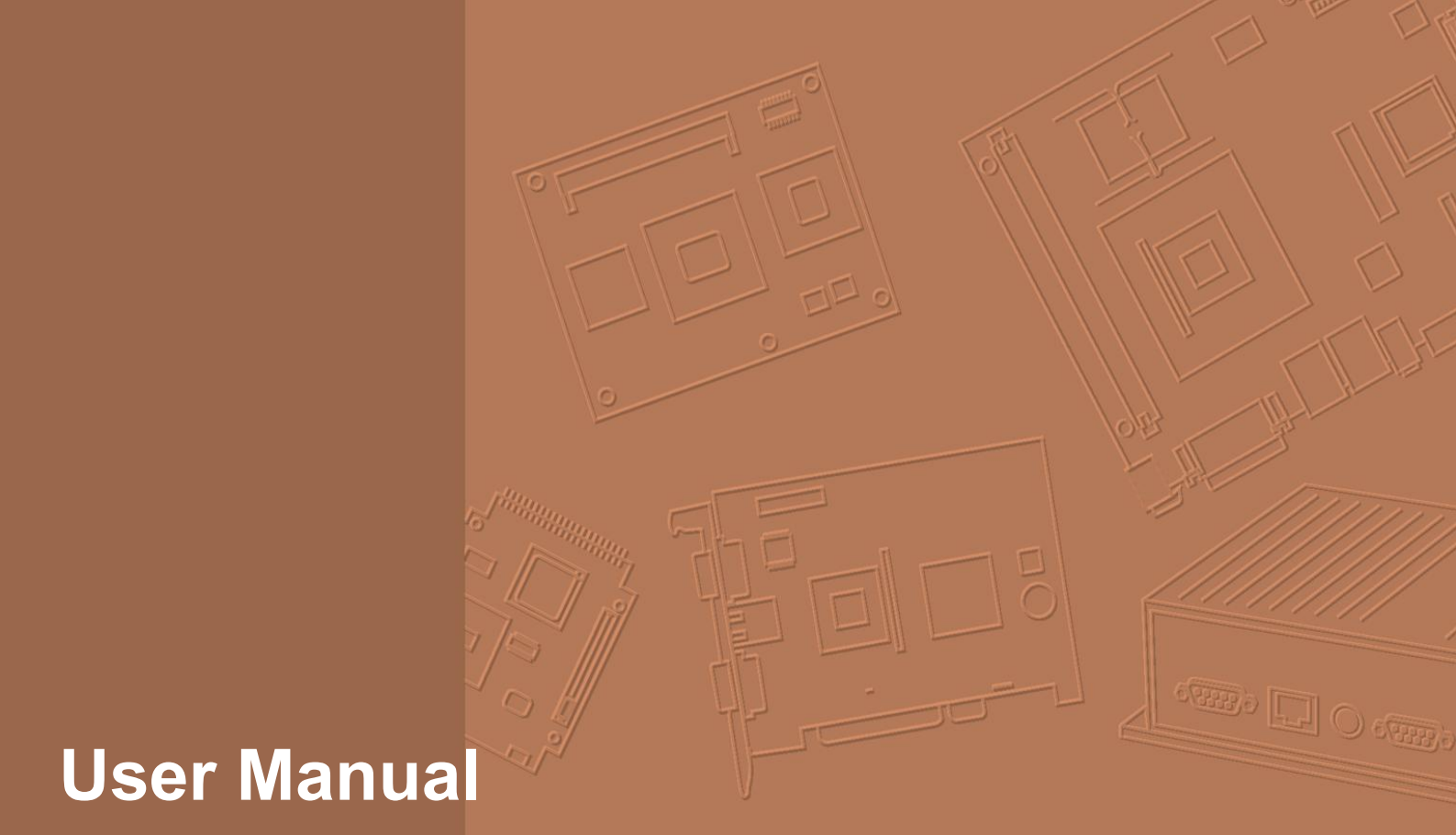




User Manual

LEO-L50 Series

Asset Tracking Device

ADVANTECH

Enabling an Intelligent Planet

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Special Conditions of Use

- Rated ambient temperature range $-30\text{ }^{\circ}\text{C} \leq T_{\text{amb}} \leq +80\text{ }^{\circ}\text{C}$
- Do not remove stainless screws in hazardous location.
- Battery use only Advantech LEO-L50-Li-ion-BAT, Li - ion, 3.6V, 4420mAh.
- No user serviceable part inside. Refer servicing to qualified personal.
- Operators should wear electrostatic wrist or heel straps when they touch the equipment.
- The fasteners used to secure the equipment may only be replaced with screws that meet the specifications and standards listed in the table below.

Amount	Purpose	Specification	Standard
10	Top & bottom cover	M3x5L F/S D=5.0 H=0.8 (1+) SUS	N/A
2	Side cover	M3x3(7.5)L F/S D=5.4 H=1.3 (1+) SUS	N/A
2	I/O door	M2x4L S/S D=3.8 H=1 1+ SUS	DIN 965 / ISO 7046
4	Device & bracket	M4x12L RH D=6.9 H=4 h SUS	DIN 912 / ISO 4762

- Equipment was submitted to tests corresponding to the low risk of mechanical danger.
- The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1.

Product Warranty

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase. This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events. Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain an RMA (return merchandise authorization) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

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1.Introduction

1.1. Asset management device

Asset tracking is a critical process for businesses seeking to efficiently monitor and manage their valuable resources throughout their lifecycle. By leveraging advanced technologies like GNSS (Global Navigation Satellite System) and LTE (Long-Term Evolution), an asset management device empowers organizations to accurately locate, identify, and track assets in real-time. This not only enhances inventory management but also minimizes loss, theft, and misuse of assets. Moreover, asset tracking facilitates better decision-making by providing insightful data on asset utilization, maintenance schedules, and performance analytics. Whether it's equipment, vehicles, or inventory, implementing an effective asset tracking solution that integrates GNSS and LTE technologies streamlines operations, improves accountability, and ultimately boosts productivity and profitability for businesses of all sizes.

Advantech LEO-L50 is specifically designed to meet the demands of asset tracking applications. With optimized battery life and durability, this device ensures long-term reliability even in harsh environments. What sets the 'LEO-L50' apart is its built-in intelligent logic tailored for asset tracking scenarios, allowing it to adapt to various complex situations and environments seamlessly. Whether it's navigating through challenging terrain or enduring extreme weather conditions, the 'LEO-L50' is equipped with the intelligence to ensure accurate and reliable asset tracking results.

1.2. Product features

- Durable and compact design
- Modular expansion ready
- Over 5 years of maintenance-free lifespan
- Built-in solar energy harvesting system
- Global LTE communication
- IP67, withstand salt and UV exposure
- Zero data loss
- Remote configuration and various operations can be commanded remotely
- OTA function
- Diverse power-saving settings
- Various alert configurations

