LW006 Smart Badge Product Specification

Version 1.2

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CONTENT

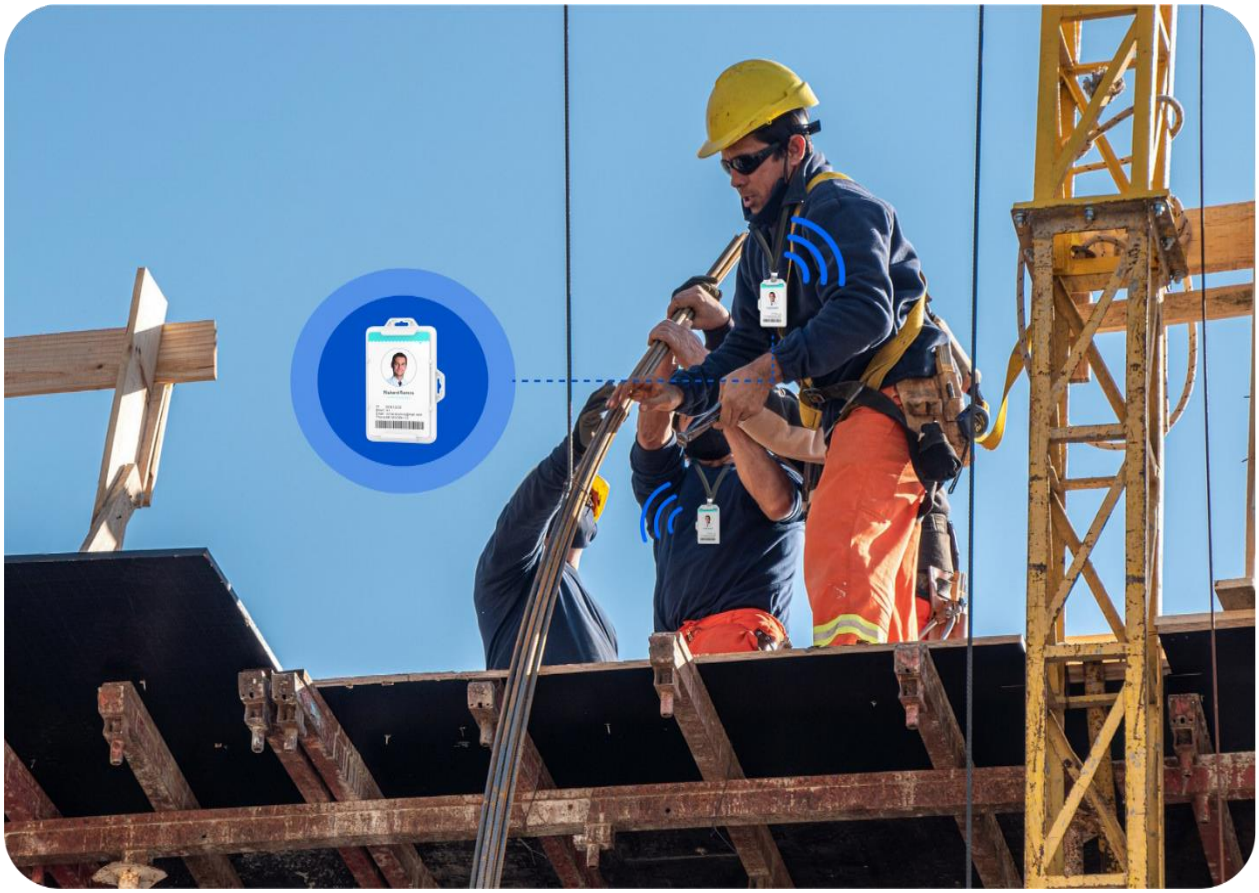
1 Product Introduction....4
2 Application Scenarios....4
3 Product Specifications....5
3.1 Appearance....5
3.2 Mechanical Size Description....6
3.3 LED Indicators and Button Operations....6
3.4 Buzzer Description....7
3.5 General Specifications....7
4 Quick Guide....8
4.1 How to Power On/Off LW006 Smart Badge....8
4.2 How to make device work quickly....9
4.3 How to enable Bluetooth connect function....9
4.4 How to connect to APP and configure parameters....10
5 General Function....10
5.1 Multiple Working Mode....10
5.1.1 Overview....10
5.1.2 Standby Mode....10
5.1.3 Timing Mode....11
5.1.4 Periodic Mode....11
5.1.5 Motion Mode....11
5.2 Auxiliary Operations....13
5.2.1 Overview....13
5.2.2 Alarm Function....13
5.2.3 Downlink for Position....14
5.2.4 Man Down Detection....14
5.3 Positioning Strategies....14
5.3.1 WIFI Fix....15
5.3.2 Bluetooth Fix....15
5.3.3 GPS Fix....16
5.3.4 Offline Fix....16
5.4 Bluetooth Broadcast Capabilities....17
5.5 LoRaWAN Capabilities....17
5.5.1 Timed Sync Command....17
5.5.2 Network Check Command....17
5.5.3 LoRa Uplink Transmission Strategy....17
5.5.4 Confirmed Message....17
5.6 3-Axis Accelerometer Capabilities....17
5.7 Local Data Sync....18
5.8 Battery Performance....18
5.8.1 Low battery Alert....18
5.8.2 Shutdown message reminder....18
5.9 Time Synchronization....18
5.10 Bluetooth Configuration Tool....19
6 Uplink Payload....19
6.1 Device Information Payload....19
6.2 Shut Down Payload....20

6.3 Heartbeat Payload 21
6.4 Low Power Payload 22
6.5 Event Payload 24
6.6 GPS Limit Payload 24
6.7 Location Payload 25
6.7.1 Location Fixed Payload 25
6.7.2 Location Failure Payload 28
7 Maintenance instruction 30
8 Revision History 31

