AgroSense_Ultrasonic Ranger Sensor

LoRaWAN® Manual

V1.0

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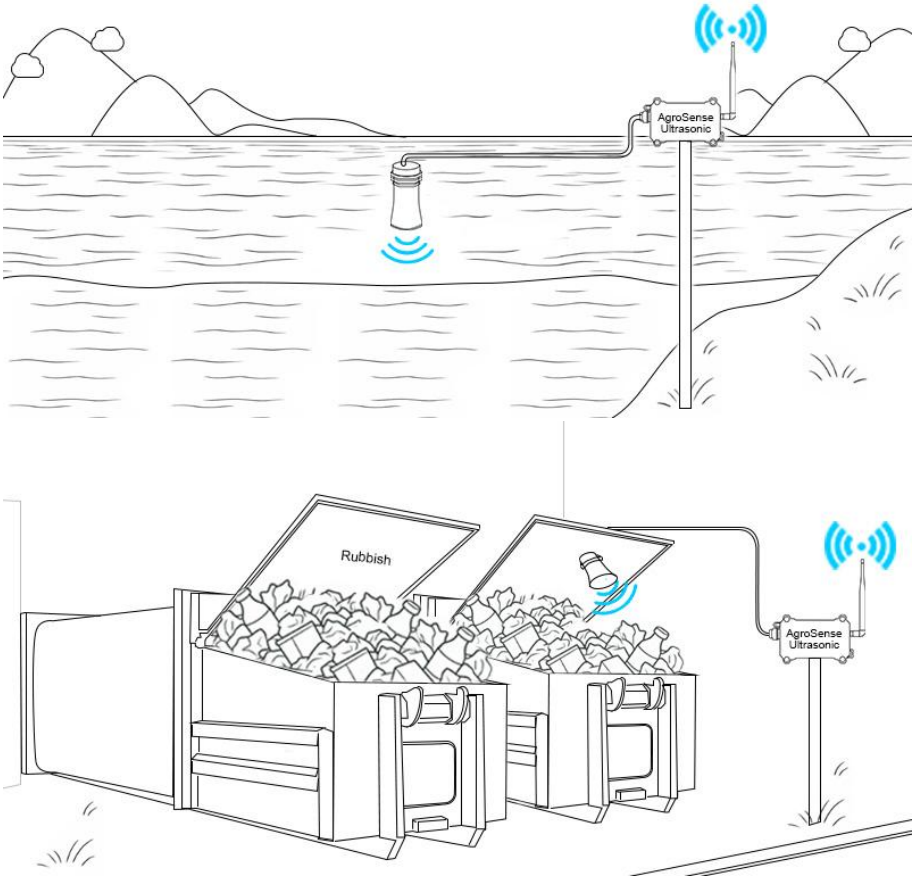
Contents

1 Product Description

1.1 Introduction

This AgroSense LoRaWAN® Ultrasonic Ranger target distance & level measurement applications/None-contact detection; the device is able to detect a wide arrange of objects include liquids, with measuring precision +/- 1%, arrange from 280 ~ 7500 mm. It reports the measurement data via LoRaWAN® protocol V1.0.3, Class A, every 1 hour by default(with user can free set this) to Cloud service such TTN or DataCake, for LoRaWAN® remote monitoring. Suitable scenarios such as horizontal distance measurement, location measurement, parking management systems, object proximity and storage detection, water level monitoring…



The device is boasted with IP68 for hash environment, unlike wireline devices, it is battery-powered, reducing the workload and complexity of deployment, with battery 18650, it works at least 1 years for each charging.

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 (5min-1440min).