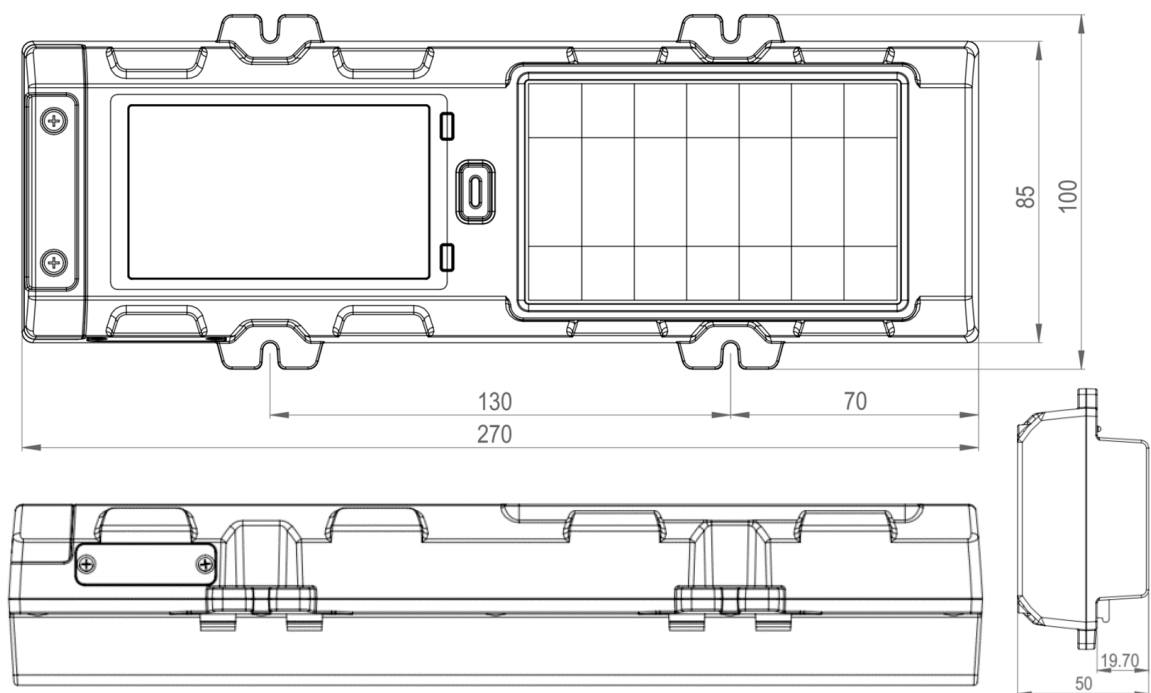
1.3. LEO-L50 specification

1.3.1. Technical Data

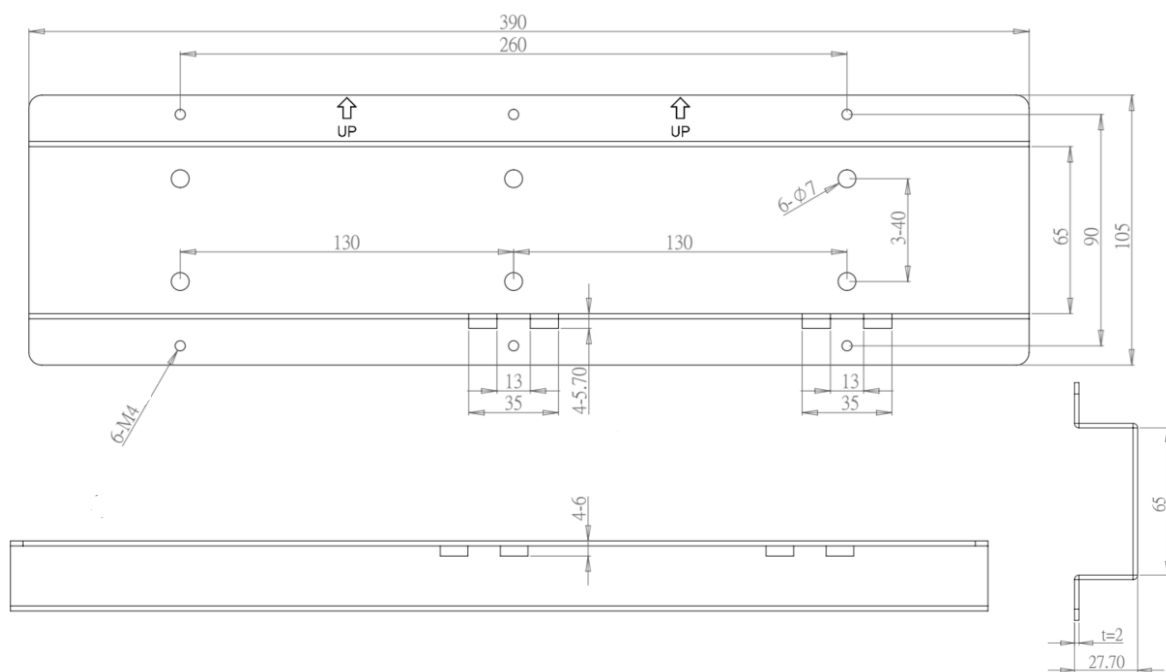
Product	LEO-L50	
Physical	Size	270 × 100 × 50 (mm)
	Weight	980 g (without bracket)
Environmental	Operating temperature	-30°C - 80°C
	Storage temperature	-40°C - 85°C
	Humidity	90% @ 40°C (non-condensing)
	IP rate	IP67
	Vibration/Shock	5M3
GNSS	Support networks	GPS, GLONASS, Galileo, BeiDou
Energy	Battery type	Lithium battery
	Energy harvesting	Solar panel
Communication	Cellular	LTE Cat-1, fallback 2G
Lifetime	Over 5 years, depending on environmental conditions and device setting	