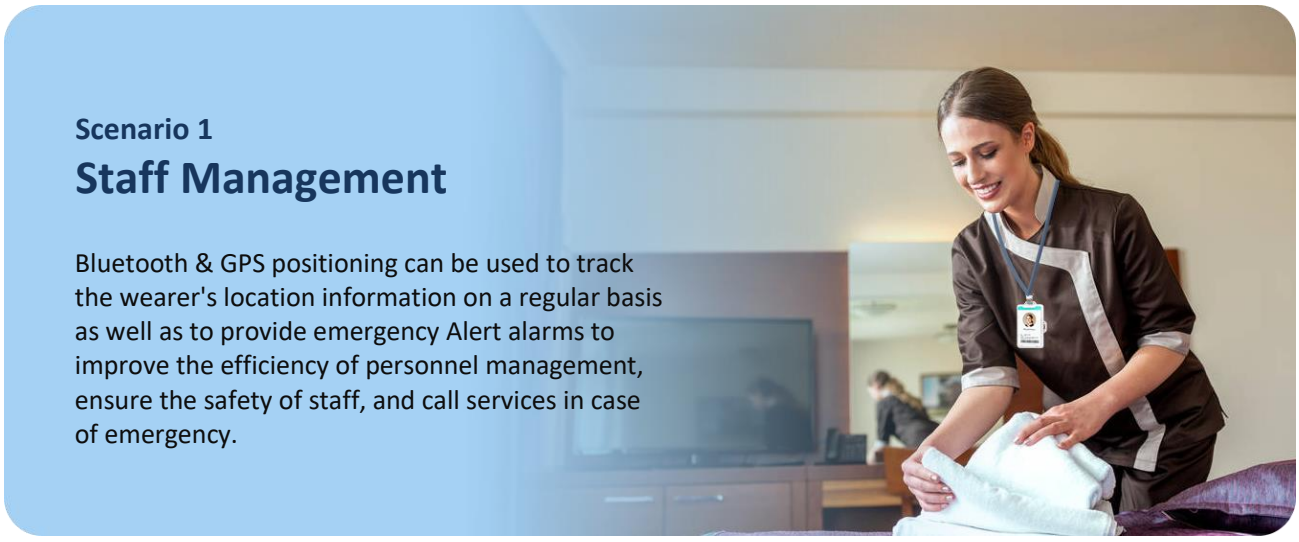
1 Product Introduction

LW006 Smart Badge, the smart badge that combines LoRaWAN network transmission with BLE, WIFI, and GPS positioning technologies.

This combination allows for reliable indoor and outdoor positioning, making it ideal for ensuring staff safety, emergency alarm capabilities, and effective personnel management.



2 Application Scenarios



Scenario 1

Staff Management

Bluetooth & GPS positioning can be used to track the wearer's location information on a regular basis as well as to provide emergency Alert alarms to improve the efficiency of personnel management, ensure the safety of staff, and call services in case of emergency.

Scenario 2

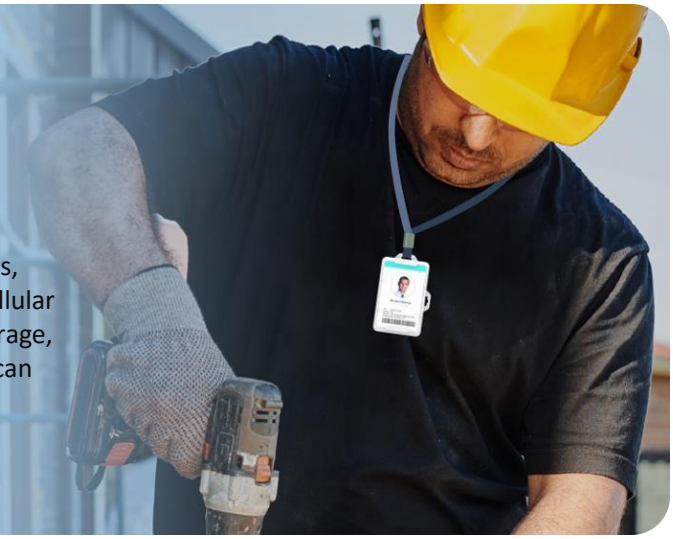
Safety management (Nursing home/convalescent home)

Using the timer mode, you can get the location information at a specific point in time to determine the situation of the personnel's activity area, in addition, you can use the alarm function and Man Down function to report an emergency situation and seek help.

Scenario 3

Construction site safety management

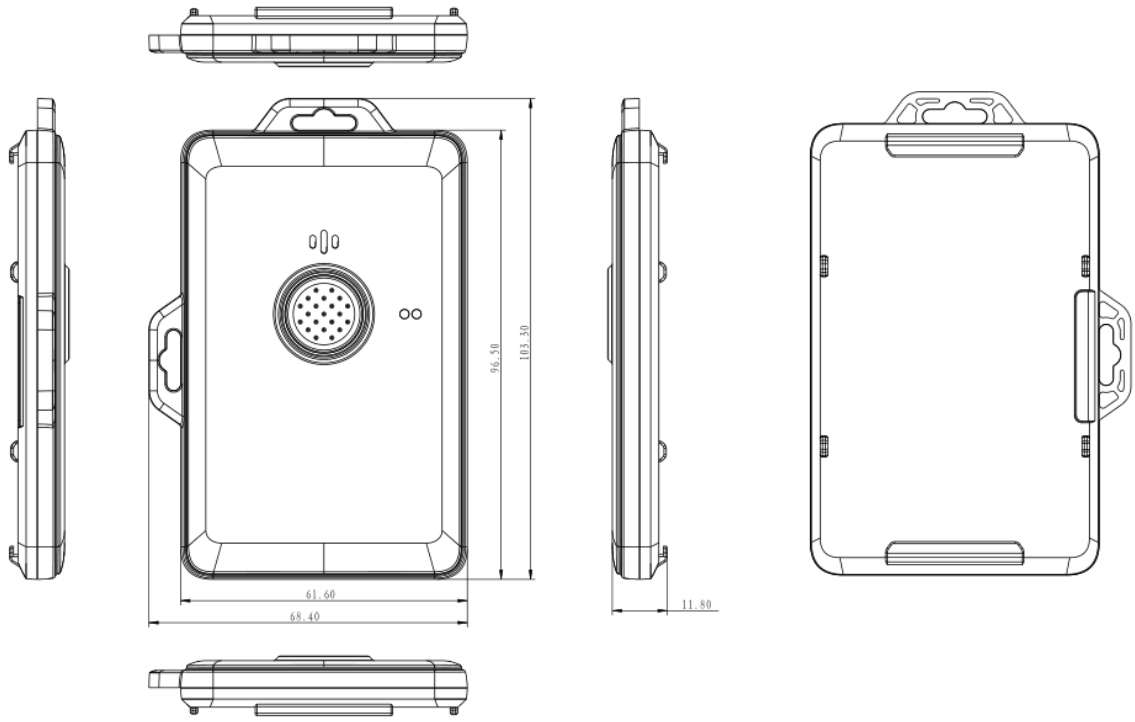
In some harsh environment sites, such as tunnels, mines, construction sites and so on. Ordinary cellular communication technology often has poor coverage, wearing the LW006 LoRaWAN smart work card can maximize the safety of personnel, providing convenient and fast emergency alarm function.



3 Product Specifications

3.1 Appearance

3.2 Mechanical Size Description



Unit: mm.

