AgroSense_GPS Tracker NEO_6M Sensor LoRaWAN® Manual

V1.0

Author: Yuki

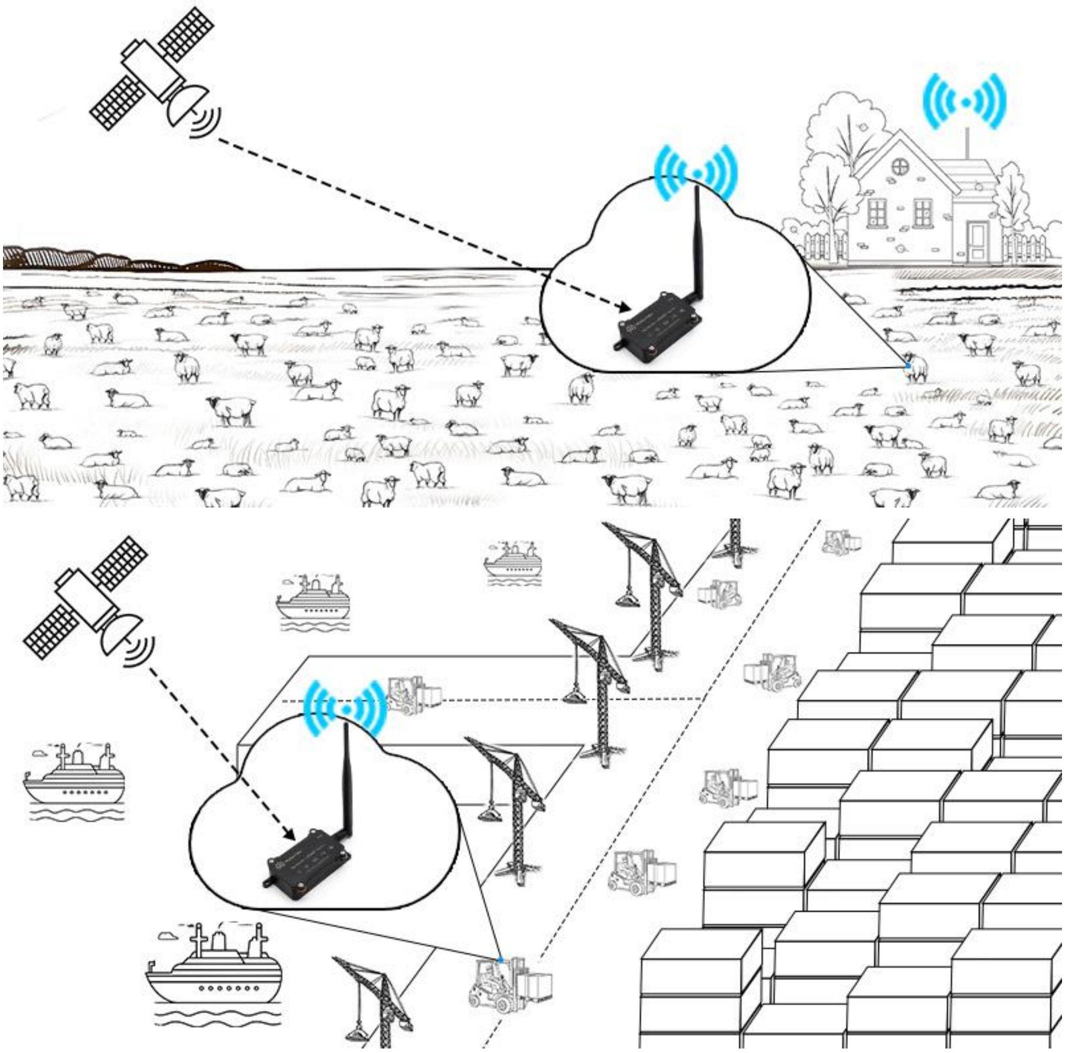
Time: 2024.11.01

Contents

1 Product Description

1.1 Introduction

The AgroSense LoRaWAN® GPS Tracker NEO_6M is an ideal GPS beacon for geolocation of equipment, it reports GPS location every 1 hour(by default, can be set from min 5 minute to max 24 hours). U-blox NEO-6M GPS module is used in this product, it is a widely used GPS module which features high precision. With onboard accelerometer LIS3DHTR, it detects vibration and reports via LoRaWAN, suitable for kinds of applications such as asset tracking, farm management. This module uses re-chargeable 18650 lipo battery, with our detailed hardware/software design, the working time can be 16 months (per the default setting) for each battery charge circle.



It can cover a transmission range of 2km in urban scenes and 5km in line-of-sight scenes while keeping lower power consumption during the transmission process. Together with a replaceable battery that supports up to 1 years of usage and an industrial IP68 enclosure. It supports at least -40℃ ~ 85℃ operating temperature and can be deployed in harsh environments. AgroSense is compatible with LoRaWAN® V1.0.3 protocol and can work with LoRaWAN® gateway.

1.2 Feature

- Includes a **high precision** sensor.
- Compatible with Worldwide **LoRaWAN® Networks**: Support the universal frequency bands EU868/ US915.
- LoRaWAN version: LoRaWAN Specification **1.0.3**.
- **Long Range**: Up to 2 kilometers in the city, up to 10 kilometers in the wilderness, receive sensitivity -137dBm , transmit power up to 21dBm.
- **Ultra-low power** consumption design, traditional AAA alkaline dry battery can be used for one year.
- **Data encryption**: Provide end-to-end secure communication, including device authentication and network data encryption, to ensure the security of data transmission and prevent data theft and malicious attacks.
- **High stability and reliability:** good stability in noisy environments, able to penetrate buildings and obstacles, so it can maintain good communication quality in urban and suburban environments.
- Suitable for **Harsh Environments**: Can work normally under the temperature of -40℃ ~ 85℃, IP68 waterproof, suitable for outdoor use in harsh conditions, high UV, dusty, heavy rain and other bad weather.
- Monitor data and upload **real-time** data regularly.
- Modify the product parameters through **AT commands**.
- Support **downlink** to modify the time interval, motion status on/off, motion status sensitivity.

1.3 Parameter

1. GNSS

Product Model	AGLWGT02
positioning system	GPS，SBAS，PPP
positioning parameters	longitude：resolution of 0.0001
	latitude：resolution of 0.0001
	altitude：resolution of 1 meter
positioning accuracy	GPS: 2.5 meters
	SBAS: 2.0 meters
	2D horizontal position accuracy < 1 meter
	3D horizontal position accuracy < 2 meters

2.Device attitude

Detection content	Normal / shock

3.Wireless Parameters

Communication Protocol	Standard LoRaWAN® protocol 1.0.3
Network Access/Operating Mode	OTAA Class A
MAX Transmit Power	21dBm
Receiver Sensitivity	-137dBm/125kHz SF=12
Frequency Band	EU868/US915

4.Physical Parameters

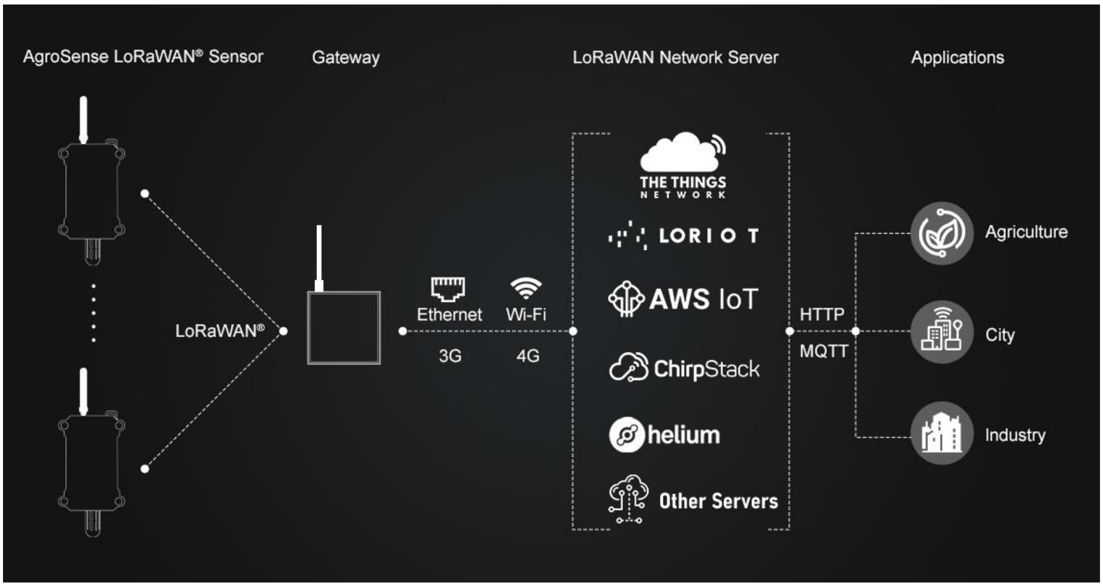
Power Supply	1 x 18650 3.7V Lion batteries
Operating Temperature	-40°C ~85°C
Protection Class	IP68
Dimensions	131 × 62.7 × 27.5 mm
Mounting	Wall Mounting
Dimensions	131 × 62.7 × 27.5 mm
Mounting	Wall Mounting

2 Technical route

2.1 System Framework

AgroSense_GPS Tracker NEO_6M Sensor uses LoRAWAN technology, and it network architecture includes four parts: End Nodes, Concentrator/Gateway, Network Server and Application Server.