1.3.2. Device dimensions

LEO-L50



Bracket



1.4. Package contents

1. LEO-L50
2. LEO-L50 Bracket
3. Mounting screw × 4

2. Getting Started

2.1. System diagram

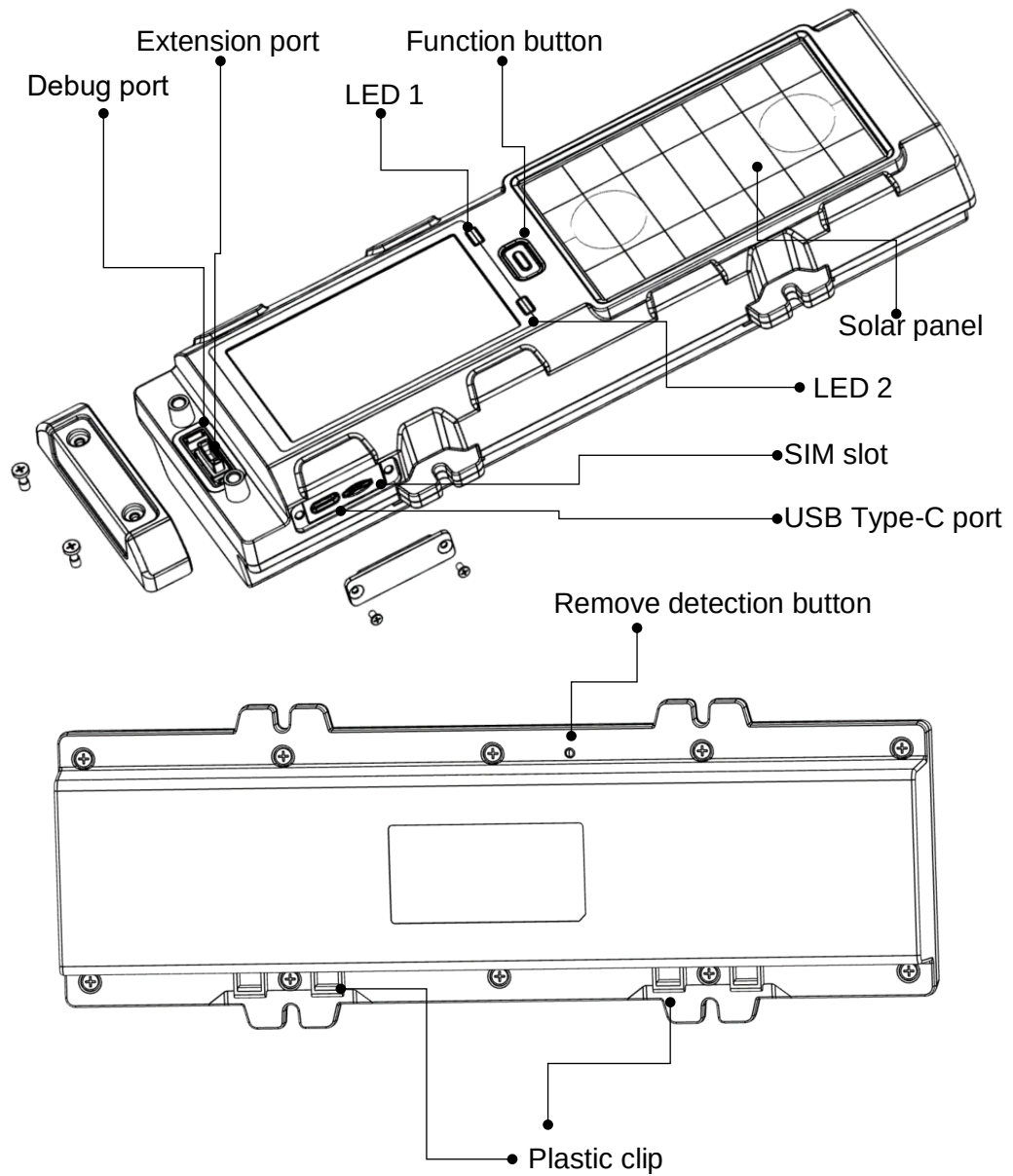


Figure 2.1 System diagram

2.2. System activation

2.2.1. Inserting a SIM card

Use a screwdriver to open the I/O door at the bottom of LEO-L50, and insert the Nano SIM card into the right-hand SIM slot inside as the figure below.

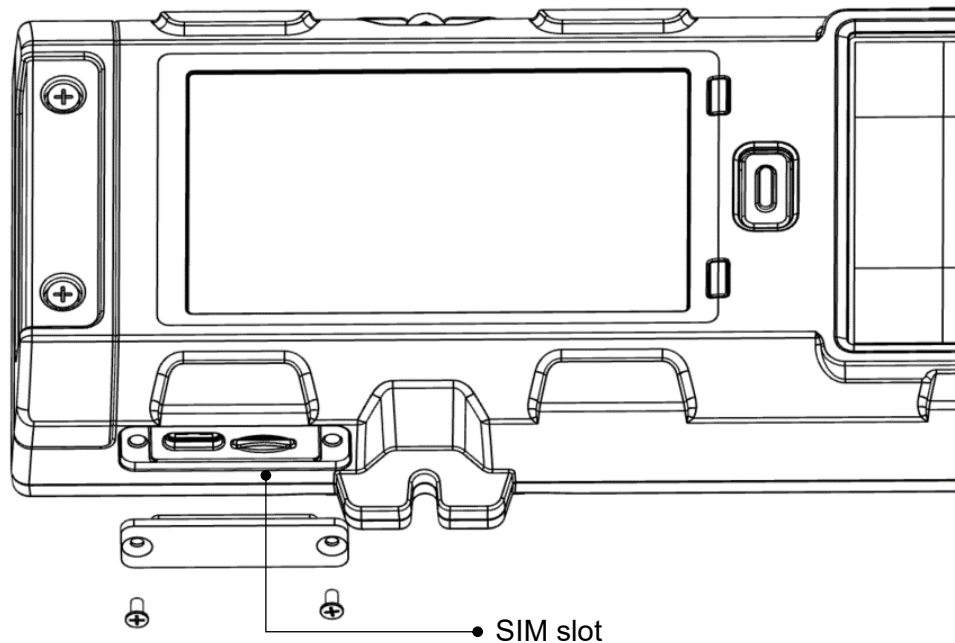


Figure 2.2 SIM card installation

2.2.2. Button function & LED indicators

The button on LEO-L50 provides a variety of functions, users can achieve specific functions by utilizing designated button combinations, and the functionality activation can be confirmed through the LEDs.

The LEO-L50's LED will not flash during normal operation to conserve power unless user specifically configures it to do so.

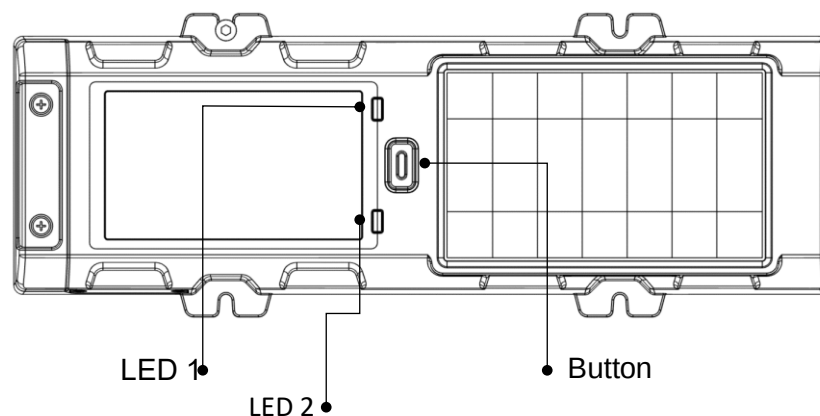


Figure 2.3 LED & Button

2.2.3. STORAGE mode

The device is factory-set to STORAGE mode. In this mode, the device can be operated via the button or USB, but it will not actively perform any data transmission.

Table 2.1 Storage mode button actions

Button action	Function	LED 1	LED 2
Single press	Show battery & device status	Battery status Green: High power Blue: Medium power Red: Low power	Device status Blue: Storage mode
Long press	Enter RUN mode	Green flash 3 times	

2.2.4. RUN mode

The device can be activated into RUN mode via the button or USB. In this mode, the device will operate according to its internal parameter settings.

Table 2.2 Run mode button actions

Button action	Function	LED 1	LED 2
Single press	Show battery & device status	Battery status Green: High power Blue: Medium power Red: Low power	Device status Green: Run mode
Long press	Enter button function mode	R/G/B three colors flash twice in sequence.	

After entering function mode, you can **toggle between functions by single-pressing the button**, and confirm the **selected function by long-pressing the button**.

Table 2.3 Button functions

LED status	Function	Note
LED 2: Green	Send a data to cloud immediately.	Does not affect existing data cycles.
LED 2: Blue	Force reboot	
LED 2: Red	Turn to STORAGE mode	
LED 1: Green LED 2: Blue	G-sensor value offset	
LED 1: Green LED 2: Red	Alert deactivate	

Note!  If no action is taken in function mode, the system will automatically return to normal operation after **10 seconds**.

3.System configuration

3.1. Configuration interface

The LEO-L50 can be configured through either of the following interfaces:

- LEO-L50 Utility Tool (recommended for most users)
- Console Mode via USB virtual COM ports

When connecting the device via USB Type-C, the system will recognize two new COM ports, used exclusively for console access, where one port provides the interactive shell for command-line control. The Utility tool, on the other hand, will automatically detect the device and manage configuration without requiring manual COM port selection.

For detailed instructions on each configuration method, please refer to the relevant application note (see: L50-AN01 – LEO-L50 utility application note & L50-AN02 – LEO-L50 console access application note).