1.3 Parameter

1. General Parameters

Product Model	AGLWUR01
Blind Zone Distance	≤ 280mm
Measurement Accuracy	±1%
Range (Without Mute Port)	280 ~ 4500 mm
Range (With Mute Port)	280 ~ 7500 mm
Angle (Without Mute Port)	≈ 40°

2.Wireless Parameters

Communication Protocol	Standard LoRaWAN® protocol V1.0.3
Network Access/Operating Mode	OTAA Class A
MAX Transmit Power	21dBm
Receiver Sensitivity	-137dBm/125kHz SF=12
Frequency Band	EU868/US915

3.Physical Parameters

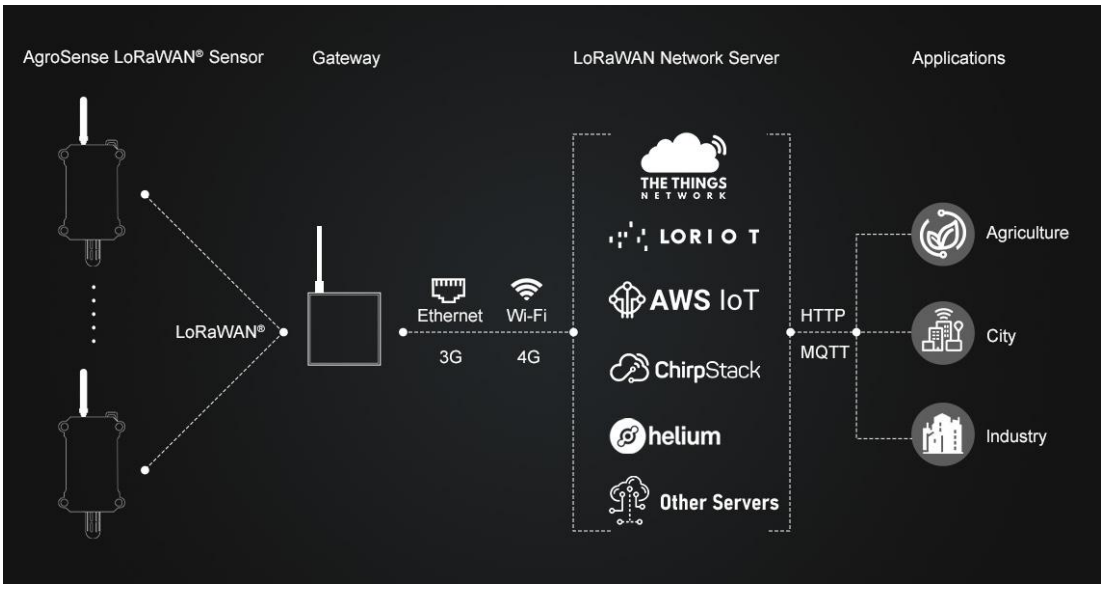
Power Supply	1 x 18650 3.7V Lion batteries
Operating Temperature	-15°C ~ 60°C
Protection Class	IP68
Dimensions	131 × 62.7 × 27.5 mm
Mounting	Wall Mounting

2 Technical route

2.1 System Framework

AgroSense_Ultrasonic Ranger 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 range is:

1. Collect the range 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 range data 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 or Datacake 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.

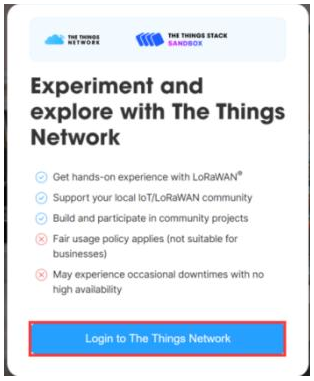
DEV EUI	Unique identification of device, authorized by IEEE
APP EUI	Unique identification of application
APP Key	One of the join network parameters on OTAA mode, calculated by DE EUI