End Nodes	It is responsible for collecting sensing data and then transmitting it to Gateway via the LoRaMAC protocol.
Concentrator/Gateway	It is mainly responsible for transmitting node data to the server.
Network Server	Organize the data into JSON packets and decode them.
Application Server	Display the data.



The steps to achieve the detection of location information and shock status is:

1. Collect the location information and motion status data by sensor, and send the data from End Node to Gateway.
2. The Gateway packages node data and transmits it to the Network Server.
3. The Network Server decodes the data and sends it to the Applications.
4. Finally, user can monitor the location information and shock status in the APP.

2.2 Regional frequency band

At the present moment, our product solely accommodates compatibility with the US915 and EU868.

area	frequency band	center frequency
China	470-510MHz	CN486MHz
America	902-928MHz	US915MHz
Europe	863-870MHz	EU868MHz
Korea	920-923MHz	KR922MHz
Australia	915-928MHz	AU923MHz
New Zealand	921-928MHz	NZ922MHz
Asia	920-923MHz	AS923MHz

3 Usage

We use The Things Network as our Network Server, we need to configuration the country/ area frequency, inputting DEV EUI/ APP EUI/ APP Key, decodes, and connect to ThingSpeak or Datacake.

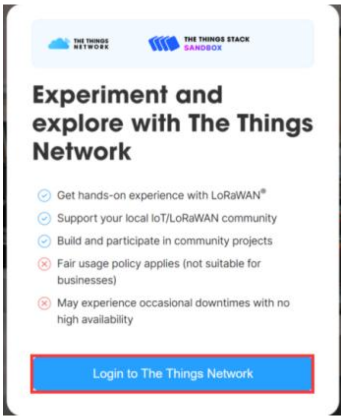
DEV EUI	Unique identification of device, authorized by IEEE
APP EUI	Unique identification of application
APP Key	One of the join network parameters on OTAA mode, calculated by DE EUI

- End Nodes and Gateway: AgroSense_GPS Tracker NEO_6M Sensor LoRaWAN®. (The AgroSense series is applicable)
- Network Server: The Things Network. (Loriot, AWS IoT, ChirpStack, ect)
- Application Server: ThingSpeak.(Datacake, Blockbax, akenza, ect)

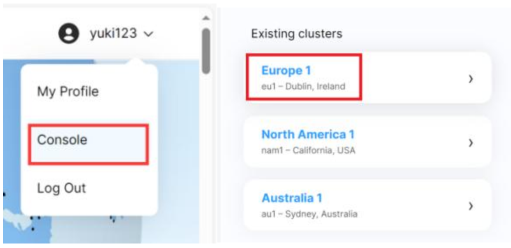
3.1 TTN and ThingSpeak

3.1.1Network Server configuration

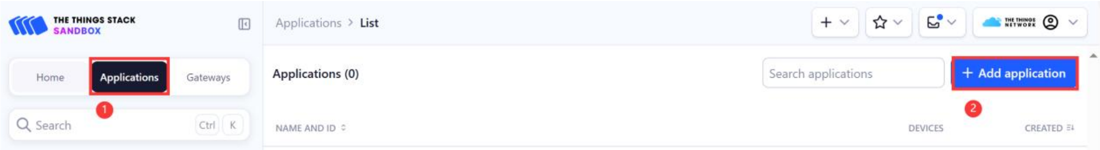
- Open The Things Network in your browser and login it. (Or register an account)



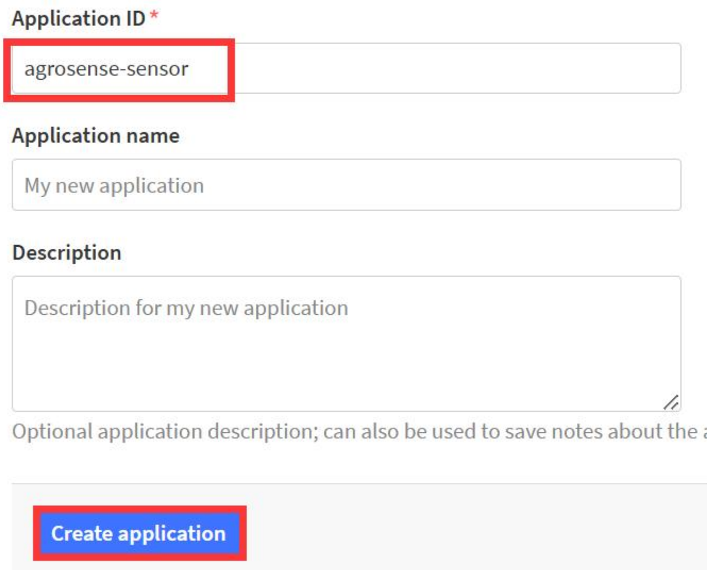
- Click “Console” and select clusters. (we take the European region for example.)



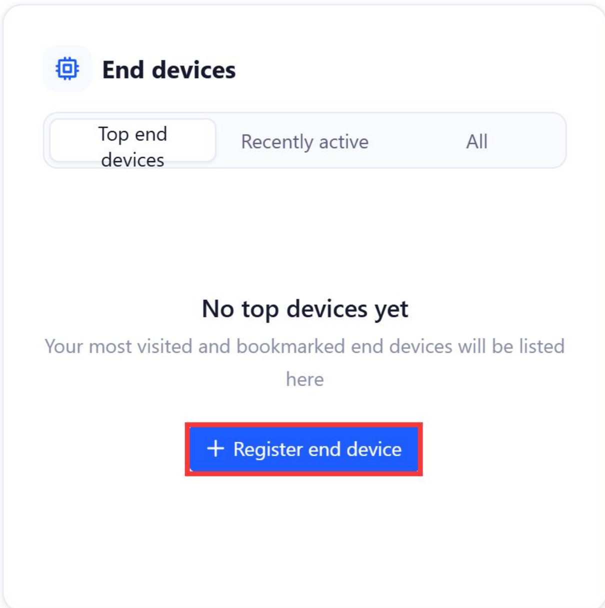
- Click “Go to applications” --> “+ Create application”.



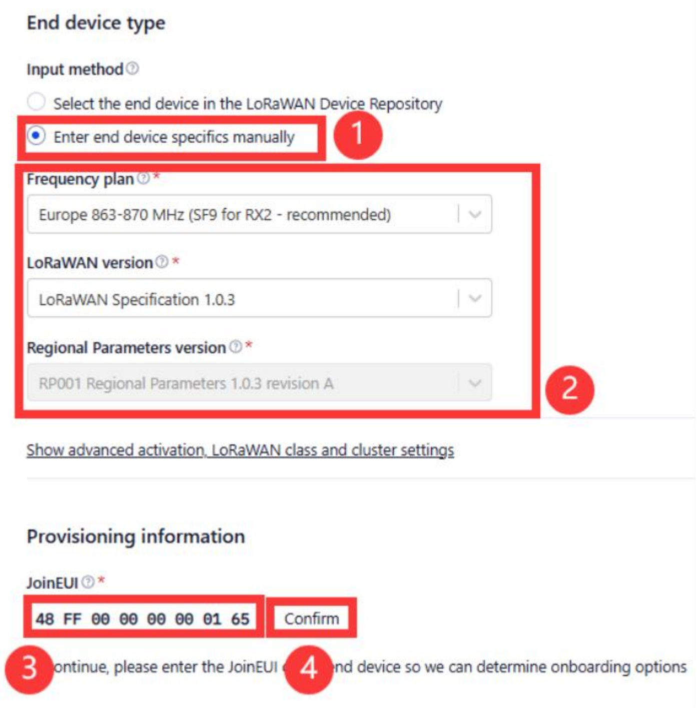
- Write the Application ID and click “Create application”.

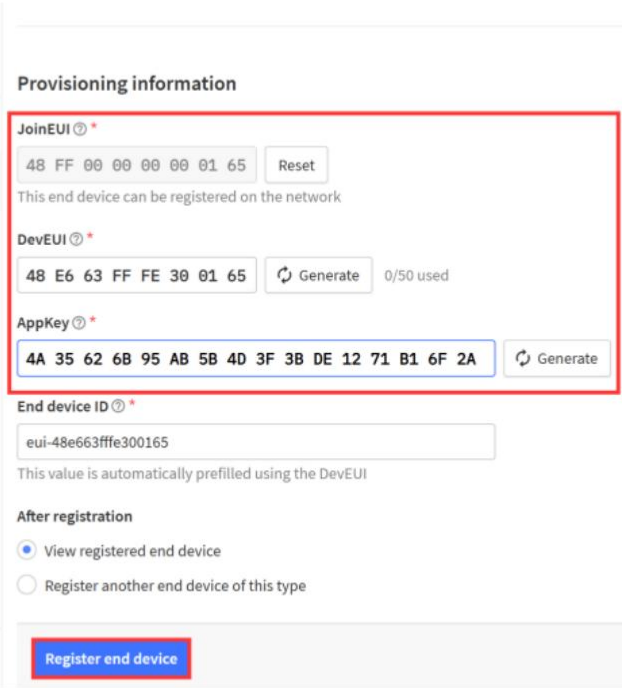


- Click “+ Register and device”.