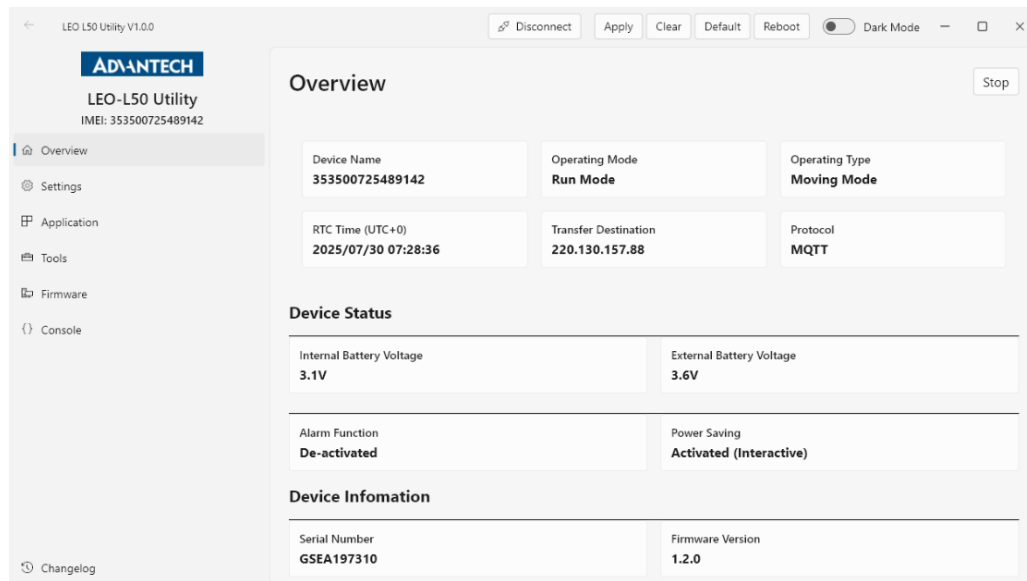


Figure 3.1 LEO-L50 Utility

```

[00:00:00.442.871] <inf> i2c_pwr_master: 01 ***** Booting *****
[00:00:00.442.901] <wrn> i2c_pwr_master: 01 last:core core:3872 liion:0 P01:3400 P02:3700
[00:00:00.442.932] <wrn> i2c_pwr_master: 01 src: core
[00:00:01.010.131] <inf> atcmd: atcmd_init
[00:00:01.020.202] <inf> ublox: ublox: lara demo gps
[00:00:01.020.233] <inf> flow: flow_init
[00:00:01.020.263] <wrn> flow: int status 0 0
[00:00:01.020.385] <inf> ublox: [PWR] com2 off
[00:00:01.021.484] <inf> main: -----
[00:00:01.021.514] <inf> main: LEO-L50 FW Version 1.0.1
[00:00:01.021.545] <inf> main: build time: Jan 16 2025 11:38:24
[00:00:01.021.545] <inf> main: build type: release
[00:00:01.021.575] <inf> main: -----
[00:00:01.021.575] <inf> main: LEO-PWR FW Version 0.2.4
[00:00:01.788.635] <wrn> flow: real cold power
[00:00:01.788.635] <inf> flow: core=3874, liion=0, solar=0 src=0
[00:00:01.788.665] <inf> flow: 0100: Wakeup Detect
[00:00:01.814.971] <inf> flow: 0100->0120: Short Btn/Cold Start, Display LED Status
[00:00:01.814.971] <inf> flow: core=3874, liion=0, solar=0 src=0
[00:00:05.918.090] <inf> flow: 9000: Shutting Down
[00:00:05.928.192] <inf> flow: 9000->9200: In Storage Mode or USB on
[00:00:05.928.192] <inf> flow: 9200: ===== Shutdown =====
[00:00:05.928.222] <inf> flow: ***** disable flash log *****
[00:00:07.938.507] <inf> flow: 9200->9300: Storage Mode, USB plugged, sys_alive=1
[00:00:07.938.537] <inf> flow: 9300: Shutdown, USB On
[00:00:07.938.537] <inf> flow: wait next wakeup time
[00:00:07.938.568] <wrn> s35390a: ALM[On] wday=[X] 0:0 (UTC)
leo:~$

```

Figure 3.2 Console command line interface

Note!



If no COM port is detected, or the LEO-L50 Utility cannot connect to the device, press the button on LEO-L50 to wake it up and try again.

4. Installation and Mounting

The packaging of the LEO-L50 includes both the device itself and the installation base.

4.1. Preparation

4.1.1. Self-prepare mounting hardware

1. Blind rivet (at least 2 for each LEO-L50)

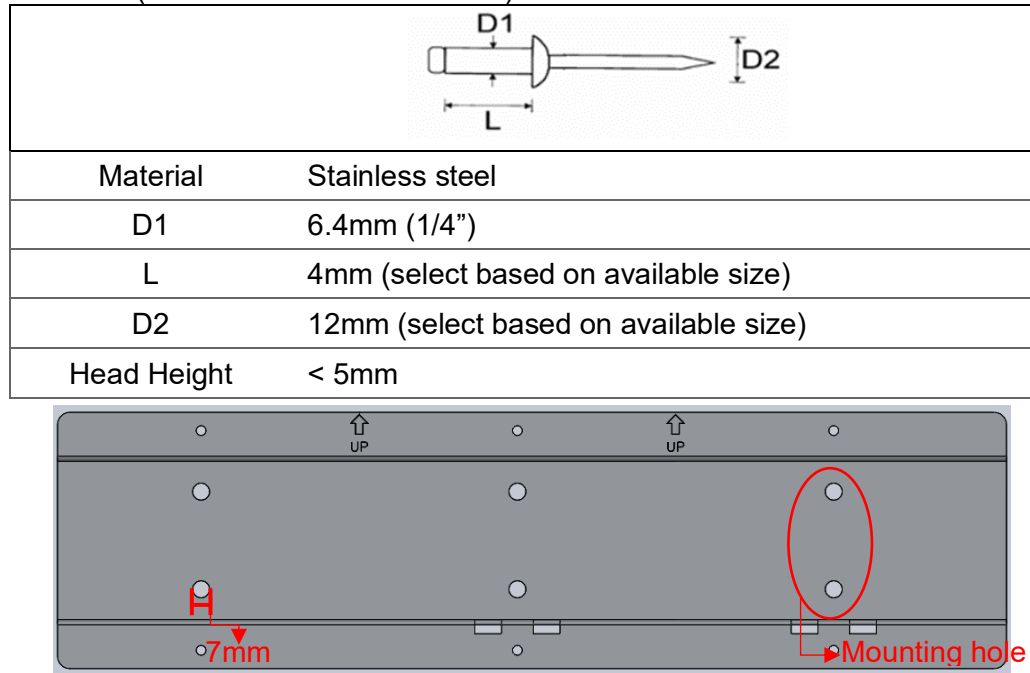


Figure 4.1 Blind rivet

2. Waterproof silicon

4.1.2. Installation tools

1. Rivet gun
2. Electric drill

4.2. Bracket installation

4.2.1. Install location

The LEO-L50 is designed to fit perfectly within the grooves of a container door. We recommend installing it in the groove located at the upper-left corner of the container door, as shown in the diagram below.

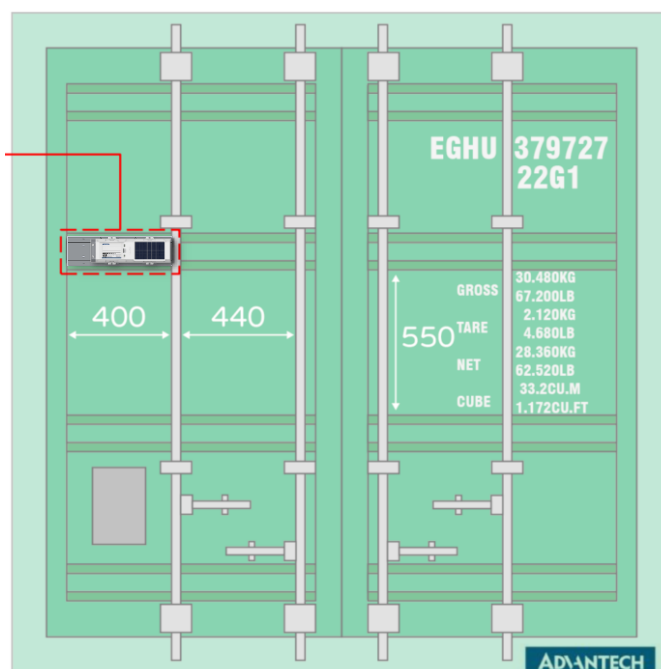


Figure 4.2 Install location

4.2.2. Bracket mounting

1. Use the product bracket to mark the drilling points at the installation location.
2. Use a power drill to make the holes, ensuring the diameter does not exceed the openings on the equipment bracket. (approximately 7mm)
3. After drilling the holes, use a rivet gun and rivets to secure the bracket in place.
4. Use waterproof silicone to seal and protect the rivet joints on the inside of the enclosure.