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

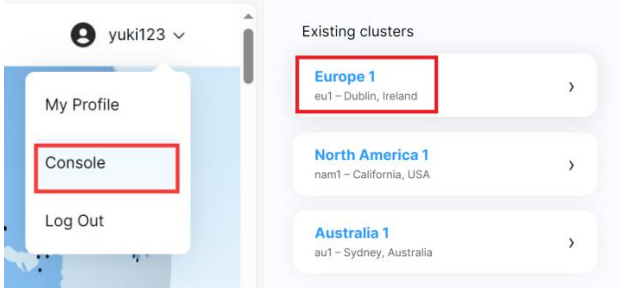
3.1 TTN and ThingSpeak

3.1.1 Network Server configuration

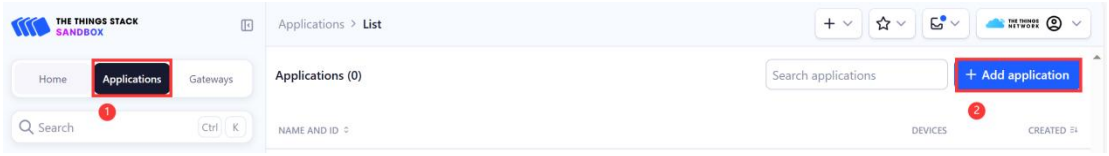
- Open The Things Network in your browser and login it. (Or register an account)



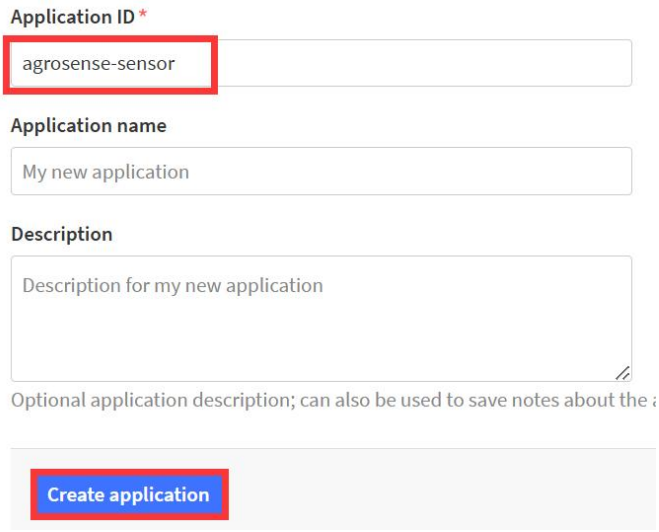
- Click “Console” and select clusters. (we take the European region for example.)



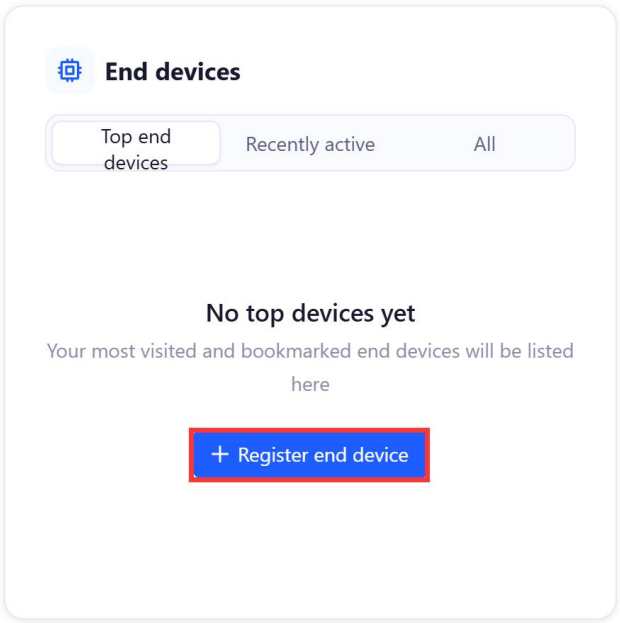
- Click “Go to applications” --> “+ Create application”.