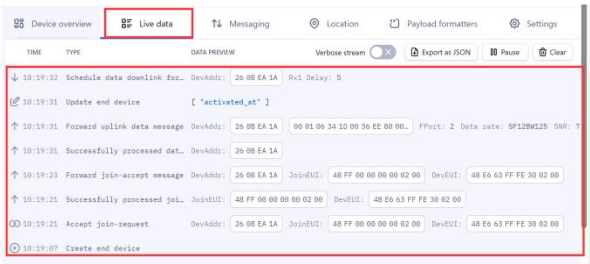


- Fllowing the steps, and input the DEV EUI/ APP EUI/ APP Key (notice: JoinEUI=APP EUI) and subsequently click on "Register end device" to complete the registration process.



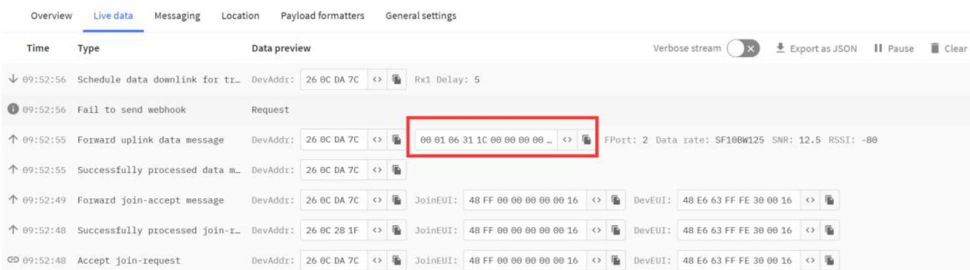


- Plug the battery and press RES button, you can see the device is connected successfully in the TTN.



3.1.2 Decoder

- Now, we need to decoder the data.



Data length	Data description	Value range	Explanation
byte 0	Data packet sequence number high 8 bits	0-0xFFFF	Counting starts from 0 and increments, resetting back to 0 after reaching 65535
byte 1	Data packet sequence number low 8 bits		
byte 2	Battery voltage		The value is obtained by amplifying the data by 10 times, and the actual value needs to be divided by 10 to convert to the actual battery voltage. The purpose of multiplying by 10 is to retain one decimal place of the voltage value. For example, if the value is 0x21 = 33, then the battery voltage is 3.3V.
byte 3	Shock status		Normal is 0, Shock is 1, Continuous Shock is 2
byte 4	GPS status		Invalid is 0, other is valid
byte 5	Year high 8 bits		For example, if the high 8 bits value is 0x07, and the low 8 bits value is 0xE8, then the obtained number of leaks is 0x07E8 = 2024. it is get number of year
byte 6	Year low 8 bits		

			value is 2024.
byte 7	Month		Corresponding month
byte 8	Day		Corresponding day
byte 9	Hour		Corresponding hour
byte 10	Minute		Corresponding minute
byte 11	Second		Corresponding second
byte 12	Latitude bits 24 to 31		The value is obtained by amplifying the data by 100000 times, and the actual value needs to be divided by 100000 to convert to the actual latitude. The purpose of multiplying by 100000 is to retain one decimal place of the latitude value. For example, if the value is 0x05316A82 = 87124610, then the latitude value is 871.24610.
byte 13	Latitude bits 16 to 23		
byte 14	Latitude bits 8 to 15		
byte 15	Latitude bits 0 to 7		
byte 16	N/S sign		Units of latitude
byte 17	Longitude bits 24 to 31		The value is obtained by amplifying the data by 100000 times, and the actual value needs to be divided by 100000 to convert to the actual longitude. The purpose of multiplying by 100000 is to retain one decimal place of the longitude value. For example, if the value is 0x02326A18 = 36858392, then the latitude value is 368.58392.
byte 18	Longitude bits 16 to 23		
byte 19	Longitude bits 8 to 15		
byte 20	Longitude bits 0 to 7		
byte 21	E/W sign		Units of longitude
byte 22	Shock switch status		Off is 0, on is 1
byte 23	Shock sensitivity status		Sensitive is 16, Not so sensitive is 32

Example: 0x00, 0x06, 0x24, 0x00, 0x01, 0x07, 0xE8, 0x0A, 0x19, 0x08, 0x39, 0x10, 0x00, 0x22, 0x7F, 0x7E, 0x4E, 0x00, 0xAD, 0xB1, 0x89, 0x45, 0x00

Data parsing：

Battery voltage is 3.6 V.

Latitude value is 22.60862

Longitude value is 113.83177

Shock status is 0.(No shock)

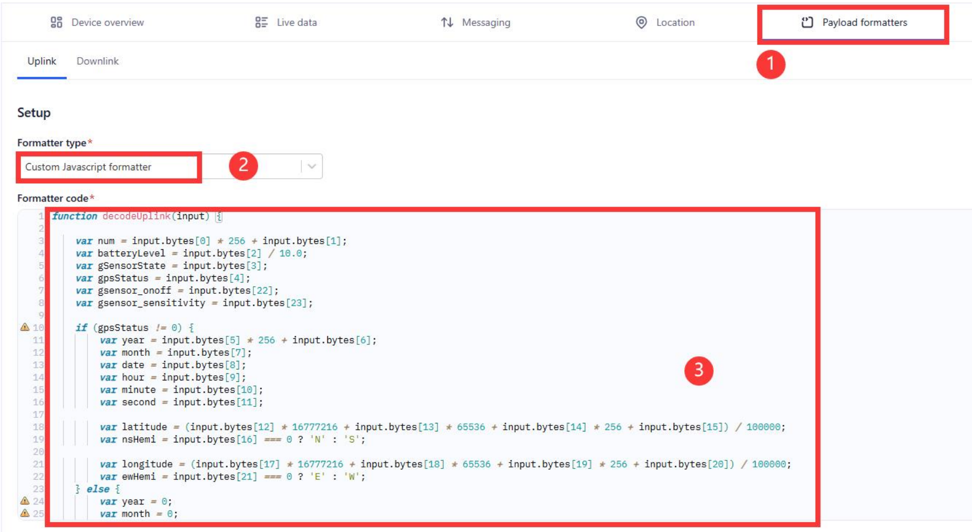
- Know how to decode it after, we need to write it in code. (You can check it out on Github)

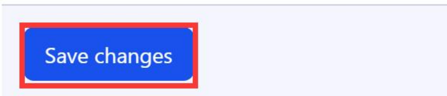
```
function decodeUplink(input) {
    var num = input.bytes[0] * 256 + input.bytes[1];
    var batteryLevel = input.bytes[2] / 10.0;
    var gSensorState = input.bytes[3];
```

```
    var gpsStatus = input.bytes[4];
    var gsensor_onoff = input.bytes[22];
    var gsensor_sensitivity = input.bytes[23];

    if (gpsStatus != 0) {
        var year = input.bytes[5] * 256 + input.bytes[6];
        var month = input.bytes[7];
        var date = input.bytes[8];
        var hour = input.bytes[9];
        var minute = input.bytes[10];
        var second = input.bytes[11];

        var latitude = (input.bytes[12] * 16777216 + input.bytes[13] * 65536 + input.bytes[14] * 256 +
input.bytes[15]) / 100000;
        var nsHemi = input.bytes[16] === 0 ? 'N' : 'S';

        var longitude = (input.bytes[17] * 16777216 + input.bytes[18] * 65536 + input.bytes[19] * 256 +
input.bytes[20]) / 100000;
        var ewHemi = input.bytes[21] === 0 ? 'E' : 'W';
    } else {
        var year = 0;
        var month = 0;
        var date = 0;
        var hour = 0;
        var minute = 0;
        var second = 0;
        var latitude = 0;
        var nsHemi = 'N';
        var longitude = 0;
        var ewHemi = 'E';
    }

    // Correct hemisphere values based on actual GPS data
    nsHemi = latitude < 0 ? 'S' : 'N';
    ewHemi = longitude < 0 ? 'W' : 'E';

    // Convert latitude and longitude to positive values if necessary
    latitude = Math.abs(latitude);
    longitude = Math.abs(longitude);

    return {
        data: {
            field1: batteryLevel,
            field2: latitude,
```

```
            field3: longitude,
            field4: gSensorState,
            field5: gsensor_onoff,
            field6: gsensor_sensitivity,
        },
    };
}
```

- Select “Payload formatters” and follow the steps.

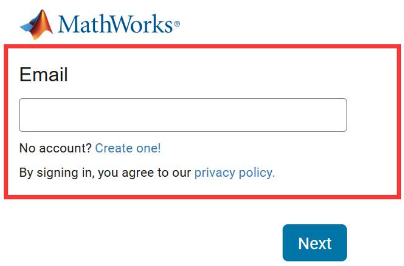




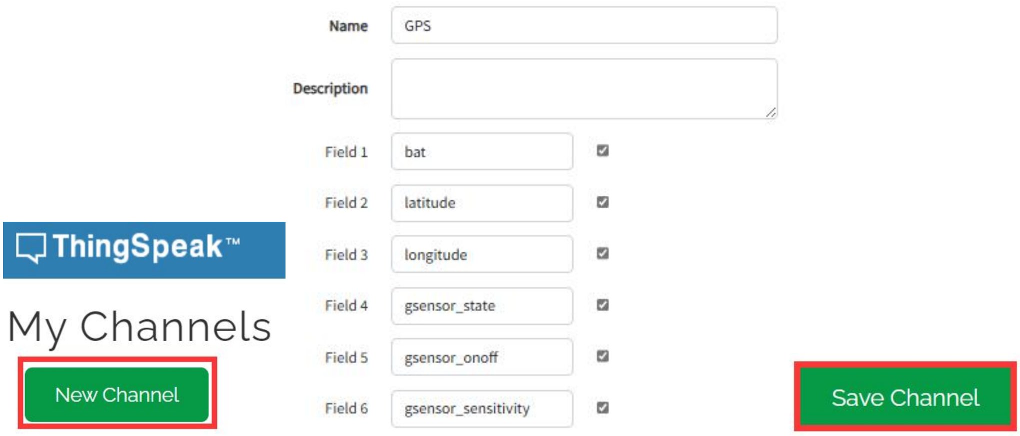
3.1.3 Application Server configuration

In the Application Server configuration, we need to create ThingSpeak channel and get Channel ID and API Key, this is the key to our connection to TTN.