3.3 LED Indicators and Button Operations

Indicator Type	Items	LED Indicator Operation	Button Operation
Power Indicators	Turn ON	Solid Green and keep 3s	Press the power button on the back of device and hold on 3s when the device is off.
	Turn OFF	Green LED blink 3s	Press the power button and SOS button together and hold on 5s when the device is on.
	Status indication	If the device is on, Green LED will blink 1s	Single click power button
	Device In charging	Green LED blink slowly all the time	/
	Device fully charged	Solid Green until charging cable unplugged	/
	Low power	Green LED blink once every 10s	/
	Join LoRa Network Successfully	Solid Orange and keep 3s	/
	In joining LoRa Network	Orange LED blink 3s rapidly	/

Network Indicators	Network check (Link Check MAC command) function trigger	Orange LED blink 3s	/
	Bluetooth connection established successfully	Orange LED blink slowly all the time	Double click power button when the device is on can make the Bluetooth broadcast function activated again
Positioning Indicators	In positioning process	Blue LED blink slowly all the time	/
	Positioning successfully	Solid Blue and keep 2s	/
	Positioning failed	Blue LED blink 2s rapidly	/
Alarm Indicators	Alarm function is triggered	Red LED blink rapidly all the time	Corresponding button operation of alarm function
	Exit alarm	Red LED stop blink	Press the SOS button and keep 15s in default (Duration can be set to 5~15s)
All indicators	During the firmware OTA upgrade	All LEDs blink all the time	/
	Firmware OTA upgrade successfully	Solid light and keep 3s	/
	Firmware OTA upgrade failed	All LEDs blink 6s rapidly	/
	Factory reset	The three indicator lights are flashing twice one by one	Press the power button and keep 10s when device is off
	Device anomaly	All LEDs are always on	If this happens, please contact the MOKOSMART team

3.4 Buzzer Description

Items	Buzzer description	Remarks
SOS Alarm or Alert Alarm is triggered	Repeat alarm sound every 5s in default	Three alarm sound effects are available (Can be selected via MKLoRa APP)

3.5 General Specifications

Categories	Parameter	Value

LoRa Wireless Specification	LoRa Protocol	LoRaWAN V1.0.3
	Lora Frequency	EU868/AU915/US915/AS923/IN865/KR920/EU433/CN470/CN779/RU864/AS923-1/AS923-2/AS923-3/AS923-4
	Tx Power	Max 21dBm
	Sensitivity	-137dBm@SF12 300bps
	LoRa Communication Distance	Up to 7 km (in urban open space)
BLE Wireless Specification	Bluetooth® (BLE)	5.0
	TX Power	Max 8 dBm
	BLE Broadcast Distance	Up to 50m in free space
	BLE Scan Distance (1M PHY)	Up to 150m in free space
	BLE Scan Distance (Coded PHY)	Up to 300m in free space
Positioning Specification	GPS Positioning Type	Support 2 versions: Traditional GPS and Semtech LoRa Cloud
Physical Parameter	Dimension	103.3*68.4*11.8mm(Includes lugs)
	Shell Material	ABS + PC
	Weight	Around 70g
	Color	White
Power Consumption	Power Supply	1500mAH Rechargeable battery
Application Parameter	Operating Temperature	-20 ~ + 60℃
	Operating Humidity	0%-95% (No condensation)
	IP Rating	IP67
	Certification	CE/FCC/Reach/RoHS
	Other	ATEX certified version optional

4 Quick Guide

4.1 How to Power On/Off LW006 Smart Badge

- **Power On:** Long press power button for 3s at least, the device will turn on. The power LED indicator (Green) will be on for 3s.

- **Power Off:** There are 3 ways to power off the device.
  - 1. Long press the power button and SOS button together and hold on 5s at least, the device will turn off. The power LED indicator (Green) will blink for 3s.

- ✧ 2. Power off the badge via MKLoRa APP.
- ✧ 3. Power off the badge via LoRaWAN downlink command.

4.2 How to make device work quickly

Step1: Check the device information.

The LW006 Smart Badge is in OTAA mode in default, user can get device's DEVEUI and region/subnet from the label on the boxes or read back these parameters via MKLoRa APP.

Step2: Confirm the LoRaWAN network server (Such as TTN, Senet, LoRIOT, Chirpstack, AWS) to be used.

Step3: Register LoRaWAN gateway on LoRaWAN network server. If the gateway model is MKGW2-LW which is from MOKO, pls refer to *MOKO LoRaWAN Gateway MKGW2-LW Configuration Guide*.

Step4: Register the device on LoRaWAN network server (OTAA mode).

The region/subnet and DEVEUI can be get on Step1.

Note: *When you use the US915 or AU915 band, the default FSB of the device is FSB2 (CH:8~15).*

And the default AppEUI of device is 70 B3 D5 7E D0 02 6B 87, the default AppKey of device is 2B 7E 15 16 28 AE D2 A6 AB F7 15 88 09 CF 4F 3C.

Step5: Join in LoRaWAN network server.

Please reboot the device, then device will send join request to LoRaWAN server automatically, then you can check the uplink payload on LoRaWAN server.

Step6: Uplink payload parse.

Option 1: You can refer to *chapter 6 Uplink Payload*, here is the description of the payload parsing rules and samples parsing.

Option 2: MOKOSMART can provide payload decoder code based on some common LoRaWAN network servers.

4.3 How to enable Bluetooth connect function

The device can make a Bluetooth broadcast and can be connected in the following three cases.

1. Within the first N minutes after the device is turned back on.

2. Double click the power button when the device is on.

2. LoRaWAN server sends LoRa command to turn on Bluetooth broadcast for N minutes.

Note: *N is the broadcast timeout duration which can be set via MKLoRa APP, the unit is s, can be configured by the user. If the device is successfully connected and then disconnected, the broadcast timeout will be refreshed, and the user can choose to establish Bluetooth connection with the device again within this time.*

4.4 How to connect to APP and configure parameters

Please download "MKLoRa" APP from app store directly. For more configuration details, please refer to *LW006 Smart Badge APP Guide*.

5 General Function

5.1 Multiple Working Mode

5.1.1 Overview

LW006 Smart Badge supports four different working modes: *Standby Mode*, *Timing Mode*, *Periodic Mode* and *Motion Mode*. The device will be in *Periodic Mode* by default when it is first switched on.

LW006 Smart Badge can only be in one mode at the same time, and the user can use the mobile app or LoRaWAN downlink command to switch the working mode.

No matter what mode the device is, *Heartbeat Payload* will be sent according to *Heartbeat Interval* (The *Heartbeat interval* can be set by user). If other uplink payload is sent during the *Heartbeat Interval*, the *Heartbeat Interval* will be recalculated with the uplink time point of that payload.

Along to the main working mode, LW006 can perform extra operations known as *Auxiliary Operations*.