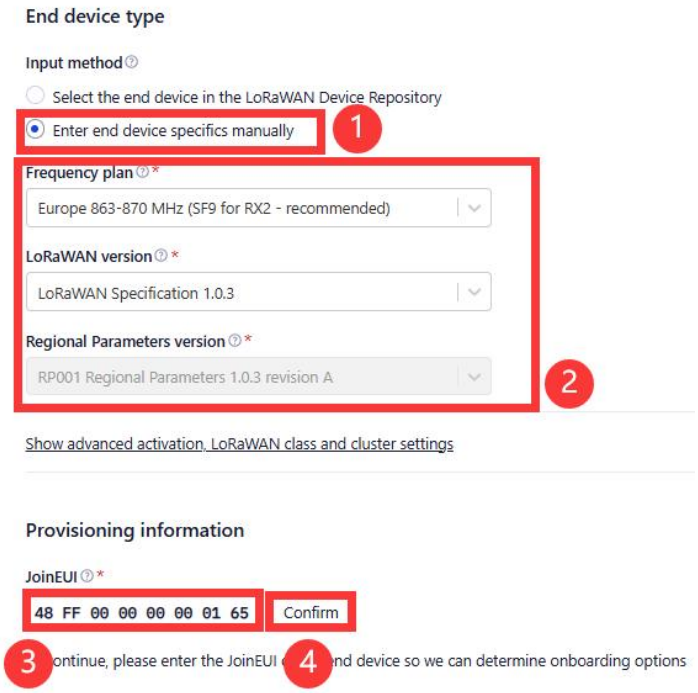
- Write the Application ID and click “Create application”.

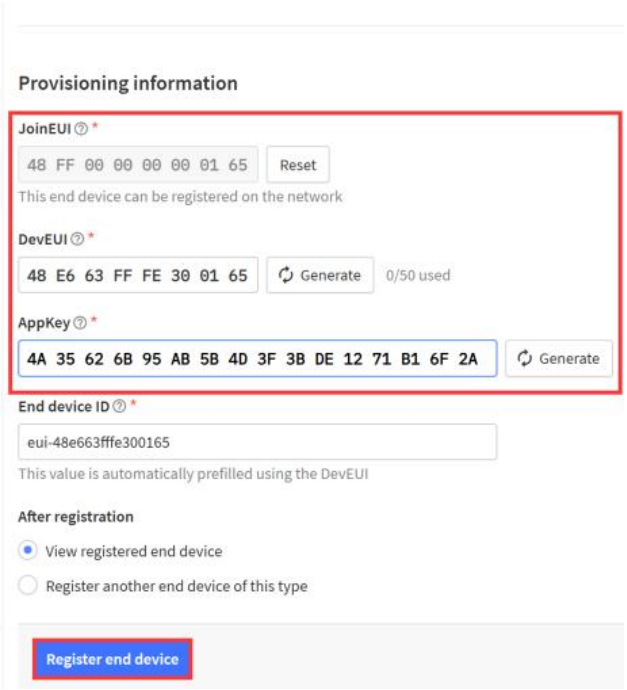


- Click “+ Register and device”.

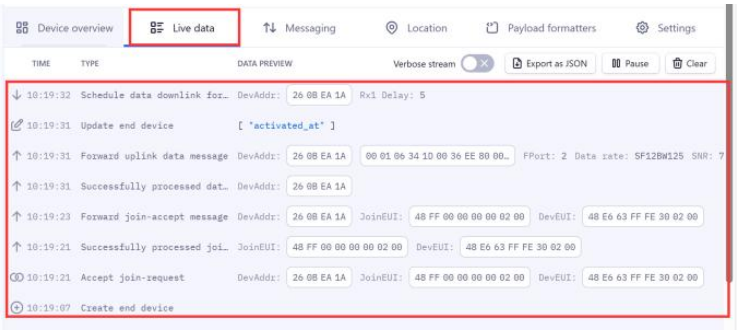


- Fllowing the steps, and input the DEV EUI/ APP EUI/ APP Key (notice: JoinEUI=APP EUI) and subsequently click on "Register end device" to complete the registration process.