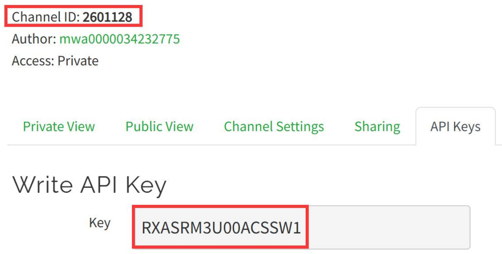
- Login to the ThingSpeak. (Or register an account)



- Click “New Channel”, fill in the Channel name and field names and click “Save Channel”.

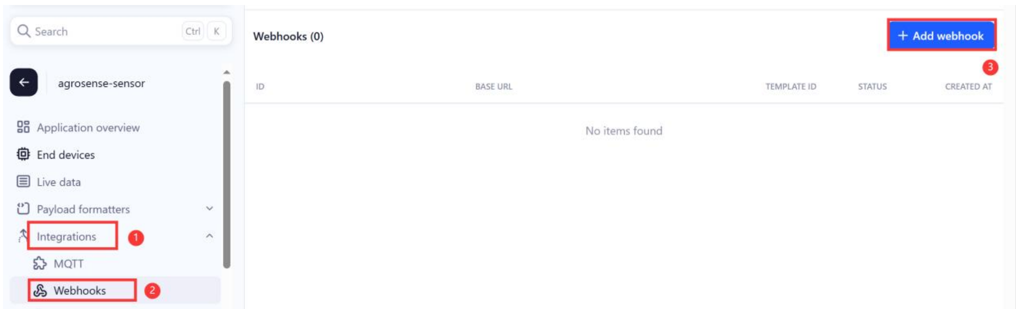


- After successful creation, copy the Channel ID and API Key.

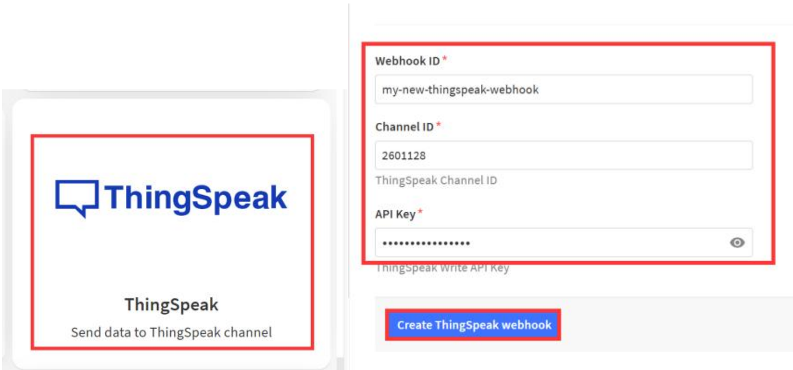


3.1.4 Connect the Network Server and Application Server

- In the TTN, click "integrations" --> "Webhooks" --> "+ Add webhook".



- Select "ThingSpeak", Fill in the Webhook ID and paste the Channel ID and API Key, click "Create ThingSpeak Webhook".

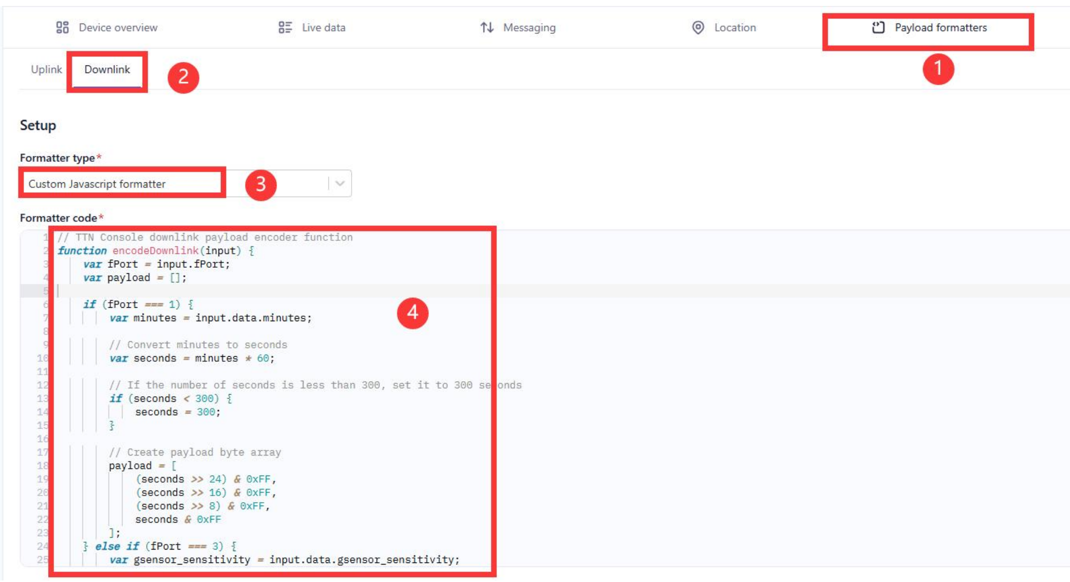


- Press RES button, wait about a minute, you will successfully see the data in ThingSpeak.(You will receive the data every hour.)

3.1.5 Change Time Interval and Sensor Sensitivity/on/off

1、If you need to change time Interval (Default 60 minutes), you can click "Payload formatters-->Downlink" and follow the steps.

Formatter code you can find in Github.

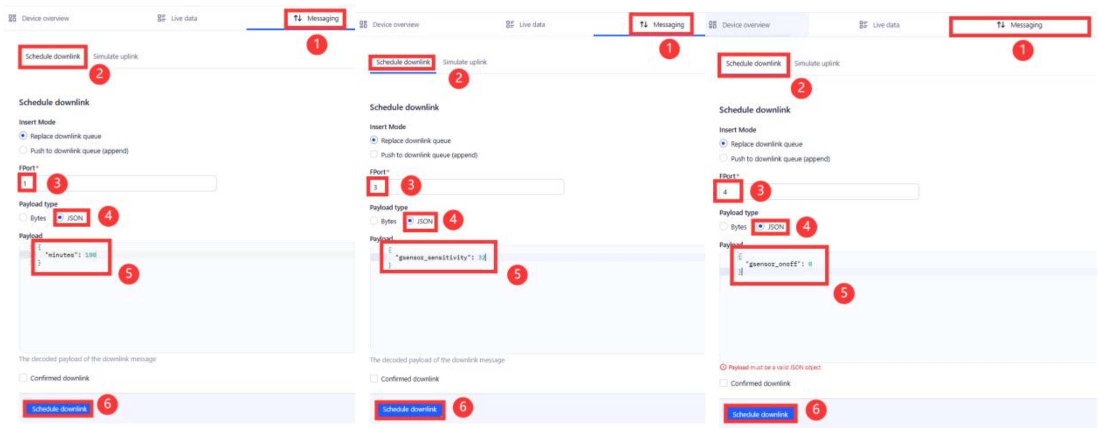


2、Click “Save changes”.

3、Click “Messaging-->Schedule downlink”.

Note: you must use this format:

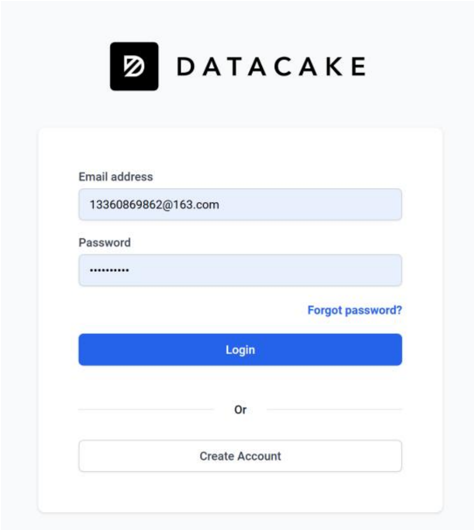
```
{
   "minutes": 5
}
{
   "gsensor_sensitivity": 32
}
{
   "gsensor_onoff": 0
}
```



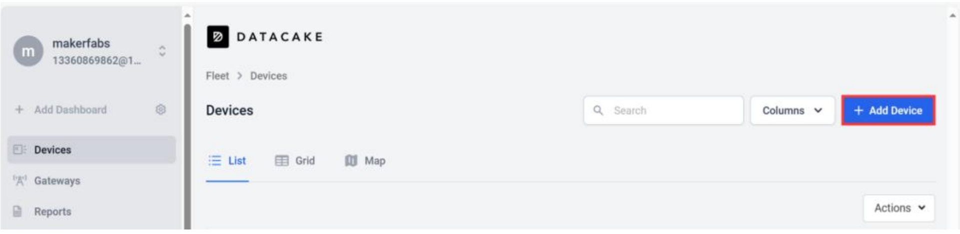
4、The modified interval will be updated after the next data upload.