Note: *When the device is switched between working modes, the device will start one time positioning process and report corresponding payload, regardless of the mode switched to, including standby mode.*

5.1.2 Standby Mode

In *Standby Mode*, the device will only report *Heartbeat Payload* according to *Heartbeat Interval* and will not send the *Location Payload* which includes device's positions except working mode switching.

If location information is needed in *Standby Mode*, user can use *Downlink for Position* (one of

Auxiliary Operations) to get the *location payload*.

In additional, the user can also enable other auxiliary operations to achieve the corresponding functions. (*Refer to 5.2 Auxiliary Operations*)

5.1.3 Timing Mode

In *Timing Mode*, LW006 will report *Location Payload* at the time point configured in advance.

We divided the day into 96 time points, each 15 minutes apart, with the first time point being 00:00. Each LW006 can set up to 10 reporting time points.

User can select different *Positioning Strategies* for *Timing Mode* to obtain location information according to different application scenarios.

User also can use *Downlink for Position* (one of *Auxiliary Operations*) to get the extra *location payload*.

In additional, the user can also enable other auxiliary operations to achieve the corresponding functions. (*Refer to 5.2 Auxiliary Operations*)

5.1.4 Periodic Mode

In *Periodic Mode*, LW006 will report its positions periodically. The report interval can be set by user.

User can select different *Positioning Strategies* for *Periodic Mode* to obtain location information according to different application scenarios.

User also can use *Downlink for Position* (one of *Auxiliary Operations*) to get the extra *location payload*.

In additional, the user can also enable other auxiliary operations to achieve the corresponding functions. (*Refer to 5.2 Auxiliary Operations*)

5.1.5 Motion Mode

When the LW006 is in motion mode, it can monitor the whole process of the LW006 from stationary to motion and from motion to stationary through the built-in 3-axis accelerometer sensor.

The whole motion process can be divided into four parts: *Start of movement*, *In movement*, *End of movement*, *Stationary*.

5.1.5.1 Start of movement

LW006 detects whether the device is moving by 3-axis accelerometer sensor, and if the preset

moving judgment condition (*Motion Threshold* & *Motion Duration*) is reached, the device is considered to start moving and start positioning.

When the positioning process is finished, LW006 will send *Location Payload*. User can choose to send this payload repeatedly. The number of repetitions can be set by user.

User can select different *Positioning Strategies* for *start of movement* to obtain location information according to different application scenarios.

***Note:** User can choose whether to report Location Payload or not at start of movement.*

5.1.5.2 In movement

After *start of movement*, LW006 will be *in movement* state.

LW006 will send *Location Payload* periodically during the movement.

User can select different *Positioning Strategies* for *in movement* to obtain location information according to different application scenarios.

***Note:** User can choose whether to report Location Payload or not in movement.*

5.1.5.3 End of movement

The LW006 detects whether the device is still moving by 3-axis accelerometer sensor. If the device never reaches the movement trigger condition within N seconds, the device is considered to have stopped moving and started positioning immediately. When the positioning process is finished, LW006 will send 1st *Location Payload*.

LW006 can report multiple different *Location Payloads*, the number of *Location Payloads* and the interval between *Location Payloads* can be set by user.

User can select different *Positioning Strategies* for *End of movement* to obtain location information according to different application scenarios.

***Note:** User can choose whether to report Location Payload or not at End of movement.*

5.1.5.4 Stationary

After the last *Location Payload* of *End of movement* was sent, the device will come into *Stationary* state.

When the device is in *Stationary state*. The device will continue to report *Location Payload* at longer intervals which can be set by user.

5.1.5.5 Event Message

Event messages are notifications sent by LW006 to inform the server about a specific event when the device is in *Motion Mode*.

There are three types of event message notifications that can be activated:

Event message at *start of movement*: Event message will be sent when the preset moving trigger condition (*Motion Threshold* & *Motion Duration*) is reached.

Event message *During the movement*: When the device is *in movement*, Event messages will be sent whenever the device starts positioning.

Event message at *End of movement*: Event message will be sent when the device come into *End of movement* state.

***Note**: All the above three events can be set individually to send or not to send event messages.*

5.2 Auxiliary Operations

5.2.1 Overview

Whatever the working mode, the LW006 supports *Auxiliary Operations*, which can be:

- Alarm Function
- Downlink for Position
- Man Down Detection

***Note:** Priority Description (Alarm function >Man Down Detection> Downlink for Position).*

5.2.2 Alarm Function

LW006 supports two alarm types: One is *Alert alarm*, another one is *SOS alarm*.

Users can choose the alarm type according to the actual application scenario, but the device can only choose one alarm type at the same time.

Alert alarm: When users encounter general emergencies or need to make special notifications, the alarm is triggered by pressing the emergency button, which sends the positioning data to the server once and notifies the background to arrange personnel to deal with it in time, then device will exit alarm state automatically.

SOS alarm: When the user encounters an emergency, the alarm is triggered by pressing the emergency button, which continuously sends the positioning data to the server to notify the background to arrange personnel to deal with the emergency in time to ensure the safety and health of the personnel till the alarm state is stopped by button or LoRaWAN downlink command.

Users can choose different ways to trigger the alarm function, such as long press or click the button, detailed setting items can be seen in *LW006 Smart Badge APP Guide.*

By default, the user can exit the alarm by pressing and holding the SOS button for 15s (Can be set in range of 5~15s via MKLoRa APP).

5.2.2.1 Alarm Event Message

To let customers clearly know the start time and the end time of the alarm, LW006 also support alarm event message function.

When the alarm starts, the event payload will be reported immediately, telling the customer that the alarm has started.

When the alarm ends, the event payload will be reported immediately to tell the customer that the alarm is over.

5.2.3 Downlink for Position

When the Downlink for Position is used, LW006's position can be requested via LoRa downlink command. (*Refer to Document "LW006 Smart Badge Downlink Command"*)

User can select different *Positioning Strategies* for this function to obtain location information according to different application scenarios.

5.2.4 Man Down Detection

The LW006's built-in three-axis sensor can detect whether the person who wear LW006 or is stationary for a long time.

If the preset Man Down detection condition is reached, LW006 will report the *Location Payload with a faster reporting frequency* to remind the user to handle the exception.

When the elderly wear LW006 during daytime hours, if the elderly encounters an emergency and do not move for a long time, they can use this function to deal with the abnormal situation in time.

5.2.4.1 Man Down Event Message

When the device comes into Man down state, *Event Message Payload* will be reported immediately.

When the device comes exits Man down state, *Event Message Payload* will be reported immediately.

5.3 Positioning Strategies

The device can set the corresponding positioning strategy in periodic mode, timing mode, and motion mode.

In addition, *Downlink for Position* can also set a separate positioning strategy, which can be different from the positioning strategy in the working mode.

