16** | **1** | **2** |
|---|---|---|---|---|---|---|---|---|
| **Item** | Type | HB | BLEPRI | DIV | BLEEN | Positioning Beacon UUID | Accelerometer Threshold | GNSSPRI |

Type Field (the most significant byte)

| **Bit** | **Name** | **Value** | **Description** |
|---|---|---|---|
| **7 ~ 4** | Type | 0x9 | Message type.<br>Bit7 is the most significant bit. |
| **3** | GNSSEN | **0**: Disable<br>**1**: Enable | GNSS enable status<br>If GNSSEN is 0 (disabled), only Bluetooth positioning is effective. When indoor positioning is needed only, this feature saves power. The default value is Enable (0x1). |
| **2 ~ 1** | Position Report Mode | **0**: Period mode<br>**1**: Autonomous mode<br>**2**: On-Demand mode | Positioning report mode<br>The default value is the autonomous mode (0x1). |
| **0** | SWITCHEN | **1**: Enable<br>**0**: Disabled | If SWITCHEN is disabled, the switch cannot shut down the device.<br>The default value is Disable (0x0). |

HB Field

| **Bit** | **Name** | **Value** | **Description** |
|---|---|---|---|
| **15 ~ 0** | Heartbeat Report Interval | 1 ~ 65535 | The period of heartbeat message, unit 30secs, big-endian<br>The heartbeat message can't be disabled.<br>The default value is 1 hour (0x78). |

BLEPRI Field

| **Bit** | **Name** | **Value** | **Description** |
|---|---|---|---|
| **15 ~ 0** | Bluetooth Position Report Interval | 0 ~ 65535 | The period of position report, unit 5secs, big-endian<br>0 means OFF.<br>The default is 5 minutes (0x3C). |

DIV Field

| **Bit** | **Name** | **Value** | **Description** |
|---|---|---|---|
| **7 ~ 0** | DIV | 0 ~ 255 | DIV divides PRI period into DIV+1 sections. The tracker turns on Bluetooth receiving 3secs before each section. It does not turn on GNSS even if no beacon is received.<br>The default is 0. Refer to ***Figure 4: Bluetooth and GNSS Position*** for a detailed explanation. |

BLEEN Field

| **Bit** | **Name** | **Value** | **Description** |
|---|---|---|---|
| **7 ~ 1** | RFU | **0x0** | Reserved for future usage. |
| **0** | BLEEN | **0**: Disable<br>**1**: Enable | BLE enable status<br>If BLEEN is disabled, only GNSS positioning is effective. When |

| | | | |
|---|---|---|---|
| | | | outdoor positioning is needed only, turning off this option saves Power.<br>The default is Enable (0x1).<br>***Note:*** *Either GNSSEN or BLEEN must be enabled.* |

Bluetooth Positioning Beacon UUID

| Bit | Name | Value | Description |
|---|---|---|---|
| **127 ~ 0** | Bluetooth Positioning UUID | 128-bit hex | Bluetooth position UUID filter<br>The default is: F2A52D43E0AB489CB64C4A8300146720 |

Accelerometer Threshold

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Accelerometer Threshold | 0 ~ 10 | Autonomous mode accelerometer threshold. The tracker is considered moved when the accelerated speed exceeds the set threshold number. The default value is 10 (0x0A, 0.1g).<br>AccelerometerThreshold = (50 + Value x 5) x 0.001g. |

GNSSPRI Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **15 ~ 0** | GNSS Position Report Interval | 0 ~ 65535 | The period of GNSS position report, unit 5s, big-endian.<br>0 means OFF.<br>The default is 30 minutes (0x0168). |

# 6.3 Command Request

| **Bytes** | **1** | **1** |
|---|---|---|
| **Item** | Type | RFU |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0xA | Message type; Bit7 is the most significant bit. |
| **3 ~ 0** | COMMAND | **0x1**: Position Request<br>**0x2**: Register Request<br>**0x3**: Device Reboot | Request command<br>**0x1**: Request the tracker to send the position. "GNSSEN" must be enabled before sending this command. The tracker does not send the position if "GNSSEN" is disabled.<br>**0x2**: Request the tracker to send a register message if AS wants to get the tracker's current parameters.<br>**0x3**: Request the tracker to reboot. |