3.2 Datacake

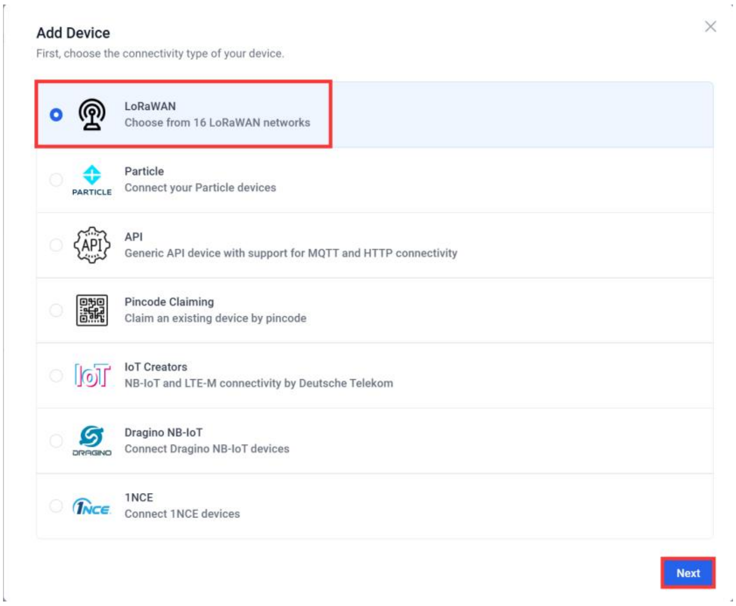
1、Login datacake or Create Account



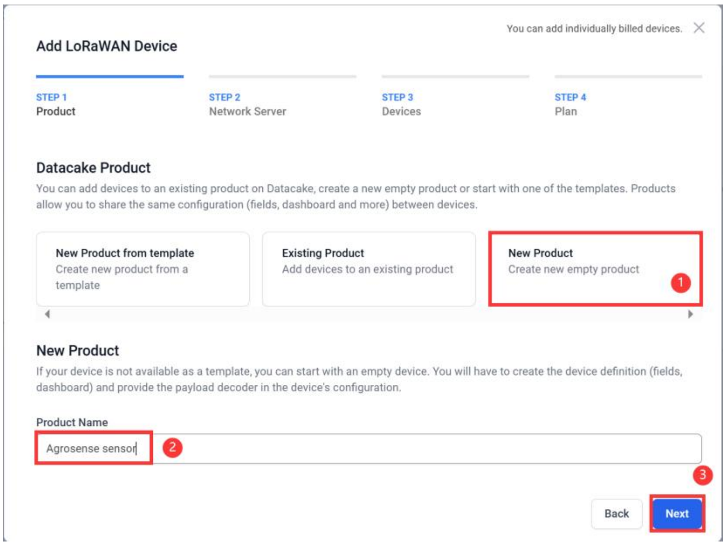
2、Click “Add Device”



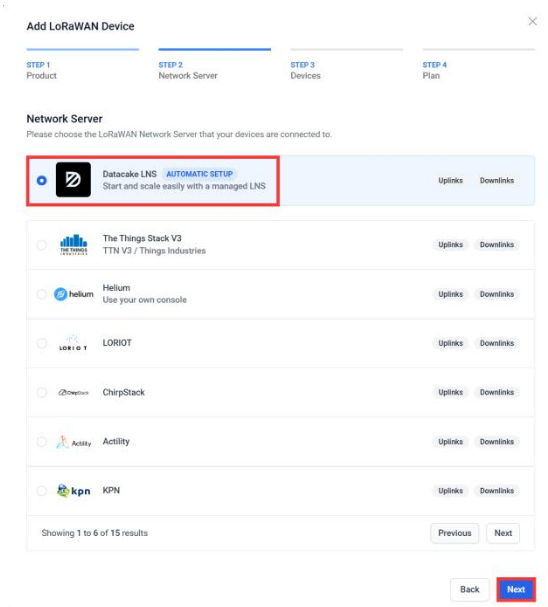
3、Select LoRaWAN and click “Next”



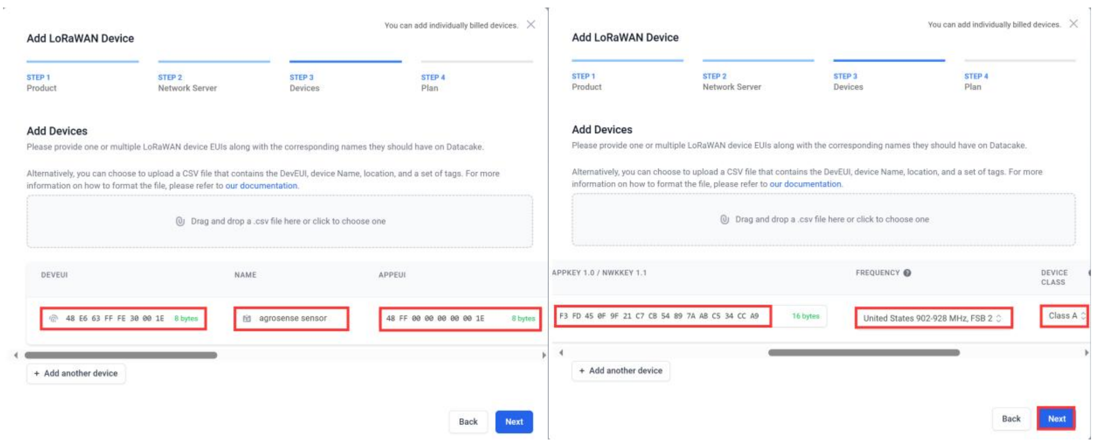
4、Select a Product based on your needs, take "Create new empty product" as an example.



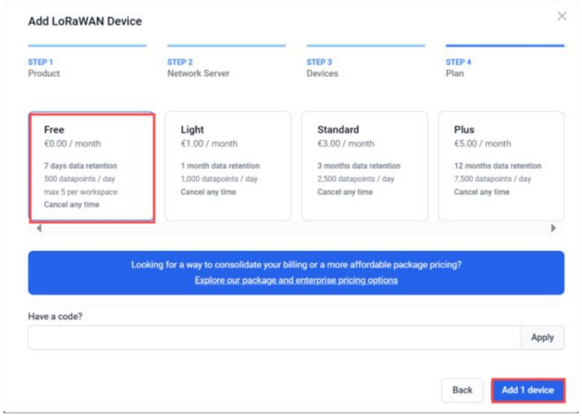
5、Select "Datacake LNS"



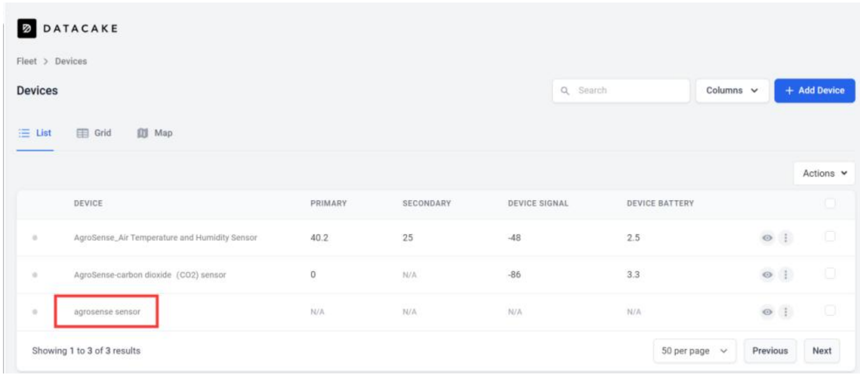
6、Enter DEVEUI、APPEUI、APPKEY、FREQUENCY(take 915 for example) and DEVICE CLASS.



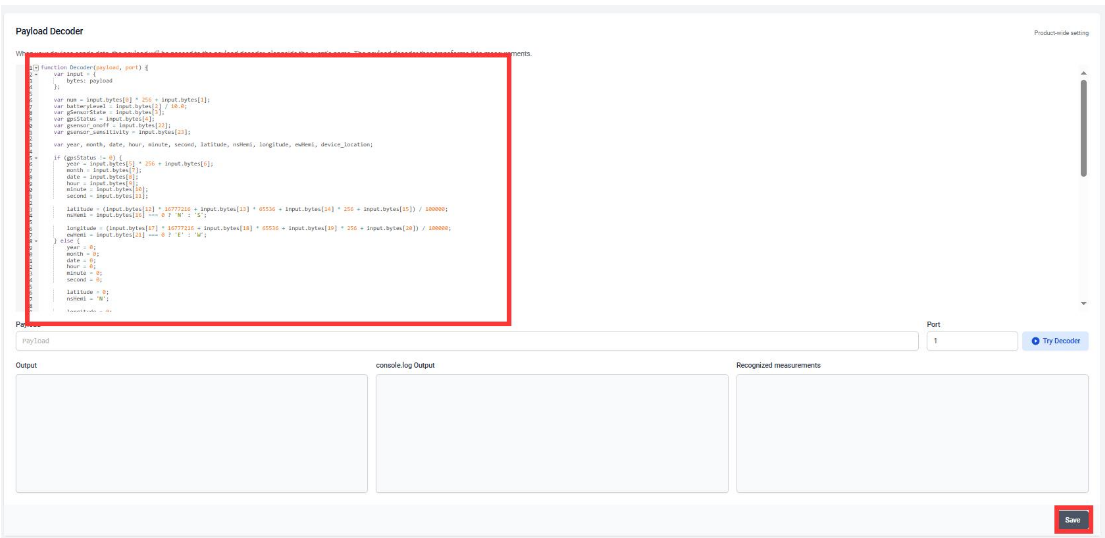
7、Choose the type according to your needs, and click “Add 1 device”.