LW006 has the following main positioning strategies:

- Only WIFI: Only WIFI scans are used for position determination.
- Only Bluetooth: Only Bluetooth scans are used for position determination.
- Only GPS: Only GPS is used for position determination.
- WIFI+GPS: WIFI then GPS if WIFI fails in one geolocation cycle.
- Bluetooth+GPS: Bluetooth then GPS if Bluetooth fails in one geolocation cycle.
- WIFI+Bluetooth: WIFI then Bluetooth if WIFI fails in one geolocation cycle.
- WIFI+Bluetooth +GPS: Use WIFI, Bluetooth, GPS for positioning in turn (switch to the next type of positioning after one type of positioning fails).

5.3.1 WIFI Fix

LW006 obtains the surrounding hotspot information through WIFI scanning function and reports the MAC address of device and the corresponding RSSI to the server through LoRa, and the application server goes to calculate the location, the accuracy of positioning depends on the actual deployment of the customer and the calculation of the location algorithm.

The success of WIFI positioning depends on the WIFI location scan time and the number of BSSIDs. the time of WIFI scan and the number of BSSIDs thresholds can be set by the user.

Note: *The WIFI scanning function of the LW006 is implemented through the LR1110 location chip, and users can choose to upload WIFI location data directly to the LoRa Cloud service or report it routinely.* LoRa Cloud

5.3.2 Bluetooth Fix

LW006 obtains the broadcast information of surrounding Bluetooth devices through Bluetooth scanning function, and reports the information (MAC address and RSSI) of Bluetooth devices that meet the conditions of Bluetooth filtering to the server through LoRa, and the application server goes to calculate the location, the accuracy of positioning depends on the actual deployment of the customer and the calculation of the location algorithm.

The following BLE Beacon types are supported for scanning：

- iBeacon (Apple)
- Eddystone (Google)
- The Moko-defined beacons
- Unknown (For example, a beacon manufacturer-defined format)

The success of Bluetooth positioning depends on the Bluetooth location scan time and Bluetooth device count threshold. The Bluetooth scan time and Bluetooth device count thresholds can be set by the user.

5.3.2.1 Filtering Rules

LW006 supports multiple data filtering methods to help you easily obtain target beacon data:

- Filter by RSSI, MAC address, advertising name and advertising raw data
- Filter out duplicate data: Only one piece of Bluetooth data is reported for beacons with the same MAC address in one Bluetooth fix period.

Detailed setup instructions can be found in *LW006 Smart Badge APP guide*.

5.3.3 GPS Fix

LW006 can obtain the corresponding positioning satellite information to Calculate the location of the product.

When the device successfully obtains the location information, it will enter the sleep mode, and the location information will be reported at the reporting time point, and the reporting content will include the successful positioning time point, so that the location trajectory analysis can be performed.

The LW006 supports both traditional GPS positioning and LoRa Cloud positioning.

The default is traditional GPS positioning.

5.3.3.1 Traditional GPS Fix

Traditional GPS positioning (Built-in independent GPS positioning module), positioning data acquisition is simpler and does not require additional integration with LoRa Cloud services.

5.3.3.2 LoRa Cloud GPS Fix

Built-in LR1110 positioning chip to achieve GPS positioning function (With LoRa Cloud), lower power consumption, longer battery life.

Note: *The GPS positioning function of the LW006 is implemented through the LR1110 location chip, and users can choose to upload GPS location data directly to the LoRa Cloud service or report it routinely.* LoRa Cloud

5.3.4 Offline Fix

The user can choose to still locate the device even if it is not successfully connected to the LoRaWAN network, and save the location information in the device. Customer can later read the local data via Bluetooth or LoRa downlink to restore the historical location information of that time period.

Offline fix function can be switched on/off by MKLoRa app or LoRaWAN downlink command.

5.4 Bluetooth Broadcast Capabilities

The device can make a Bluetooth broadcast and can be connected in the following two cases.

1. Within the first N minutes after the device is turned back on.

2. LoRaWAN server sends LoRa command to turn on Bluetooth broadcast for N minutes.

Note: *N is the broadcast timeout time, the unit is s, can be configured by the user. If the device is successfully connected and then disconnected, the broadcast timeout will be refreshed, and the user can choose to establish Bluetooth connection with the device again within this time.*

5.5 LoRaWAN Capabilities

The data of LW006 will be transmitted via LoRa and LW006 is based on the standard LoRaWAN protocol V1.0.3.

LW006 series are compatible with mainstream gateways and mainstream servers (TTN, AWS, SENET, LORIOT, etc.) in the market.

5.5.1 Timed Sync Command

DeviceTimeReq MAC Command: LW006 supports the DeviceTime feature, which enables users to periodically time their devices to avoid time offset. The *Time Sync Interval* of the MKLoRa APP is the Device Time MAC Command interval. (Please refer to *LW006 Smart Badge APP Guide*)

5.5.2 Network Check Command

LinkCheckReq MAC Command: LW006 supports the LinkCheck feature, which enables users to periodically check the network connection status. The *Network Check Interval* of the MKLoRa APP is the LinkCheck MAC Command interval. (Please refer to *LW006 Smart Badge APP Guide*)

5.5.3 LoRa Uplink Transmission Strategy

Considering the load balance of the gateway, the battery power consumption and the reliability of the messages, the LW006 is equipped with a LoRa uplink mechanism for users to choose, so that users can select a suitable sending strategy according to different application scenarios.

5.5.4 Confirmed Message

The product supports confirmed message type for uplink payload. User can select confirmed message type via MKLoRa APP.

If the device doesn't receive a reply from the server for uplink payload, the device will automatically retransmit the uplink payload, the maximum number of retransmissions for uplink payload can be set by the customer via MKLoRa APP.

5.6 3-Axis Accelerometer Capabilities

With the built-in three-axis sensor, the device can achieve *Man Down Detection* and motion detection in *Motion Mode*.

Moving judgment condition (*Motion Threshold* & *Motion Duration*): If LW006 exceeds the *Motion Threshold* and continues for a period of time (*Motion Duration)*, LW006 will be considered to have reached the moving judgment condition.

5.7 Local Data Sync

LW006 Built-in 4M FLASH memory chip, can support 20,000 pieces of data local storage at most. All data uploaded by the device is stored in the device.

Users can read data of the past 1 day, 7 days, 1 month, 3 months, 6 months, 1 year or custom days via Bluetooth or downlink command.

When the LoRaWAN network has problems or data loss is severe, users can quickly get the historical reporting data from the device.

5.8 Battery Performance

The LW006 is equipped with 1100mAH rechargeable battery.