RFU Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | RFU | 0x0 | Reserved for future usage. |

# 6.4 Offline Configuration

| **Bytes** | **1** | **1** | **1** | **2** |
|---|---|---|---|---|
| **Item** | Type | CFMMSG | HBCOUNT | RFU |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0xB | Message type<br>Bit7 is the most significant bit. |
| **3** | RFU | 0x0 | Reserved for future usage. |
| **2** | Offline cache enable | 0x0 ~ 0x1 | 0: disable 1: enable, the default value is 0. |
| **1** | Alarm enable | 0x0 ~ 0x1 | 0: disable 1: enable, the default value is 0. |
| **0** | Single key enable | 0x0 ~ 0x1 | 0: disable 1: enable, the default value is 0. |

CFMMSG Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | CFMMSG | 0 ~ 255 | The interval of messages that need to be acknowledged.<br>The default value is 2, meaning the server must acknowledge the first one for every two heartbeat messages. |

HBCOUNT Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | HBCOUNT | 0 ~ 255 | The number of heartbeat ACK that the tracker misses. When it reaches this number, the tracker considers itself disconnected from the network.<br>The default value is 5.<br>If 5 consecutive confirmed heartbeat messages are missed, the device is disconnected from LoRaWAN and will rejoin the network.<br>Refer to section ***4.6 LoRa Network Connectivity*** on how the tracker rejoins the network. |

# 6.5 Asset Beacon Configuration

| **Bytes** | **1** | **1** | **1** | **1** | **16** |
|---|---|---|---|---|---|
| **Item** | Type | Bluetooth Receive Period | Bluetooth Receiving Duration | Extra Asset Beacon Report Interval | Asset Beacon UUID |

Type Field (the most significant byte)

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 4** | Type | 0xC | Message type<br>Bit7 is the most significant bit. |
| **3 ~ 0** | RFU | 0x0 | Reserved for future usage. |

Asset Beacon report period Field

| Bit | Name | Value | Description |
|---|---|---|---|
| **7 ~ 0** | Asset Beacon Report Period | 0 ~ 255 | Unit: 1min, the period of Bluetooth receiving and LoRa report.<br>0 means OFF, and it is 30 minutes by default. |
| **7 ~ 0** | Bluetooth Receiving Duration | 0 ~ 10 | Unit: 1s. The length of Bluetooth receiving. The default is 3s.<br>It must be more significant than twice the beacon advertisement interval.<br>The Bluetooth receiving is on at the beginning of every report.<br>The tracker supports a maximum of 105 asset beacons and reports them every 10 seconds. Refer to ***Figure 5: Asset Beacon*** |

| | | | |
|---|---|---|---|
| | | | ***Report.*** |
| **7 ~ 0** | Extra Asset Beacon Report Interval | 0 ~ 255 | The interval of single beacon report, unit: 10secs,<br>The default is 20 seconds.<br>When more the 15 beacons are received, the tracker sends the rest every 10 seconds. |
| **127 ~ 0** | Asset UUID | 128-bit hex | Asset tracker UUID filter<br>The default is:<br>0xF2, 0xA5, 0x2D, 0x43, 0xE0, 0xAB, 0x48, 0x9C,<br>0xB6, 0x4C, 0x4A, 0x83, 0x00, 0x14, 0x67, 0x21 |

## 6.6 Shock Detection Report Configuration

| **Bytes** | **1** | **2** |
|---|---|---|
| **Item** | Type | Shock Detection |