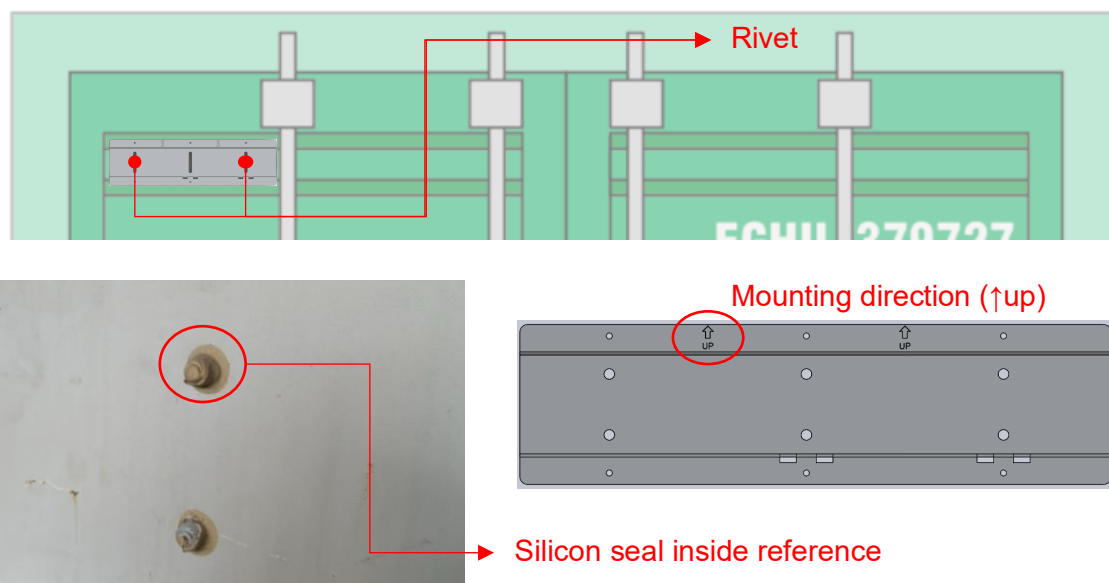


Figure 4.3 Bracket installation

4.3. LEO-L50 installation

Align the latch on the bottom of the LEO-L50 with the latch hole on the bottom of the LEO-L50 bracket, and insert it parallelly.

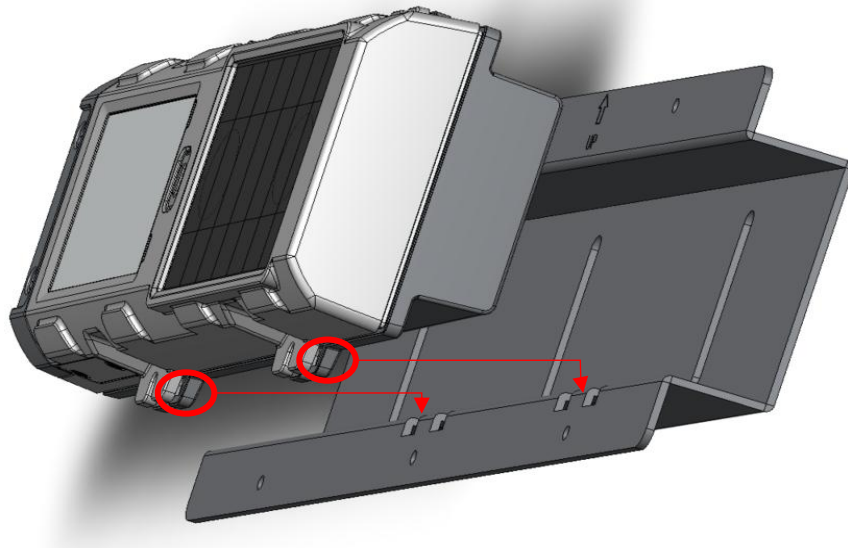


Figure 4.4 LEO-L50 installation

Secure the LEO-L50 using the screws included in the packaging.

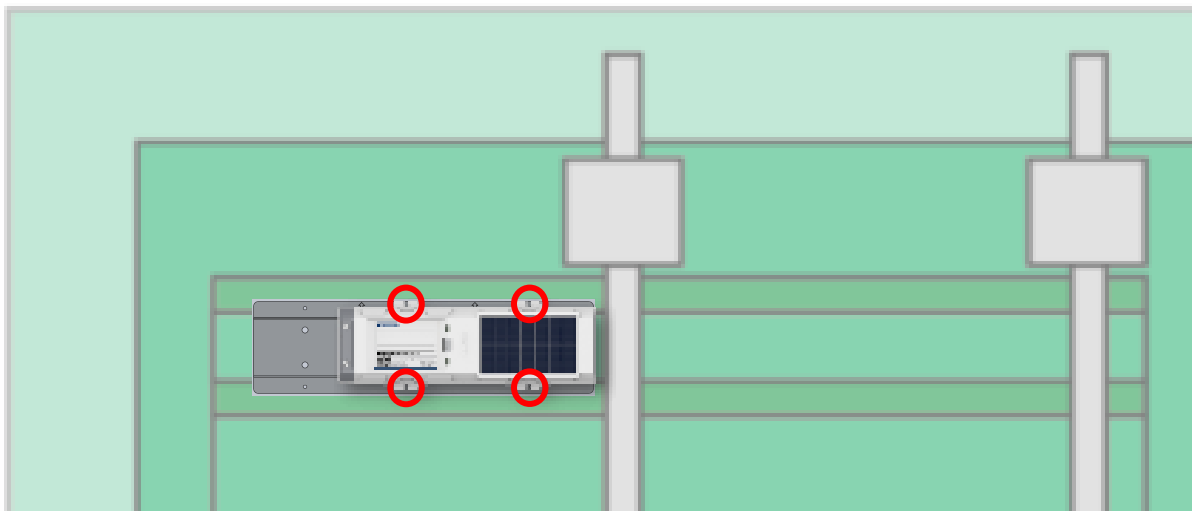


Figure 4.5 LEO-L50 screw lock

5. Operating Type

LEO-L50 provides two selectable operating modes for users.

5.1. Normal mode

In Normal Mode, the device records and transmits data periodically based on user-defined intervals.

For example, if you want the device to record data every 60 minutes and transmit collected data every 6 hours, the following configuration logic applies:

Table 5.1 Normal mode parameter example

Parameter	Value
Operation type	Normal Mode
Log interval	60 (Minutes)
Transfer interval	6 (Multiple)

By applying these settings, the device will regularly log data at fixed intervals, and transmit data every 6 entries. Each dot in the figure represents a single log.

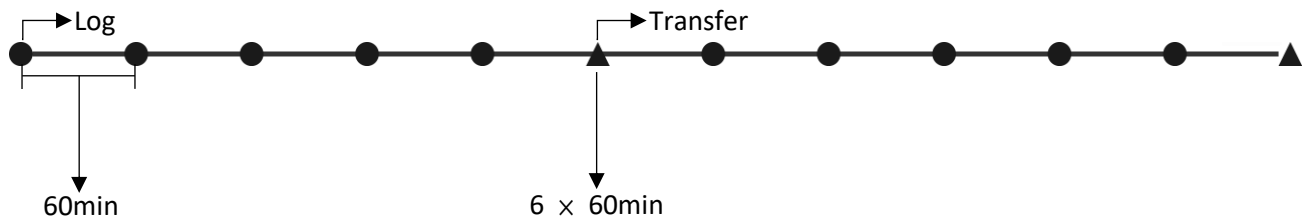


Figure 5.1 Normal operating mode

5.2. Movement mode

In Movement Mode, the device dynamically adjusts its logging and transmission behavior based on motion status. When movement is detected (acceleration threshold ≥ 0.05 g), the device enters a high-frequency logging mode. Once the device becomes stationary, it switches back to a low-frequency heartbeat mode to conserve power.