5.8.1 Low battery Alert

When LW006's battery level is low, its power indicator will flash every 10s and it will report *Low Power Payload (With low power prompt)* to the server as a prompt.

Note: *User can also choose not to blink the LEDs and not to report the Low Power Payload when battery is low.*

Note: *Low battery threshold can be to set 10%,20%,30%,40%,50% or 60%.*

5.8.2 Shutdown message reminder

LW006 supports sending the *shutdown payload* as a notification when the device is turned off. Users can also choose to turn off this feature.

Note: If the battery is suddenly disconnected or pulled out, the device cannot send the shutdown payload.

5.9 Time Synchronization

There are three methods to sync time of LW006.

1. LW006 supports the DeviceTimeReq MAC Command, which enables users to periodically time their devices to avoid time offset.

2.When the APP connect with the device success the phone system time will be sync to the device via Bluetooth.

3. Time synchronization via GPS satellite (Traditional GPS Fix only).

5.10 Bluetooth Configuration Tool

The device can use MKLoRa app developed by MOKO for quick OTA upgrades and parameter configuration.

About the detail of MKLoRa, pls refer to ***LW006 Smart Badge APP Guide***.

6 Uplink Payload

6.1 Device Information Payload

Device Information Payload will be sent in Port 1.

Byte Index	Content
Byte 0	Battery Level
Byte 1	Temperature (MCU Temperature)
Byte 2	Firmware Version
Byte 3	Hardware Version
Byte 4	Current Working Mode
Byte 5	Current Auxiliary Operation

Battery Level: Convert to binary.

- ✧ Bit 7 (00 means device isn't in charging; 01 device is in charging)
- ✧ Bit 0 ~ Bit 6 (Convert to decimal, the unit is %. It is the current battery level)

Temperature: Temperature measured in the device, it is the temperature of MCU, expressed in degree Celsius.

Encoder rule: If the value > 128, convert to decimal and then minus 256, the unit is ℃;
If the value <=128, just convert to decimal, the unit is ℃.

Example 1: The original data of payload is 1C, the temperature is 28℃.
Example 2: The original data of payload is E6, the temperature is -26℃.

Firmware Version: Firmware version of the device.

FW version

Bit Index	Content
Bit 6~7	Major version number: 01 means V 1.X.X
Bit 4~5	Sub-version number: 02 means V X.2.X
Bit 0~3	Patch:0101 means V X.X.5

Example 1: If the data of FW version is 0x43, it means that the FW version is V1.0.3

Hardware Version: Firstly, convert to 8-bit binary number. Example: 0x23 is 0010 0011 in binary number, 0010 equals to 2, 0011 equals to 3, so the hardware version is V 2.3

Current Working Mode: Convert to decimal.
0 means standby mode;
1 means timing mode;
2 means periodic mode;
3 means stationary state in motion mode;
4 means start of movement in motion mode;
5 means in movement for motion mode;
6 means end of movement in motion mode

Current Auxiliary Operation: Convert to decimal.
0 means no auxiliary operation;
1 means downlink for position;
2 means Man Down status;
3 means Alert alarm;
4 means SOS alarm

6.2 Shut Down Payload

Shut Down Payload will be sent in Port 2.

Byte Index	Content
Byte 0	Battery Level
Byte 1	Temperature (MCU Temperature)
Byte 2~5	Timestamp
Byte 6	Time Zone
Byte 7	Current Working Mode
Byte 8	Current Auxiliary Operation
Byte 9	Shut Down Type

Battery Level:

Convert to binary.

- ✧ Bit 7 (00 means device isn't in charging; 01 device is in charging)
- ✧ Bit 0 ~ Bit 6 (Convert to decimal, the unit is %. It is the current battery level)

Temperature: Temperature measured in the device, it is the temperature of MCU, expressed in degree Celsius.

Encoder rule: If the value > 128, convert to decimal and then minus 256, the unit is ℃;
If the value <=128, just convert to decimal, the unit is ℃.

Example 1: The original data of payload is 1C, the temperature is 28℃.
Example 2: The original data of payload is E6, the temperature is -26℃.

Timestamp: Standard UTC time.

Time zone: It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone.

Current Working Mode: Convert to decimal.
0 means standby mode;
1 means timing mode;
2 means periodic mode;
3 means stationary state in motion mode;
4 means start of movement in motion mode;
5 means in movement for motion mode;
6 means end of movement in motion mode

Current Auxiliary Operation: Convert to decimal.
0 means no auxiliary operation;
1 means downlink for position;
2 means Man Down status;
3 means Alert alarm;
4 means SOS alarm

Shut Down Type: The reason of power off. 00 means Bluetooth command or App; 01 means LoRaWAN Command; 02 means power button; 03 means battery run out.

6.3 Heartbeat Payload

Heartbeat Payload will be sent in Port 3.

Byte Index	Content
Byte 0	Battery Level
Byte 1	Temperature (MCU Temperature)
Byte 2~5	Timestamp
Byte 6	Time Zone
Byte 7	Current Working Mode
Byte 8	Current Auxiliary Operation

Battery Level: Convert to binary.

- ✧ Bit 7 (00 means device isn't in charging; 01 device is in charging)
- ✧ Bit 0 ~ Bit 6 (Convert to decimal, the unit is %. It is the current battery level)

Temperature: Temperature measured in the device, it is the temperature of MCU, expressed in degree Celsius.

Encoder rule: If the value > 128, convert to decimal and then minus 256, the unit is ℃;
If the value <=128, just convert to decimal, the unit is ℃.

Example 1: The original data of payload is 1C, the temperature is 28℃.
Example 2: The original data of payload is E6, the temperature is -26℃.

Timestamp: Standard UTC time.

Time zone: It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone.

Current Working Mode: Convert to decimal.
0 means standby mode;
1 means timing mode;
2 means periodic mode;
3 means stationary state in motion mode;
4 means start of movement in motion mode;
5 means in movement for motion mode;
6 means end of movement in motion mode

Current Auxiliary Operation: Convert to decimal.
0 means no auxiliary operation;
1 means downlink for position;
2 means Man Down status;
3 means Alert alarm;
4 means SOS alarm

6.4 Low Power Payload

Low Power Payload will be sent in Port 4.

Byte Index	Content
Byte 0	Battery Level
Byte 1	Temperature (MCU Temperature)
Byte 2~5	Timestamp
Byte 6	Time Zone
Byte 7	Current Working Mode
Byte 8	Current Auxiliary Operation

Byte 9	Low Power Prompt percent

Battery Level: Convert to binary.

- ✧ Bit 7 (00 means device isn't in charging; 01 device is in charging)
- ✧ Bit 0 ~ Bit 6 (Convert to decimal, the unit is %. It is the current battery level)

Temperature: Temperature measured in the device, it is the temperature of MCU, expressed in degree Celsius.