8、Click to go to the device you just added.



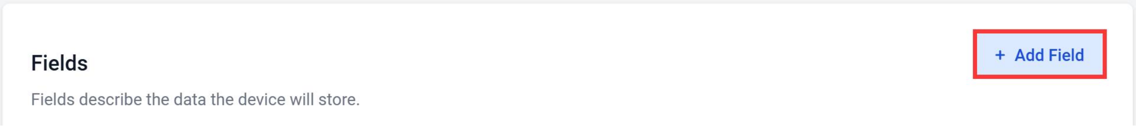
9、Click “Configuration”, enter Decoder and click “Save”.(You can check it out on Guihub)

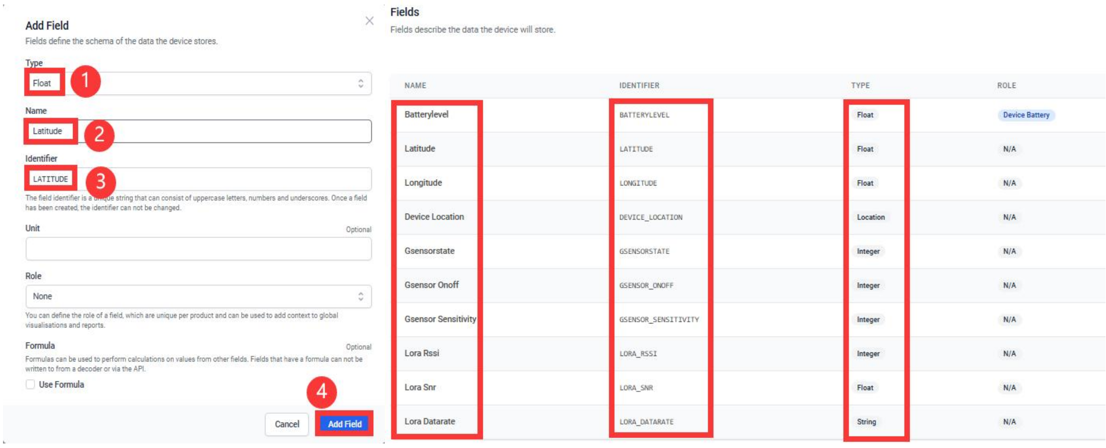


```
function Decoder(payload, port) {
    var input = {
        bytes: payload
    };

    var num = input.bytes[0] * 256 + input.bytes[1];
    var batteryLevel = input.bytes[2] / 10.0;
    var gSensorState = input.bytes[3];
    var gpsStatus = input.bytes[4];
    var gsensor_onoff = input.bytes[22];
    var gsensor_sensitivity = input.bytes[23];

    var year, month, date, hour, minute, second, latitude, nsHemi, longitude, ewHemi, device_location;

    if (gpsStatus != 0) {
        year = input.bytes[5] * 256 + input.bytes[6];
        month = input.bytes[7];
        date = input.bytes[8];
        hour = input.bytes[9];
        minute = input.bytes[10];
        second = input.bytes[11];

        latitude = (input.bytes[12] * 16777216 + input.bytes[13] * 65536 + input.bytes[14] * 256 +
input.bytes[15]) / 100000;
        nsHemi = input.bytes[16] === 0 ? 'N' : 'S';

        longitude = (input.bytes[17] * 16777216 + input.bytes[18] * 65536 + input.bytes[19] * 256 +
input.bytes[20]) / 100000;
        ewHemi = input.bytes[21] === 0 ? 'E' : 'W';
    } else {
        year = 0;
        month = 0;
        date = 0;
        hour = 0;
        minute = 0;
        second = 0;
        latitude = 0;
        nsHemi = 'N';
        longitude = 0;
        ewHemi = 'E';
    }

    // Correct hemisphere values based on actual GPS data
    nsHemi = latitude < 0 ? 'S' : 'N';
```

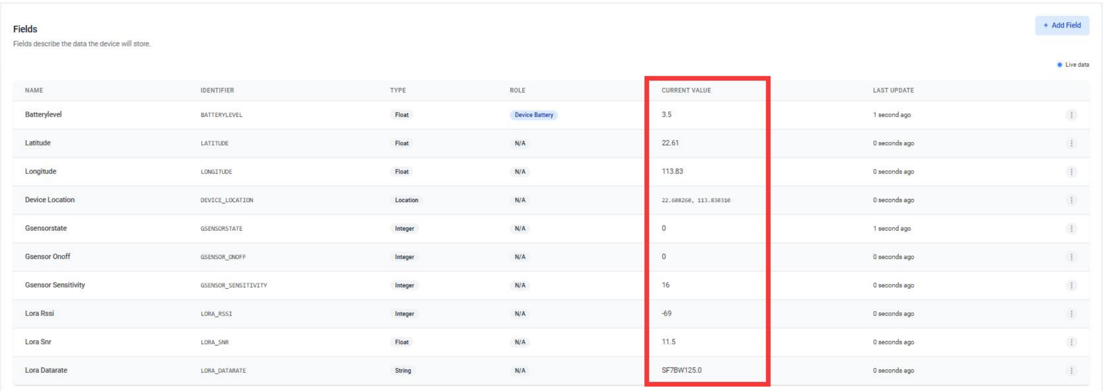
```
    ewHemi = longitude < 0 ? 'W' : 'E';

    // Convert latitude and longitude to positive values if necessary
    latitude = Math.abs(latitude);
    longitude = Math.abs(longitude);

    var decoded = {
        batteryLevel: batteryLevel,
        gSensorState: gSensorState,
        latitude: latitude,
        longitude: longitude,
        device_location: "(" + latitude + "," + longitude + ")"
        gsensor_onoff: gsensor_onoff,
        gsensor_sensitivity: gsensor_sensitivity
    };

    // Test for LoRa properties in normalizedPayload
    try {
        console.log('normalizedPayload:', normalizedPayload);    // Log to check normalizedPayload structure
        decoded.lora_rssi =
            (normalizedPayload.gateways && Array.isArray(normalizedPayload.gateways) &&
normalizedPayload.gateways.length > 0 && normalizedPayload.gateways[0].rssi) || 0;
        decoded.lora_snr =
            (normalizedPayload.gateways && Array.isArray(normalizedPayload.gateways) &&
normalizedPayload.gateways.length > 0 && normalizedPayload.gateways[0].snr) || 0;
        decoded.lora_datarate = normalizedPayload.data_rate || 'not retrievable';
    } catch (error) {
        console.log('Error occurred while decoding LoRa properties: ' + error);
    }

    return [
        { field: "batteryLevel", value: decoded.batteryLevel },
        { field: "gSensorState", value: decoded.gSensorState },
        { field: "latitude", value: decoded.latitude },
        { field: "longitude", value: decoded.longitude },
        { field: "device_location", value: decoded.device_location },
        { field: "gsensor_onoff", value: decoded.gsensor_onoff },
        { field: "gsensor_sensitivity", value: decoded.gsensor_sensitivity },
        { field: "lora_rssi", value: decoded.lora_rssi },
        { field: "lora_snr", value: decoded.lora_snr },
        { field: "lora_datarate", value: decoded.lora_datarate }
    ];
}
```

10、 Follow the steps to add a field. (Every fields is the same way)





11、 Press RST button, wait until the sensor connects to the gateway successfully, you will see the data the sensor is currently reading.



Fields

Fields describe the data the device will store.