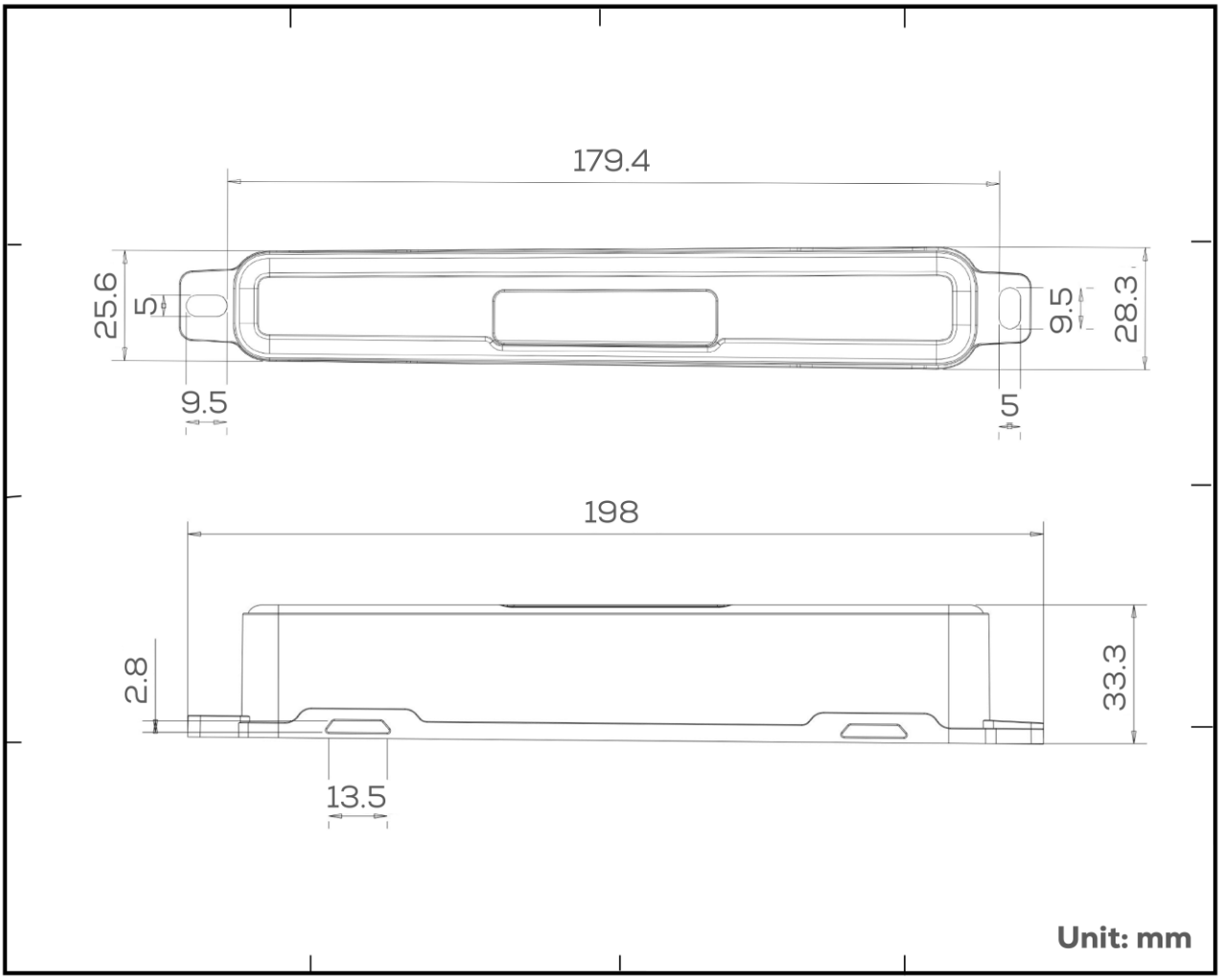
Type Field (the most significant byte)

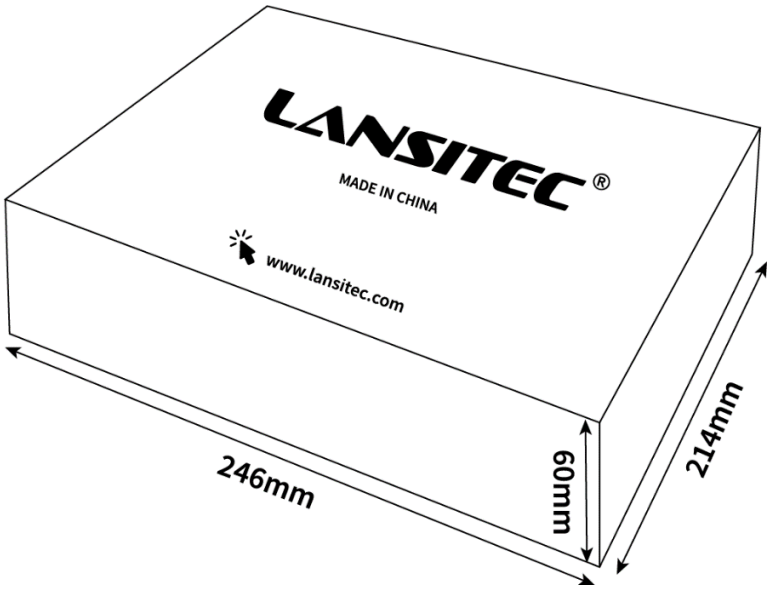
| **Bit** | **Name** | **Value** | **Description** |
|---|---|---|---|
| **7 ~ 4** | Type | 0xD | Message type<br>Bit7 is the most significant bit. |
| **3 ~ 0** | RFU | 0x0 | Reserved for future usage. |