Encoder rule: If the value > 128, convert to decimal and then minus 256, the unit is ℃;
If the value <=128, just convert to decimal, the unit is ℃.

Example 1: The original data of payload is 1C, the temperature is 28℃.
Example 2: The original data of payload is E6, the temperature is -26℃.

Timestamp: Standard UTC time.

Time zone: It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone.

Current Working Mode: Convert to decimal.
0 means standby mode;
1 means timing mode;
2 means periodic mode;
3 means stationary state in motion mode;
4 means start of movement in motion mode;
5 means in movement for motion mode;
6 means end of movement in motion mode

Current Auxiliary Operation: Convert to decimal.
0 means no auxiliary operation;
1 means downlink for position;
2 means Man Down status;
3 means Alert alarm;
4 means SOS alarm

Low Power Prompt Percent: When the battery is less than or equal to low power prompt battery percent, the green LED will flash once every 10 seconds. Convert to decimal, the unit is %.

6.5 Event Payload

Event Payload will be sent in Port 5.

Byte Index	Content
Byte 0	Battery Level
Byte 1~4	Timestamp
Byte 5	Time Zone
Byte 6	Event Type

Battery Level: Convert to binary.

- ✧ Bit 7 (00 means device isn't in charging; 01 device is in charging)
- ✧ Bit 0 ~ Bit 6 (Convert to decimal, the unit is %. It is the current battery level)

Timestamp: Standard UTC time.

Time zone: It is a signed number, convert to decimal, then then divide by 2, and this is UTC time zone.

Event type:

0x00 -- Start of movement
0x01 -- In movement
0x02 -- End of movement
0x03 -- Come into Man Down status
0x04 -- Exit Man Down status.
0x05 -- Start SOS alarm
0x06 -- SOS alarm exit
0x07 -- Start alert alarm
0x08 -- Alert alarm exit
0x09 -- Notify of ephemeris update start
0x0A -- Notify of ephemeris update end
0x0B -- Uplink Payload triggered by downlink message

6.6 GPS Limit Payload

GPS Limit Payload will be sent in Port 6.

Byte Index	Bit Index	Content
Byte 0~1	Bit 0~11	Age
	Bit 12~15	Positioning type

Byte 2~5	/	Longitude
Byte 6~9	/	Latitude
Byte 10	/	PDOP

Age: Convert to decimal, the unit is S. Time difference between the time of successful GPS positioning and the time of reporting. If the age is 100s, the report timestamp is 10:30:20 am, so the timestamp of successful GPS positioning is 10:28:40 am.

Positioning Type:
0x00 – Working mode positioning
0x01 – Man Down positioning
0x02 – Downlink for positioning
0x03 – Alert alarm positioning
0x04 – SOS alarm positioning

Latitude and Longitude encoder rule: Big-Endian format. It is a singed number.
If the value > 0x80 00 00 00, minus 0x01 00 00 00 00 and convert to decimal, then divide by 10 00 00 00, the unit is degree (°);
If the value<=0x80 00 00 00, convert to decimal and then divide by 10 00 00 00, the unit is degree (°);

PDOP encoder rule: Convert to decimal and divide by 10.

6.7 Location Payload

Depending on whether the positioning process is successful or not, there are two types location payloads: Location Fixed Payload and Location Failure Payload.

6.7.1 Location Fixed Payload

Location Fixed Payload will be sent in Port 8.

Byte Index	Bit Index	Content
Byte 0	/	Battery Level
Byte 1~2	/	Age
Byte 3	Bit 4~7	Positioning type
	Bit 0~3	Positioning success type

Byte 4	Bit 4~7	Current working mode
	Bit 0~3	Current auxiliary operation
Byte 5	/	The length of positioning data
Byte 6~XX	/	Positioning data

Battery Level: Convert to binary.

- ✧ Bit 7 (00 means device isn't in charging; 01 device is in charging)
- ✧ Bit 0 ~ Bit 6 (Convert to decimal, the unit is %. It is the current battery level)

Age: Convert to decimal, the unit is S. Time difference between the time of successful GPS positioning and the time of reporting. If the age is 100s, the report timestamp is 10:30:20 am, so the timestamp of successful GPS positioning is 10:28:40 am.

Positioning Type:
0x00 – Working mode positioning
0x01 – Man Down positioning
0x02 – Downlink for positioning
0x03 – Alert alarm positioning
0x04 – SOS alarm positioning

Positioning Success Type:

00 -- WIFI positioning success (Customized Format)
01 -- Bluetooth positioning success
02 -- GPS positioning success (LoRa Cloud Customized Format)
03 -- GPS positioning success (Traditional GPS Positioning)
04 -- WIFI positioning success (LoRa Cloud DAS Format, the positioning date would be upload to LoRa Cloud)
05 -- GPS positioning success (LoRa Cloud DAS Format, the positioning date would be upload to LoRa Cloud)

Current Working Mode: Convert to decimal.
0 means standby mode;
1 means timing mode;
2 means periodic mode;
3 means stationary state in motion mode;
4 means start of movement in motion mode;
5 means in movement for motion mode;
6 means end of movement in motion mode

Current Auxiliary Operation: Convert to decimal.
0 means no auxiliary operation;
1 means downlink for position;
2 means Man Down status;
3 means Alert alarm;
4 means SOS alarm

The length of location fixed data: Convert to decimal. The unit is Bytes.

Location fixed data:

0. If positioning success type is 00 WIFI positioning success (Customized Format), the location data is as below:

WIFI Location Fixed Data					
Byte 0~5	Byte 6	Byte 7~12	Byte 13	……..	……
MAC address of WIFI device 1	RSSI of WIFI device 1	MAC address of WIFI device 2	RSSI of WIFI device2	……..	……..

The number of reported WIFI devices can be set by the customer.
RSSI encoded rule: Convert to decimal and then minus 256, the unit is dBm.

1. If positioning success type is 01(Bluetooth positioning success), the location data is as below:

Bluetooth Location Fixed Data					
Byte 0~5	Byte 6	Byte 7~12	Byte 13	……..	……..
MAC address of Bluetooth device 1	RSSI of Bluetooth device 1	MAC address of Bluetooth device 2	RSSI of Bluetooth device 2	……..	……..

The number of reported Bluetooth devices can be set by the customer.
RSSI encoded rule: Convert to decimal and then minus 256, the unit is dBm.

2. If positioning success type is 02 -- GPS positioning success (LoRa Cloud Customized Format) , the location data is in streaming formats, need to be parsed by LoRa Cloud rule.