For example, the default configuration logs data every 5 minutes during movement, and reverts to every 1440 minutes (once a day) when stationary:

Table 5.2 Movement mode parameter example

Parameter	Value
Operation type	Movement Mode
Movement mode interval	5 (Minutes)
Movement mode heartbeat interval	1440 (Minutes)

By applying these settings, the device will automatically adjust logging frequency based on movement status, denser dots in the figure represent more frequent logs during motion.

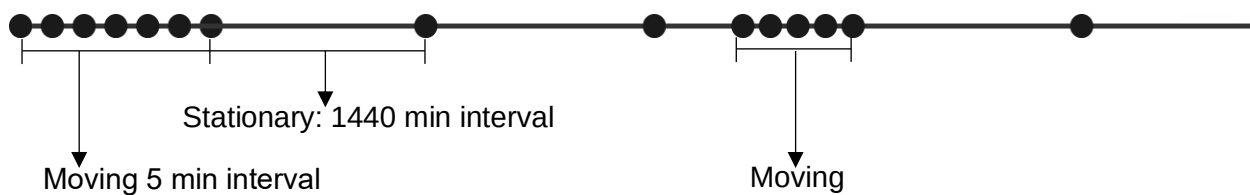


Figure 5.2 Movement operating mode

6.Data Transmission

When the LEO-L50 is operating, it will automatically gather real-time data and transmit it to the MQTT broker destination specified by the user. Additionally, it includes support for acknowledgement message listening functionality to verify the completion of data transmission.

Each type of edge triggered message will adhere to the basic transmission rules described in this chapter.

6.1. MQTT topics definition

Stable transmission relies on the MQTT topics specified by the user, which can be configured within the LEO-L50.

The basic transmission flow is illustrated in the figure below.

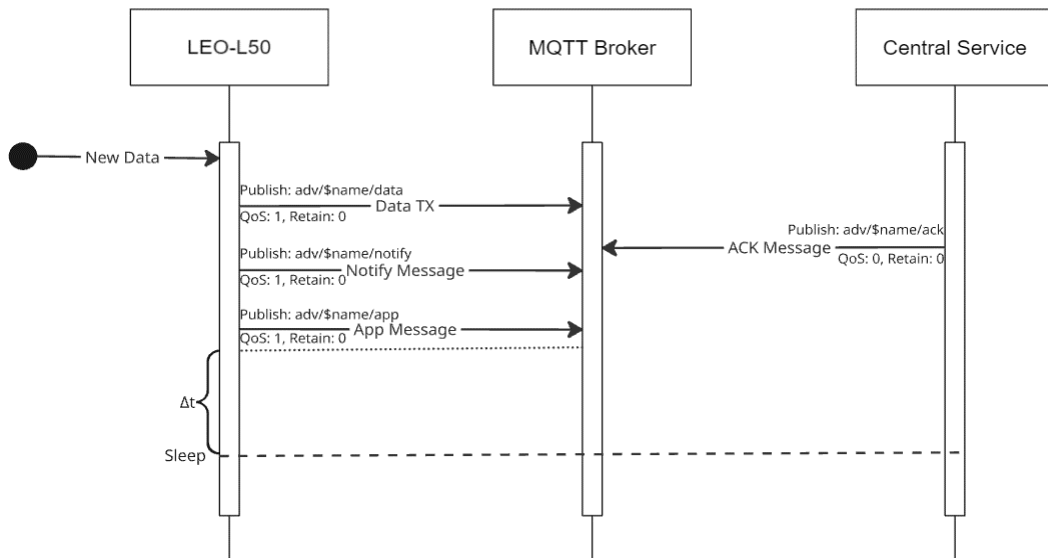


Figure 6.1 Basic transmission flow

As depicted in the figure, the LEO-L50 will publish the data payload message at the start of the current transmission cycle, and will subsequently publish additional messages upon receiving the ACK message.

The related topics are:

- Data topic
- ACK topic
- Notify topic
- App topic

In the event of an unsuccessful transmission or failure to receive the ACK message, the LEO-L50 will consider it an unsuccessful transmission cycle, store the data, and resend it as historical data in the next transmission cycle.

6.2. General format header

In the communication between the LEO-L50 and the system, aside from the transmitted messages, all interactions will include the standard format content described below.

```
{
  "msg":{
    "id": 1846138698,
    "ts": 1698821605,
    "imei": "353500725508545"
  },
  "net":{
    "oper": "Chunghwa Telecom Telenor CXN",
    "ip": "10.96.237.100"
  }
}
```

- id: message sequence ID
- ts: current transfer UNIX timestamp
- oper: current connection carrier (LEO-L50 messages only)
- ip: current connection IP address (LEO-L50 messages only)

6.3. Data message

At each scheduled transmission time, the LEO-L50 will trigger a transmission cycle. After connecting the MQTT broker, the LEO-L50 will publish the data message to the data topic, and subscribes to the ACK topic for the ACK message from the cloud system.

6.3.1. Data message format

The data message will follow the format below.

```
Retain: 0
QoS: 1
{
  "msg":{
    "id": 1846138698,
    "ts": 1698821605,
    "imei": "353500725508545"
  },
  "net": {
```

```

    "oper": "Chunghwa Telecom Telenor CXN",
    "ip": "10.96.237.123"
  },
  "data": "pRMBAPzzQWVAxX4BuH0/B/YJAABZAApt",
  "remark": "Test_Device"
}

```

- Data: Current transfer data payload
- Remark: Remark defined in parameter

If the message contains multiple data, it will automatically migrate inside “data”, please refer to Chapter 8. Data Decoding for more information about decoding the data.

6.3.2. Multiple data messages transmission

If the un-send storage data exceeded the limit in single message, the LEO-L50 will automatically split it into multiple messages, as the figure below. Each message will be subsequently published upon receiving the ACK message

Multiple Message TX Flow

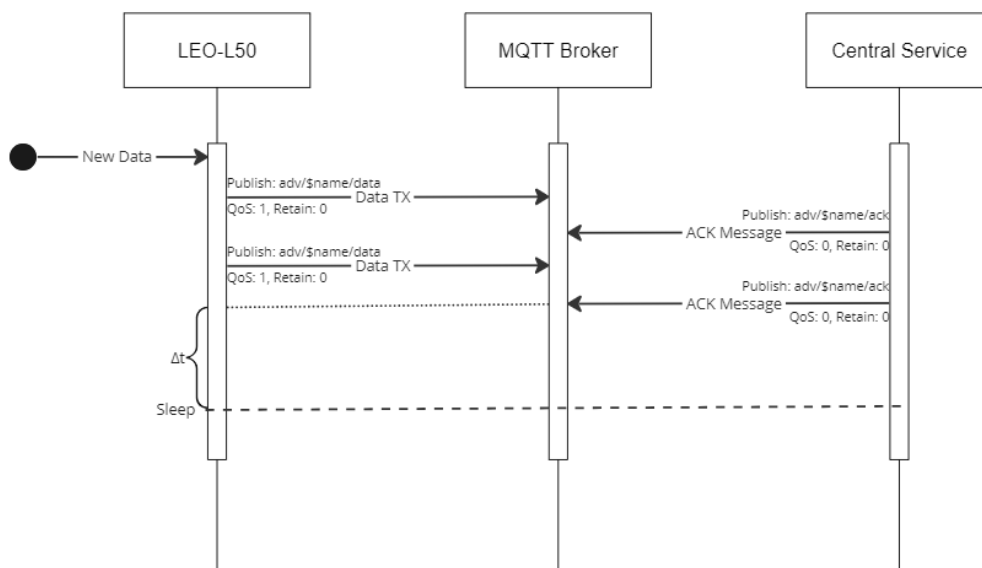


Figure 6.2 Multiple message TX flow

6.4. ACK message

If the ACK function is enabled, the LEO-L50 will determine whether a data message has been successfully delivered based on whether an ACK message is received. Other message types, such as notify or response, are not subject to the ACK mechanism.