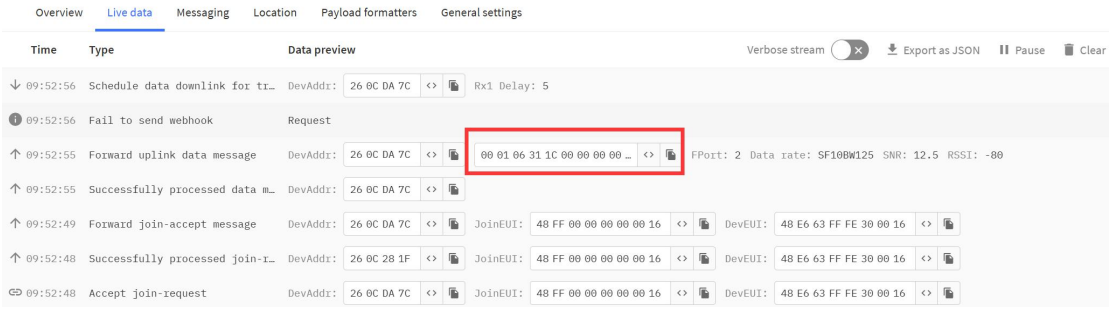


- Plug the battery and press RES button, you can see the device is connected successfully in the TTN.



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	Ranger bits 8 to 15		if the value is 0x21 (33), the actual voltage is 33 mm

byte 4	Ranger bits 0 to 7		
byte 5	data transmission interval bits 24 to 31		The time interval for data transmission has been increased by a factor of 100. The unit is seconds.
byte 6	data transmission interval bits 16 to 23		
byte 7	data transmission interval bits 8 to 15		
byte 8	data transmission interval bits 0 to 7		
Fport 1	Change the data sending interval		5min-1440min

Example: 0x00, 0x01, 0x21, 0x01, 0x2C, 0x00, 0x09, 0x27, 0xC0

Data parsing：

Battery voltage is 3.3V.

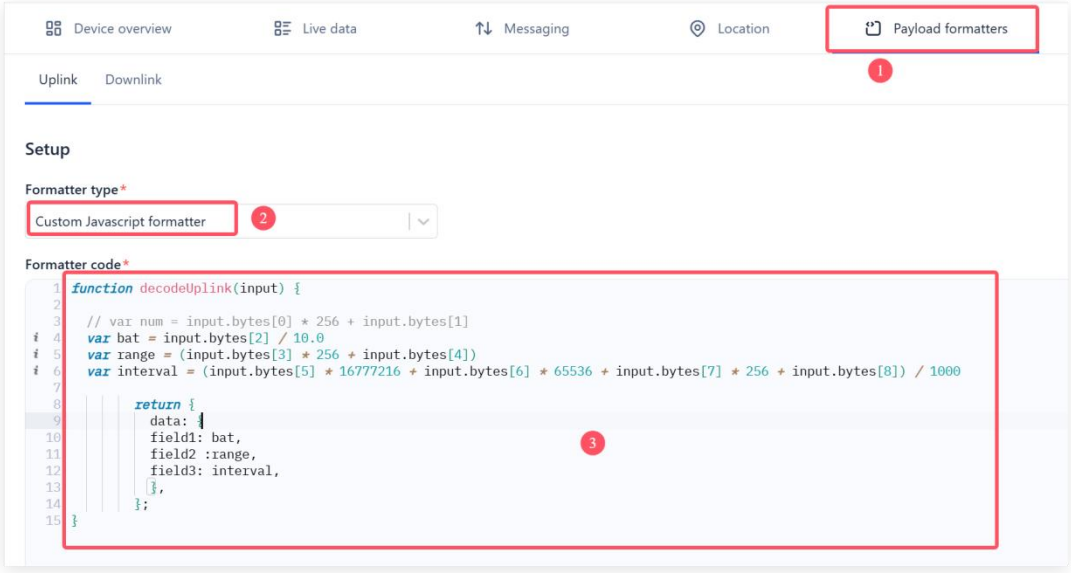
Range value is 300mm.

Data transmission interval value is 600s.