+ Add Field

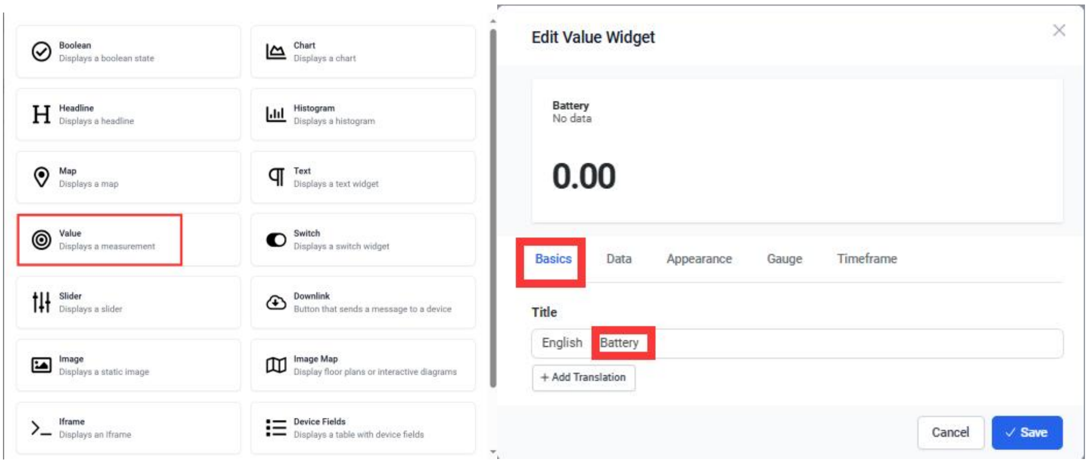
Live data

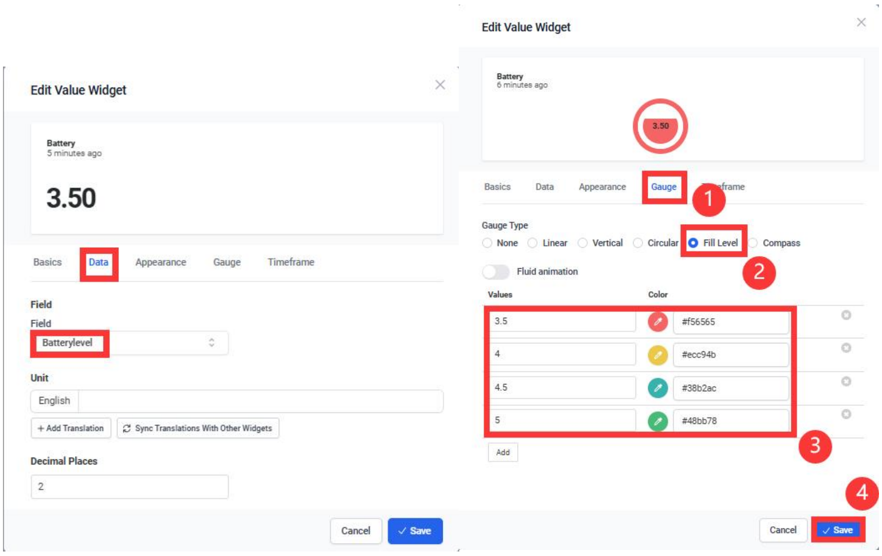
NAME	IDENTIFIER	TYPE	ROLE	CURRENT VALUE	LAST UPDATE
Batterylevel	BATTERYLEVEL	Float	Device Battery	3.5	1 second ago
Latitude	LATITUDE	Float	N/A	22.61	0 seconds ago
Longitude	LONGITUDE	Float	N/A	113.83	0 seconds ago
Device Location	DEVICE_LOCATION	Location	N/A	22.608260, 113.830310	0 seconds ago
Gsensorstate	GSENSORSTATE	Integer	N/A	0	1 second ago
Gsensor Onoff	GSENSOR_ONOFF	Integer	N/A	0	0 seconds ago
Gsensor Sensitivity	GSENSOR_SENSITIVITY	Integer	N/A	16	0 seconds ago
Lora Rssi	LORA_RSSI	Integer	N/A	-69	0 seconds ago
Lora Snr	LORA_SNR	Float	N/A	11.5	0 seconds ago
Lora Datarate	LORA_DATARATE	String	N/A	SF7BW125.0	0 seconds ago

12、 To get a better look at the data, we can add widget.

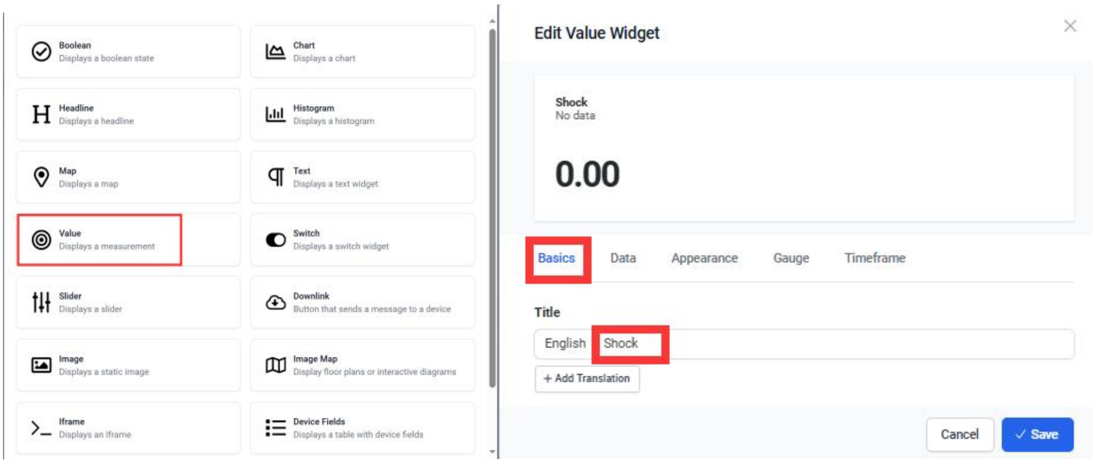
Click “Dashboard-->switch-->+ Add Widget”.

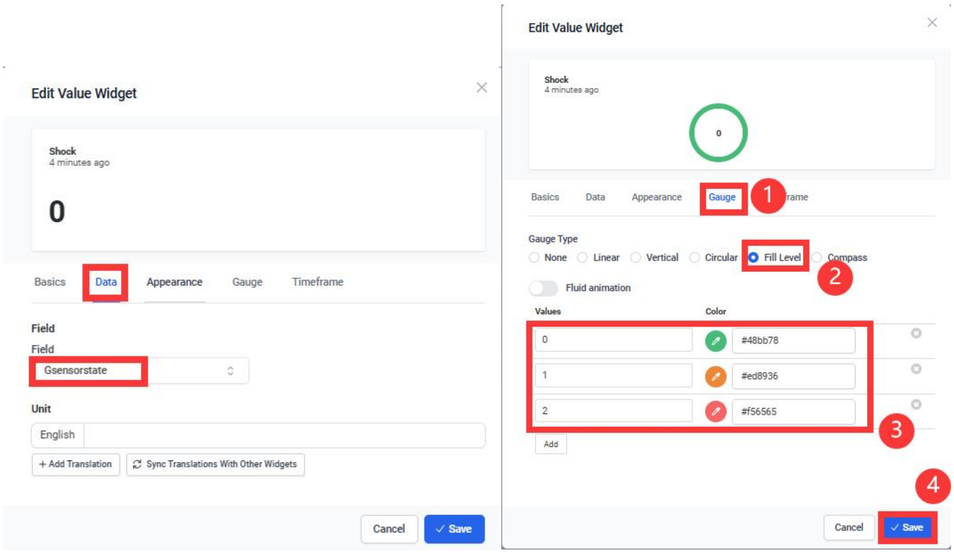
13、Select “Value” and set Title, Field and presentation form as well as the interval color.



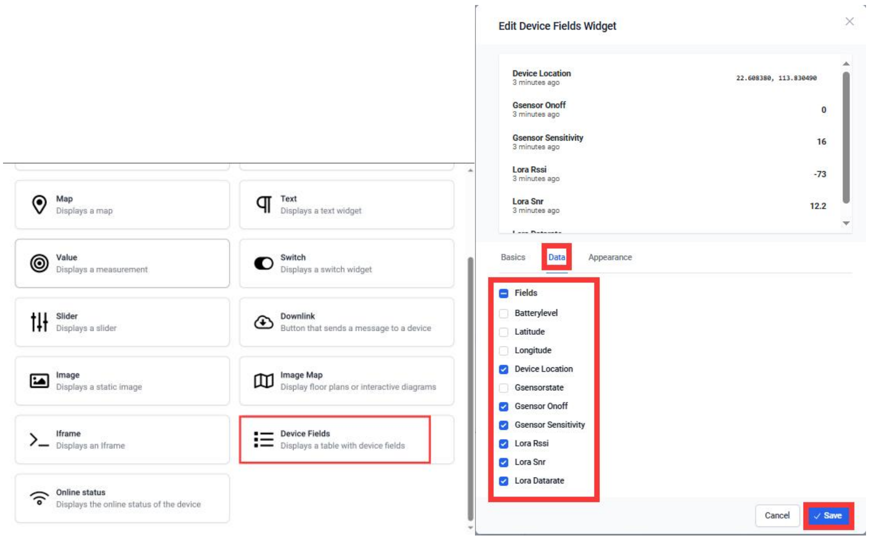


14、Select “Value” and set Title, Field and presentation form as well as the interval color.