6.4.1. ACK message format

The ACK message should follow the format depicted in the figure below.

```

Retain: 0
QoS: 0
{
  "msg":{
    "id": 1846138698,
    "ts": 1698821605
  }
}

```

The “id” value should correspond to the received message “id”.

6.5. Notify/App message

The LEO-L50 will send an additional notify/app message if there is any additional information that needs to be communicated to the central system. The message will always be sent after receiving an ACK message.

6.5.1. Notify message format

The notify message will follow the format depicted in the figure below.

```

Retain: 0
QoS: 1
{
  "msg":{
    "id": 1846138698,
    "ts": 1698821605,
    "imei": "353500725508545"
  },
  "net": {
    "oper": "Chunghwa Telecom Telenor CXN",
    "ip": "10.96.237.123"
  },
  "notify": "alert",
  "value": "0001"
}

```

- Notify: Notify type
- Value: Notify message

In the message, the “notify” field will indicate the type of message, and the value will contain the contents if needed.

6.5.2. Notify message types

Notify type	Value message
eng	Engineering data
alert	Alert status
power	Power protection messages
aware	Qualcomm® Aware Service status code

6.5.3. App message format

The app message will follow the format depicted in the figure below.

```
Retain: 0
QoS: 1
{
  "msg": {
    "id": 1846138698,
    "ts": 1698821605,
    "imei": "353500725508545"
  },
  "net": {
    "oper": "Chunghwa Telecom Telenor CXN",
    "ip": "10.96.237.123"
  },
  "appdata": {
    "aware": " b8qKaJxdfgFoITwH"
  }
}
```

- Appdata: Contains pre-defined application data

6.5.4. App message types

App type	Definition
aware	Qualcomm Aware service related data

Note!



The app message may contain multiple types of application data in a single message.

7.OTA Function

The LEO-L50 supports OTA (Over-The-Air) updates. By defining conversation topics through the MQTT protocol, the SaaS service and the LEO-L50 can perform OTA updates in a request-response manner.

Note! *The OTA function may cause some additional power consumption. Please confirm its necessity before use.*



7.1. OTA topics definition

Same as data transmission, the OTA related topics can be defined by user. The basic transmission flow is illustrated in the figure below.

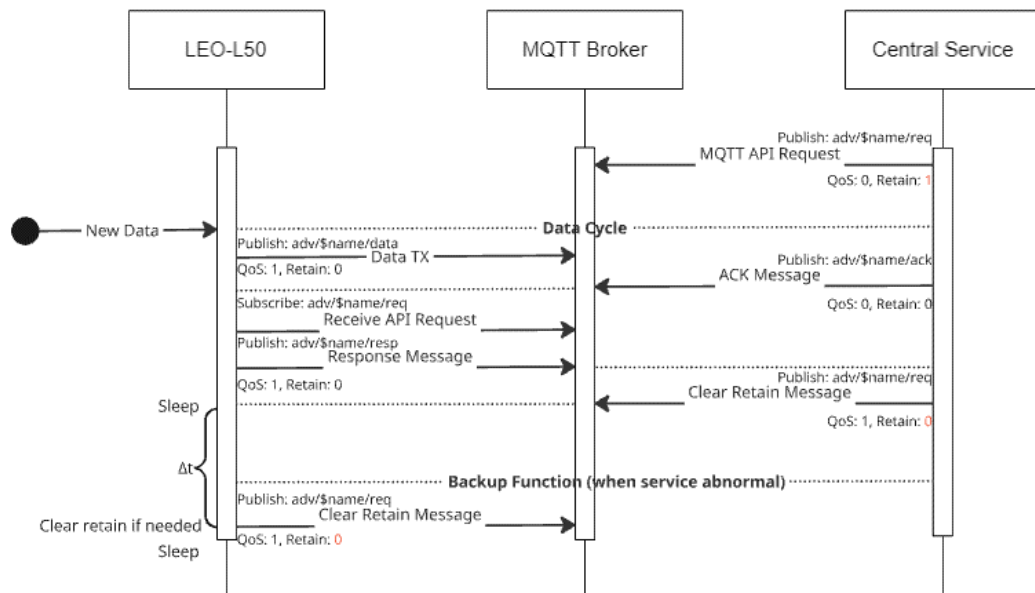


Figure 7.1 OTA transmission flow

As depicted in the figure, the OTA service is always triggered by central service. Upon receiving a request, the LEO-L50 will send a response. If requests are sent before sleep periods, the LEO-L50 will still sequentially receive and reply with the results

The related topics are:

- Request topic
- Response topic

The OTA function is based on message publishing and receiving between the central service and the LEO-L50 on the MQTT broker. The central service will first create a Request message for the OTA and set it as a **Retain message**. When the LEO-L50 finishes its sleep cycle and successfully connects, it will automatically retrieve the Request message.

After receiving the Request, the LEO-L50 will act based on the received message and issue a Response message to notify the central service that the Request has been completed. The central service will then clear the Retain message.

Note!



If the service fails to clear the retain message, the LEO-L50 will handle it from the edge side.

7.2. Request message

The request message will follow the format depicted in the figure below, divided into GET or PUT formats.

Note!



1. Ensure that the request message is configured with **Retain: 1**.
2. Changing name or MQTT parameters may interrupt MQTT transmission.
Please consult Advantech before OTA adjustment.

GET request

```
Retain: 1
QoS: 0
{
  "msg":{
    "id": 1846138698,
    "ts": 1698821605
  },
  "method":"GET",
  "function":"info"
}
```

- Method: Request method type, GET is used for query parameter
- Function: Parameter category

PUT request

```
Retain: 1
QoS: 0
{
  "msg":{
    "id": 1846138698,
    "ts": 1698821605
  },
  "method":"PUT",
```

```
"function": "op",  
"value": "litvl=60;remark='api'"  
}
```

- Method: Request method type, PUT is used for adjusting parameter
- Function: Parameter category
- Value: Parameter modification

Note!



1. *Function: corresponds to console command category*
2. *Value: corresponds to console sub-command*
3. *For detailed parameter definitions, please refer to L50-AN02 – Console Access Application Note*

7.3. Response message

The data message will follow the format depicted in the figure below, divided into GET or PUT formats.

In a GET request, the response message will contain “value” that includes the parameter queried from request message. But in PUT request, will only reply return code to show if the setting is done.

GET response

```
Retain: 0  
QoS: 1  
{  
  "msg": {  
    "id": 1846138698,  
    "ts": 1698821605,  
    "imei": "353500725508545"  
  },  
  "net": {  
    "oper": "Chunghwa Telecom Telenor CXN",  
    "ip": "10.96.237.123"  
  },  
  "method": "GET",  
  "function": "info",  
  "code": 200,
```

```
"value": "name='353500725507432';model='LEO-L50';sn='abcdef';  
mcusn='12345';fw='1.0.0';pcbasn='12345'"
```

- Method: Reply method from request message
- Function: Reply function from request message
- Code: Return code
- Value: GET request, reply parameter value

PUT response

```
Retain: 0  
QoS: 1  
{  
  "msg": {  
    "id": 1846138698,  
    "ts": 1698821605,  
    "imei": "353500725508545"  
  },  
  "net": {  
    "oper": "Chunghwa Telecom Telenor CXN",  
    "ip": "10.96.237.123"  
  },  
  "method": "PUT",  
  "function": "op",  
  "code": 200  
}
```

- Method: Reply method from request message
- Function: Reply function from request message
- Code: Return code

7.3.1. Return code

Upon successful commands sent, the device response message will contain a return code. The return code indicates the status of the operation performed by the device. The following table details the list of return codes and their corresponding meaning.