- 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 bat = input.bytes[2] / 10.0
  var range = (input.bytes[3] * 256 + input.bytes[4])
  var interval = (input.bytes[5] * 16777216 + input.bytes[6] * 65536 + input.bytes[7] * 256 + input.bytes[8]) /
1000

        return {
          data: {
          field1: bat,
          field2 :range,
          field3: interval,
          },
        };
}
```

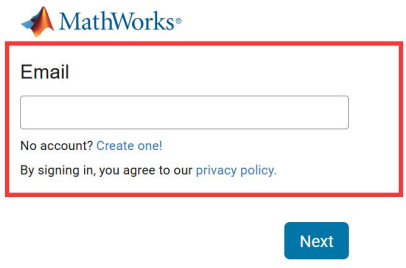
- Select “Payload formatters” and follow the steps.



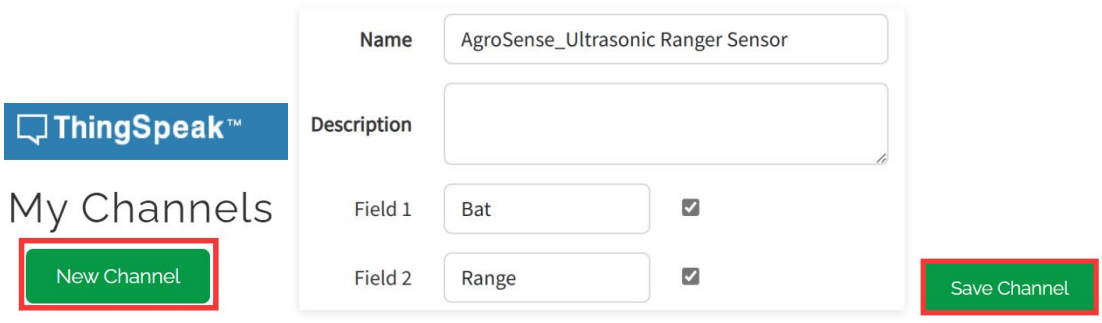
3.1.3 Application Server configuration