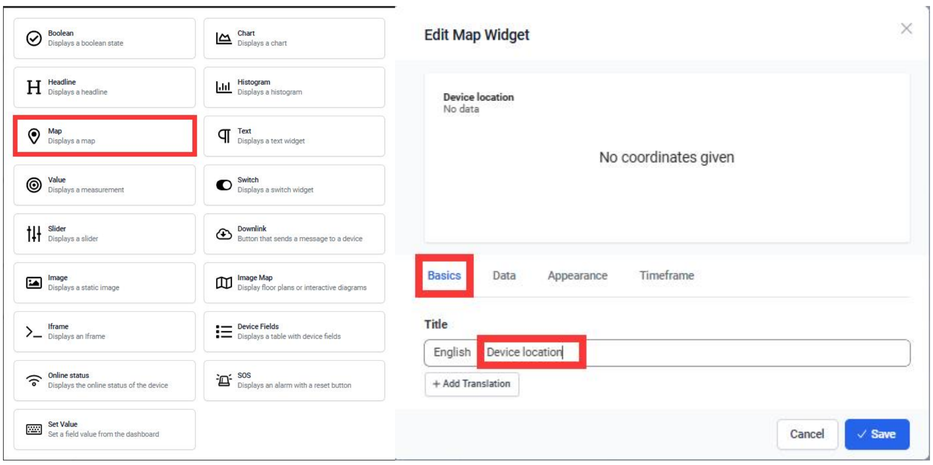


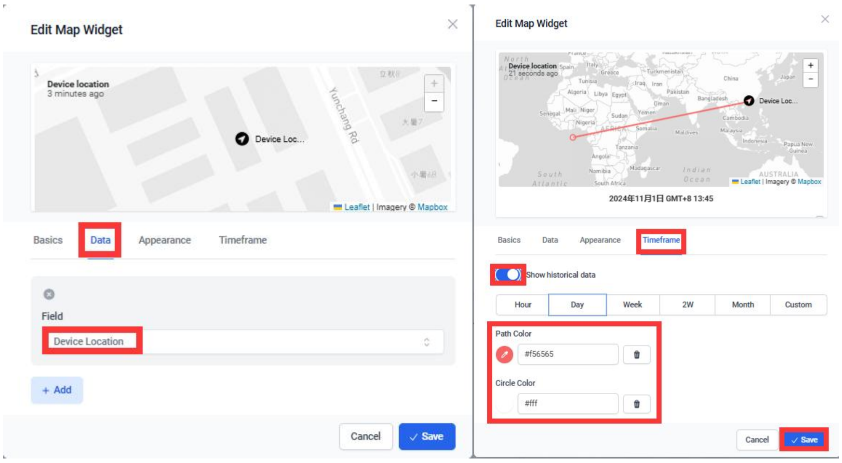


15、Select Device Fields, select the field you want to monitor and click “Save”.

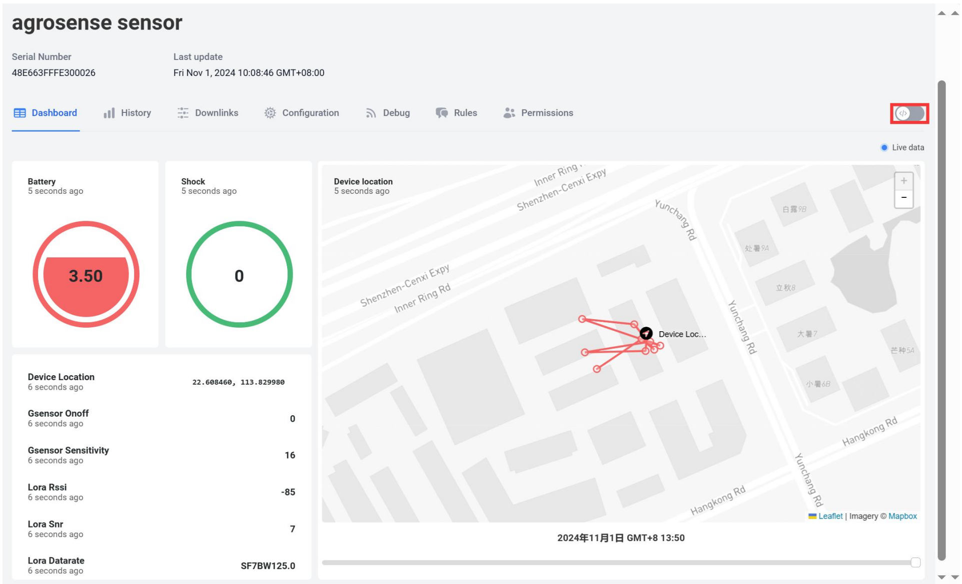


16、Select Map, and set Title, Field and color.



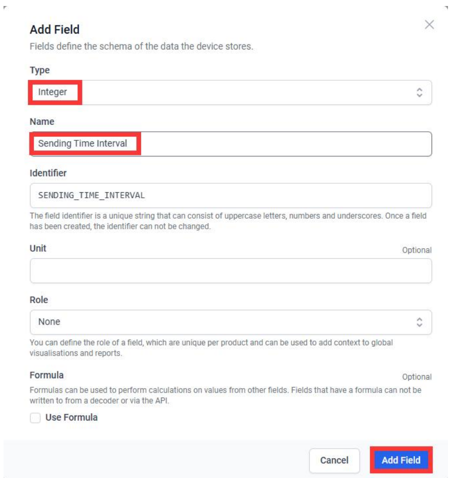


17、Click the switch to save, and you can see the data visually.

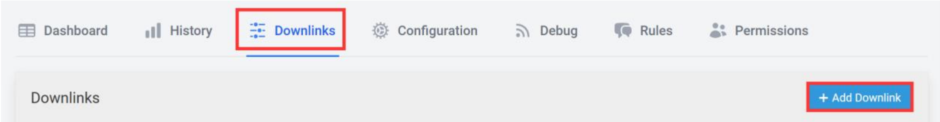


3.2.1 Change Time Interval and Sensor On/Off/Sensitivity

1、If you need to change time Interval (Default 60 minutes), Shock Sensor on/off (Default on), Shock Sensor Sensitivity (Default 16), you can click “Configuration-->Fields-->+Add Field”.



2、Click ”Downlink-->Add Downlink”.



Enter name、description、fields used and payload encoder respectively.

Change time Interval:

Name: Set User-Defined Sending Time Interval

Description: Set the user-defined report transmission interval and store it in the configuration variable.(5Min-1440Min).

Shock Sensor on/off:

Name: Change GSensor On/Off.

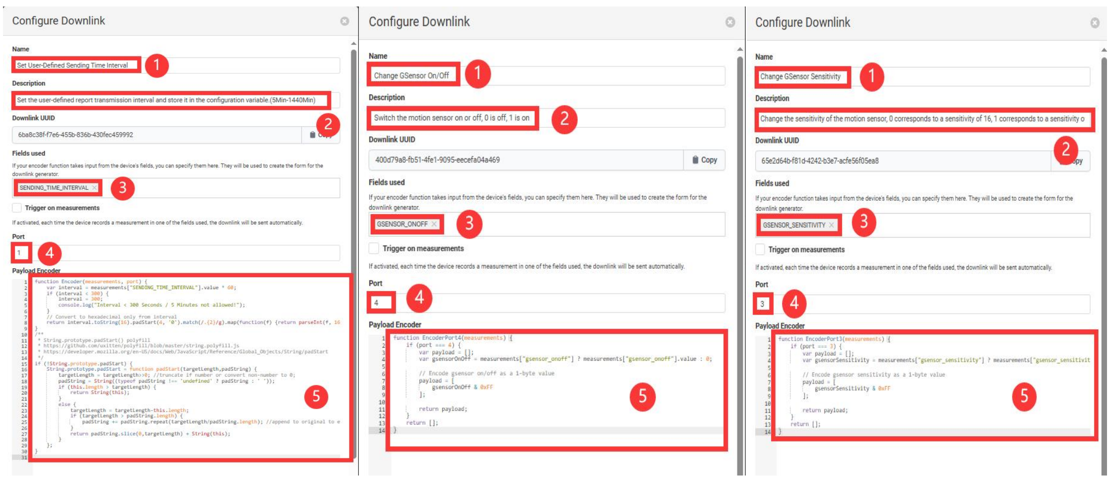
Description: Switch the motion sensor on or off, 0 is off, 1 is on.

Shock Sensor Sensitivity:

Name: Change GSensor Sensitivity.

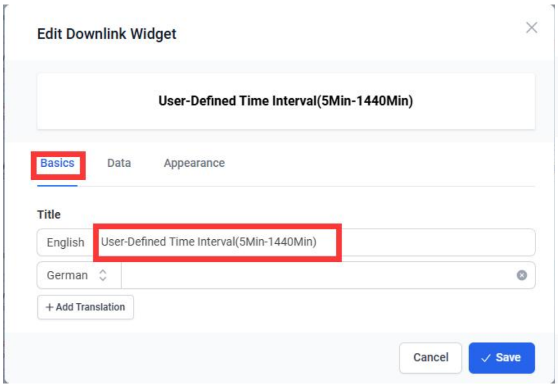
Description: Change the sensitivity of the motion sensor, 0 corresponds to a sensitivity of 16, 1 corresponds to a sensitivity of 32.

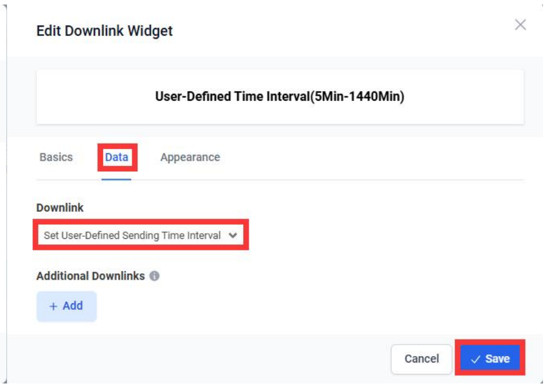
Payload Encoder: copy in Github.



3、Click “Dashboard-->switch-->+ Add Widget”.

Select “Downlink” and setting as follow image. (Sensor On/Off/Sensitivity as the same way)





4、 Click the switch to save, and you can click to change your time Interval, shock sensor on/off/sensitivity.