Table 7.1 Return code list

Return code	Definition
200	Success
2	Unknown error
3	Method error
4	Function error
5	Value error
6	Device unable to perform such operation

7.4. Remote action functions

Beyond parameter configuration, OTA provides a set of remote functionalities, collectively referred to as "action" functions that can be executed. These action functions enable users to perform various operations on the device remotely.

Action functions are invoked using the "action" method, followed by the specific action name and its corresponding parameters. The parameters are specified within the "value" field.

```
Retain: 1
QoS: 0
{
  "msg":{
    "id": 1846138698,
    "ts": 1698821605
  },
  "method":"action",
  "function":"deactivate",
  "value":"deac=1"
}
```

- Method: Action
- Function: Triggered action function
- Value: Messages per function required

For detailed instructions on each configuration method, please refer to the relevant application note (see: L50-AN03 – LEO-L50 remote actions).

8.Data Decoding

For data security purpose, all uploaded critical information will undergo Base64 encoding. This section will detail how to decode the uploaded data.

8.1. Payload format

Each data entry will consist of a 4 bytes fixed-format header and the data itself in **little endian** byte order.

Header:

Start byte	Length	Definition	Description
0	1	Check byte	Check byte = a5
1	1	Payload size	How many bytes a data packed, normally = 19 bytes = 13(HEX)
2	1	Data count	How many data in current payload message
3	1	Reserved	

Data:

Start byte	Length	Definition	Unit	Calculation	Description
0	4	UNIX timestamp	NA	Unsigned	Data timestamp in UNIX format
4	4	Latitude	NA	*0.000001, Signed	GNSS latitude
8	4	Longitude	NA	*0.000001, Signed	GNSS longitude
12	2	Temperature	°C	*0.01, Signed	On board temperature
14	1	Tilt X-axis	Angle degree	Signed	Compared with offset value
15	1	Tilt Y-axis	Angle degree	Signed	Compared with offset value
16	1	Tilt Z-axis	Angle degree	Signed	Compared with offset value
17	1	Core battery voltage	V	*0.1, Unsigned	Core one-time battery voltage

18	1	Solar battery voltage	V	*0.1, Unsigned	Solar rechargeable battery voltage
----	---	-----------------------	---	----------------	------------------------------------

8.2. Single payload decoding

Data format:

Header				Data
Prefix	Data size	Data count	Reserved	Position data
1 byte	1 byte	1 byte	1 byte	data size

Example:

Raw data	pRMBaORrs2XMXn4BOCU8BxQFqQL/Hig=
Base64 decoded	a5 13 01 00 e4 6b b3 65 cc 5e 7e 01 38 25 3c 07 14 05 a9 02 ff 1e 28

Example header decoded:

Bytes	Description	Value
a5	Check byte	Check pass
13	Data size	13(HEX) = 19 bytes
01	Data count	1 data
00	Reserved	

Example data decoded:

Bytes	Description	Value	Unit
65 b3 6b e4	Unix timestamp	1706257380 = GMT: 2024/01/26 08:23:00	NA
01 7e 5e cc	Latitude	25059020 = 25.059020	NA
07 3c 25 38	Longitude	121382200 = 121.382200	NA
05 14	Temperature	1300 * 0.1 = 13	°C
a9	Tilt X-axis	-87	Degree
02	Tilt Y-axis	2	Degree
ff	Tilt Z-axis	-1	Degree
1e	Core battery	30 * 0.1 = 3.0	V
28	Solar battery	40 * 0.1 = 4.0	V

8.3. Multiple payload decoding

Data format:

Header				Data 1	Data 2	Data 3
1	1	1	1	Data size	Data size	Data size

Example:

Raw data	pRMDAORrs2XMXn4BOCU8BxQFqQL/HiiMabNI1I5+ATAIPAdGBakC/x4oNGezZb xefgFIJTwHFAWpAv8eKA==
Base64 decode d	a5 13 03 00 e4 6b b3 65 cc 5e 7e 01 38 25 3c 07 14 05 a9 02 ff 1e 28 8c 69 b3 65 d6 5e 7e 01 30 25 3c 07 46 05 a9 02 ff 1e 28 34 67 b3 65 bc 5e 7e 01 48 25 3c 07 14 05 a9 02 ff 1e 28

The 3rd byte 03 indicates 3 data included.

Decoded:

	Data 1		Data 2		Data 3	
	Bytes	Value	Bytes	Value	Bytes	Value
Timestamp	65 b3 6b e4	20240126 08:23:00	65 b3 69 8c	20240126 08:13:00	65 b3 67 34	20240126 08:03:00
Latitude	01 7e 5e cc	25.059020	01 7e 5e d6	25.059030	01 7e 5e bc	25.059004
Longitude	07 3c 25 38	121.382200	07 3c 25 30	121.382192	07 3c 25 48	121.382216
Temperature	05 14	13	05 46	13.5	05 14	13
Tilt X-axis	a9	-87	a9	-87	a9	-87
Tilt Y-axis	02	2	02	2	02	2
Tilt Z-axis	ff	-1	ff	-1	ff	-1
Core battery voltage	1e	3.0	1e	3.0	1e	3.0
Solar battery voltage	28	4.0	28	4.0	28	4.0

9. Advanced Functions Overview

9.1. Alert Function Overview

LEO-L50 supports built-in real-time alert functions that monitor specific conditions and notify the cloud platform when triggered.

There are three types of alerts available:

- Remove alert: Triggered when the device is physically detached from its mounting point
- Tilt alert: Triggered when device orientation changes significantly
- Temperature alert: Triggered when internal temperature exceeds configured thresholds

Note!



1. *Even if the alert condition has cleared, the alert event will persist until it is acknowledged by the user.*
2. *Activating the alert function will consume additional power.*

For setup details, please refer to the relevant application note (see: L50-AN04 – LEO-L50 alert function).

9.2. Power Saving Function

The LEO-L50 offers two built-in power saving modes to help extend battery life in various deployment scenarios. These modes intelligently reduce power usage when the device is idle, out of coverage, or not in active use. Users can choose to enable either or both depending on operational needs.

9.2.1. Interactive power saving

IPS allows the server to pre-schedule when the device should reduce its activity. It is ideal for use cases where the device will be out of network coverage (e.g., offshore periods). During the scheduled period, the device stops logging and transmission to conserve energy.

9.2.2. 3-Tier power saving

SPS is an automatic fallback mechanism triggered by repeated LTE registration failures. It progressively increases the interval between logging and transmission in three layers. Once communication resumes successfully, the device exits SPS and returns to normal operation.

Note!



1. *Both modes can be enabled independently or together*
2. *Alerts can be enabled or disabled independently while in power saving mode.*
3. *Both modes are fully configurable via the LEO-L50 Utility*

For setup details, please refer to the relevant application note (see: L50-AN05 – LEO-L50 power saving function).

9.3. Other applications

9.3.1. Qualcomm® Aware Service

LEO-L50 supports integration with Qualcomm® Aware service as an alternative positioning source when GNSS is unavailable.

This feature enables the device to use Aware service for fallback location under poor satellite visibility conditions, such as indoor, covered yards, or deep container stacks.

To activate this function, users must input a valid Aware user ID and API key via the Utility interface. When enabled, the device will attempt to obtain fallback location data from the cloud if GNSS fix times out.

Note!



1. *GNSS remains the primary source of positioning*
2. *Aware service is used only when satellite signal cannot be acquired within the configured timeout*
3. *Active LTE connection is required for fallback to succeed*

For setup details, please refer to the relevant application note (see: L50-AN06 – LEO-L50 Qualcomm® Aware service).

10. Application Note Index

Code	Title
L50-AN01	LEO-L50 utility application note
L50-AN02	LEO-L50 console access application note
L50-AN03	LEO-L50 OTA function
L50-AN04	LEO-L50 alert function
L50-AN05	LEO-L50 power saving function
L50-AN06	LEO-L50 Qualcomm® Aware service