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.

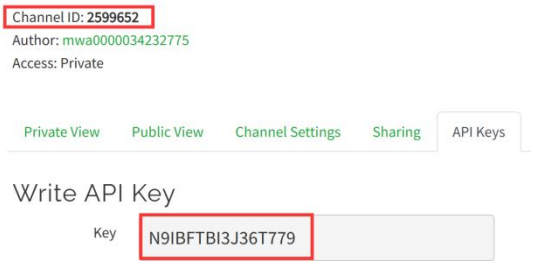
- Login to the ThingSpeak. (Or register an account)



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

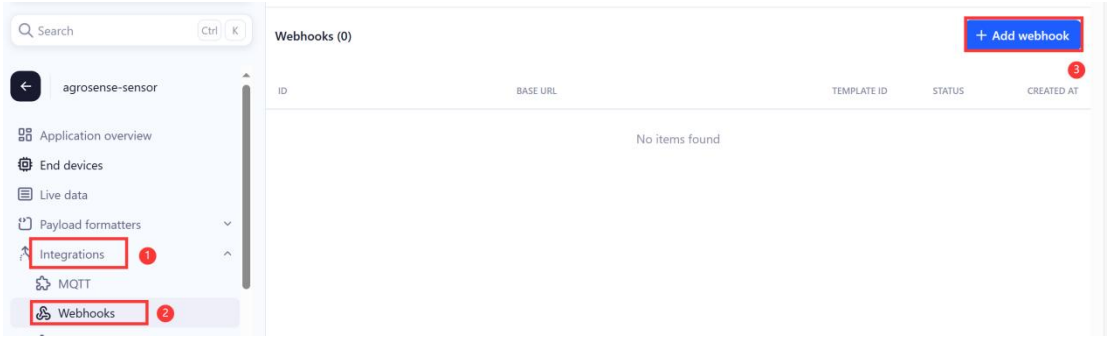


- After successful creation, copy the Channel ID and API Key.

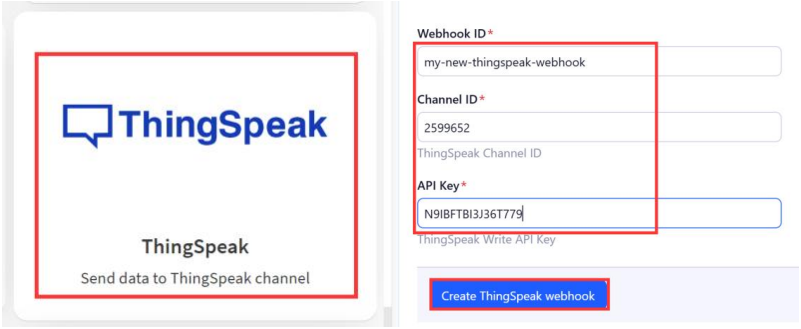


3.1.4 Connect the Network Server and Application Server

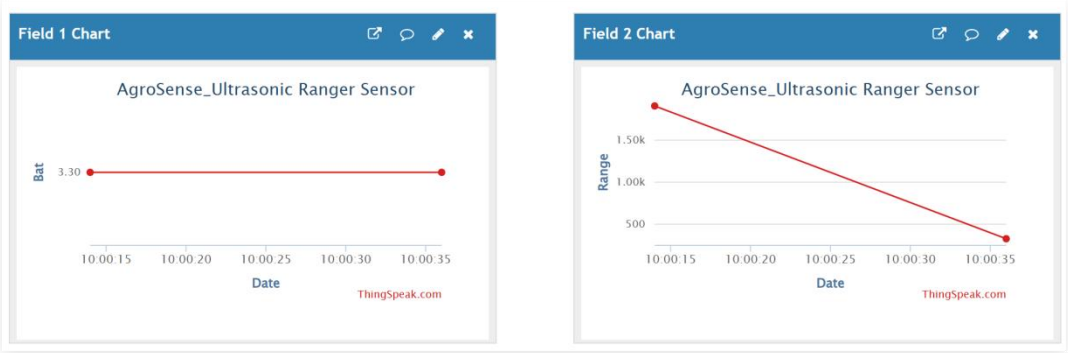
- In the TTN, click “integrations” --> “Webhooks” --> “+ Add webhook”.



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