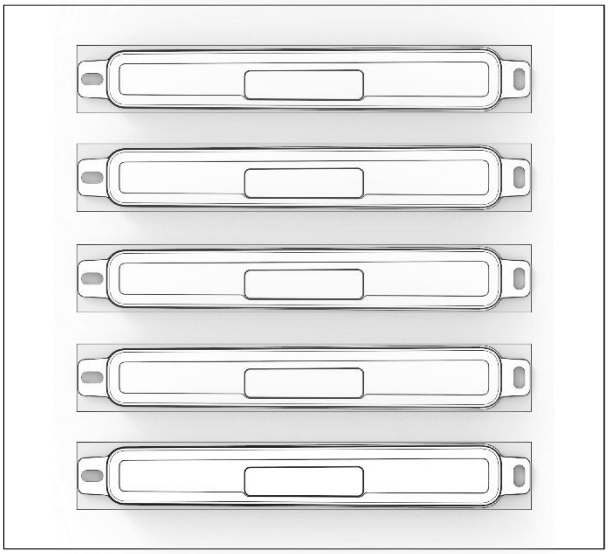
Shock Detection Field

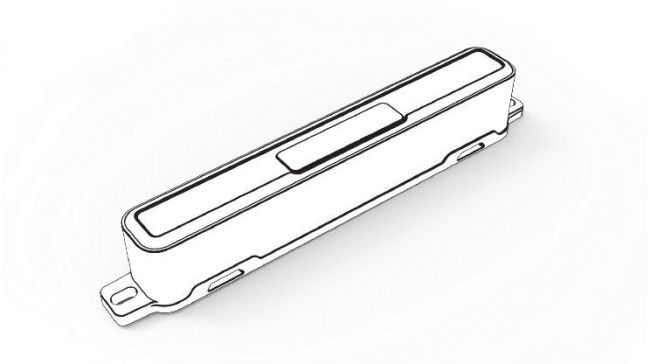
| **Bit** | **Name** | **Value** | **Description** |
|---|---|---|---|
| **7 ~ 0** | Shock Detection Threshold | 0 ~ 100 | The threshold of Shock detection.<br>The tracker checks the accelerometer once every 2secs.<br>The shock is valid only when the accelerated speed of the tracker is larger than the set threshold number.<br>The default value is 10 (0x0A, 0.1g).<br>Shock Detection threshold = (50 + value x 5) x 0.001g. |
| **7 ~ 0** | Shock Period | 0 ~ 255 | The period of shock detection report, unit 30secs, big-endian<br>0 means OFF.<br>The default is 0 (0x00). |

# 7. Packaging


179.4
25.6
5
9.5
28.3
9.5
5
198
2.8
33.3
13.5
Unit: mm


LANSITEC
MADE IN CHINA
www.lansitec.com
246mm
60mm
214mm





Each packaging box contains: Five trackers

# 8. Ordering Information

| Description | Part Number |
|---|---|
| Container Tracker, AS923, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02394 |
| Container Tracker, In865, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02702 |
| Container Tracker, EU868, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02393 |
| Container Tracker, US915, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-00160 |
| Container Tracker, RU864, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02705 |
| Container Tracker, AU915, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02706 |
| Container Tracker, KR920, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02707 |
| Container Tracker, ID920, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02708 |
| Container Tracker, CN470, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02709 |
| Container Tracker, CN470-Ali, Bluetooth5.0, GNSS, 198x28.3x33.3, 2x4000mAh | 100-02710 |

**End of document**