3. If positioning success type is 03 -- GPS positioning success (Traditional GPS Positioning) , the location data is as below:

GPS Location Fixed Data		
Byte 0~3	Byte 4~7	Byte 8
Latitude	Longitude	PDOP

Latitude and Longitude encoder rule: Big-Endian format. It is a singed number.
If the value > 0x80 00 00 00, minus 0x01 00 00 00 00 and convert to decimal, then divide by 10 00 00 00, the unit is degree (°);
If the value<=0x80 00 00 00, convert to decimal and then divide by 10 00 00 00, the unit is degree (°);

PDOP encoder rule: Convert to decimal and divide by 10.

4. If positioning success type is 04 -- WIFI positioning success (LoRa Cloud DAS Format, the positioning date would be upload to LoRa Cloud), the location data is empty in this payload.

5. If positioning success type is 05 -- GPS positioning success (LoRa Cloud DAS Format, the positioning date would be upload to LoRa Cloud), the location data is empty in this payload.

6.7.2 Location Failure Payload

Location Failure Payload will be sent in Port 9.

Byte Index	Content
Byte 0	Battery Level
Byte 1	Positioning type
Byte 2	Current working mode
Byte 3	Current auxiliary operation
Byte 4	Reasons for positioning failure
Byte 5	The length of location failure data
Byte 6~XX	Location failure data

Battery Level: Convert to binary.

- ✧ Bit 7 (00 means device isn't in charging; 01 device is in charging)
- ✧ Bit 0 ~ Bit 6 (Convert to decimal, the unit is %. It is the current battery level)

Positioning Type:
0x00 – Working mode positioning
0x01 – Man Down positioning
0x02 – Downlink for positioning
0x03 – Alert alarm positioning
0x04 – SOS alarm positioning

Current Working Mode: Convert to decimal.
0 means standby mode;
1 means timing mode;
2 means periodic mode;
3 means stationary state in motion mode;
4 means start of movement in motion mode;
5 means in movement for motion mode;
6 means end of movement in motion mode

Current Auxiliary Operation: Convert to decimal.
0 means no auxiliary operation;
1 means downlink for position;
2 means Man Down status;

3 means Alert alarm;
4 means SOS alarm

Reasons for positioning failure:
00 -- WIFI positioning time is not enough (The location payload reporting interval is set too short, please increase the report interval of the current working mode via MKLoRa app)
01 -- WIFI positioning strategies timeout (Please increase the WIFI positioning timeout via MKLoRa app)
02 – Bluetooth broadcasting in progress causes WIFI location failure (Please reduce the Bluetooth broadcast timeout or avoid Bluetooth positioning when Bluetooth broadcasting in process via MKLoRa app)
03 -- Bluetooth positioning time is not enough (The location payload reporting interval is set too short, please increase the report interval of the current working mode via MKLoRa app)
04 -- Bluetooth positioning strategies timeout (Please increase the Bluetooth positioning timeout via MKLoRa app)
05 -- Bluetooth broadcasting in progress (Please reduce the Bluetooth broadcast timeout or avoid Bluetooth positioning when Bluetooth broadcasting in process via MKLoRa app)
06 -- GPS positioning timeout (Pls increase GPS positioning timeout via MKLoRa app)
07 -- GPS positioning time is not enough (The location payload reporting interval is set too short, please increase the report interval of the current working mode via MKLoRa app)
08 -- GPS aiding positioning timeout (Please adjust GPS autonomous latitude and autonomous longitude)
09 -- The ephemeris of GPS aiding positioning is too old, need to be updated.
0A – PDOP limit (Please increase the PDOP value via MKLoRa app)
0B -- Interrupted positioning at *start of movement* (the movement ends too quickly, resulting in not enough time to complete the positioning)
0C -- Interrupted positioning at *end of movement* (the movement restarted too quickly, resulting in not enough time to complete the positioning)
0D -- Interrupted by *Man Down Detection State*
0E -- Interrupted by *Downlink for Position*
0F -- Interrupted by *Alarm Function*

The length of location failure data: Convert to decimal. The unit is Bytes.

Location failure data:

If it is WIFI positioning failure, the location data is as below:

WIFI Location Failure Data					
Byte 0~5	Byte 6	Byte 7~12	Byte 13	……..	……..
MAC address of WIFI device 1	RSSI of WIFI device 1	MAC address of WIFI device 2	RSSI of WIFI device2	……..	……..

The information of the scanned WIFI devices will be reported.
RSSI encoded rule: Convert to decimal and then minus 256, the unit is dBm.

If it is Bluetooth positioning failure, the location data is as below:

Bluetooth Location Failure Data					
Byte 0~5	Byte 6	Byte 7~12	Byte 13	……..	……
MAC address of	RSSI of Bluetooth	MAC address of	RSSI of Bluetooth	……..	……

Bluetooth device 1	device 1	Bluetooth device 2	device 2		

The information of the scanned Bluetooth devices which meet filter conditions will be reported.
RSSI encoded rule: Convert to decimal and then minus 256, the unit is dBm.

If it is GPS positioning failure, the location data is as below:

GPS Location Failure Data				
Byte 0 (Optional)	Byte 1	Byte 2	Byte 3	Byte 4
PDOP of GPS positioning failure (Traditional GPS positioning only)	C/N 0	C/N 1	C/N 2	C/N 3

PDOP of GPS positioning failure encoder rule: Convert to decimal and divide by 10. 0xFF means that the PDOP is unknown. (Traditional GPS positioning only)

C/N 0: Carrier over noise (dBm) for the strongest signal satellite seen.
C/N 1: Carrier over noise (dBm) for the 2nd strongest signal satellite seen.
C/N 2: Carrier over noise (dBm) for the 3rd strongest signal satellite seen.
C/N 3: Carrier over noise (dBm) for the 4th strongest signal satellite seen.
C/N encoder: Convert to decimal, the unit is dBm.

7 Maintenance instruction

- Do not use or store the device in dusty or dirty areas.
- Do not use or store the device in extremely hot temperatures. High temperatures may damage the device or battery.
- Do not use or store the device in extremely cold temperatures .when the device warms to its normal temperature, moisture can form inside the device and damage the device or battery.
- Do not drop ,knock, or shake the device. Rough handing would break it.
- Do not use strong chemicals or washing to clean the device.
- Do not paint the device ,paint would cause improper operation
- Do not disassemble the device casually or use the tools for maintenance without permission

Handle your device, battery and accessories with care. The suggestions above help you keep your device operational.

FCC STATEMENT

1. 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.

(2) This device must accept any interference received, including interference that may cause undesired operation.

2. any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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.

FCC Radiation Exposure Statement

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

8 Revision History

Version	Description	Editor	Date
1.0	Initial version	Allen	2023-7-10
1.1	Official release version	Allen	2023-11-27
1.2	Modify the power capacity	Allen	2023-12-13

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