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



3.1.5 Downlink

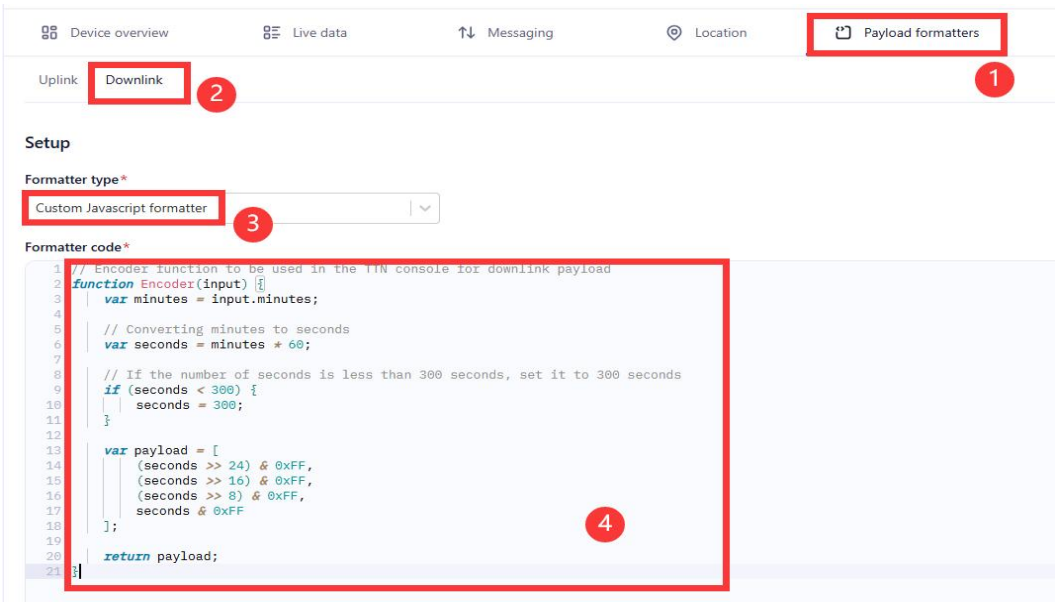
The downlink has two functions:

- Modification time interva (Fport1)

Modify the time interval for uploading data, the default is one hour.

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”.

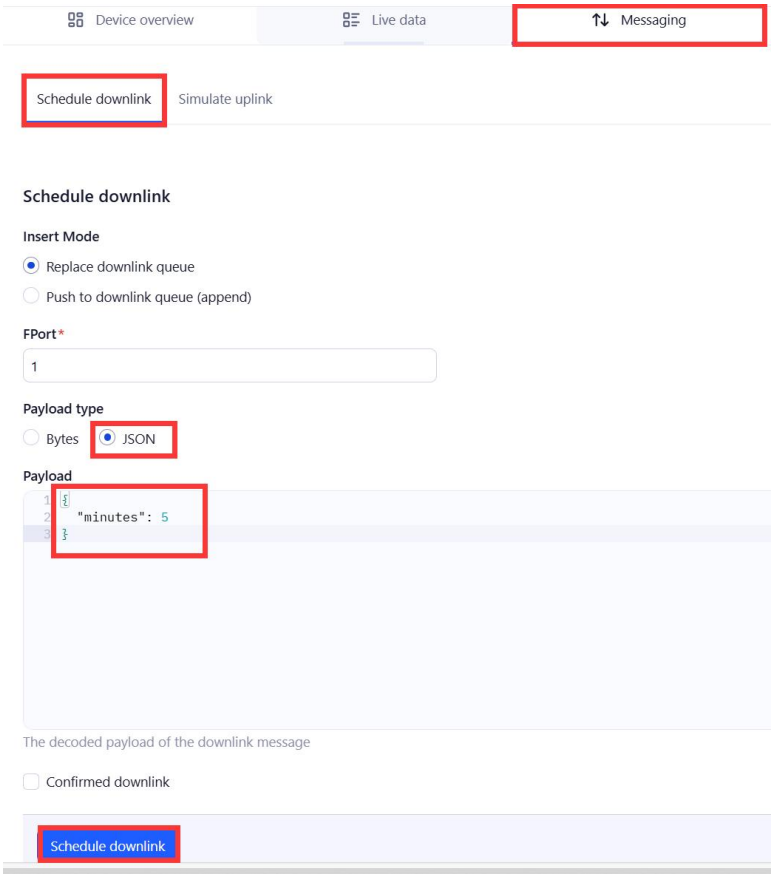
3、Click “Messaging-->Schedule downlink”.

Note: you must use this format:

{

"minutes": 5

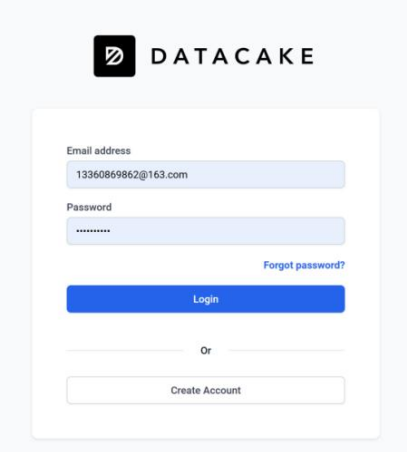
}



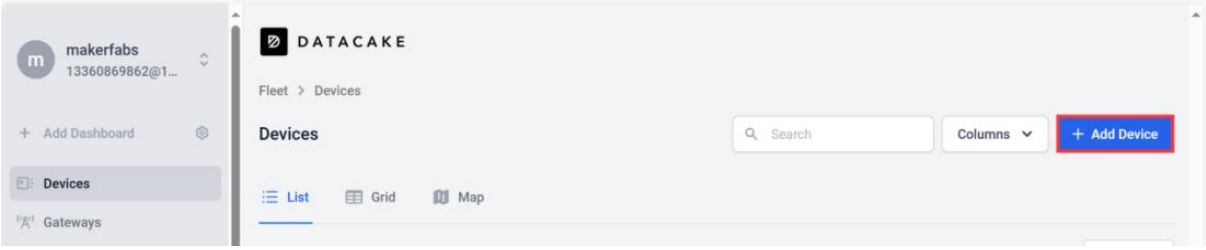
4、The modified interval will be updated after the next data upload.

3.2 Datacake

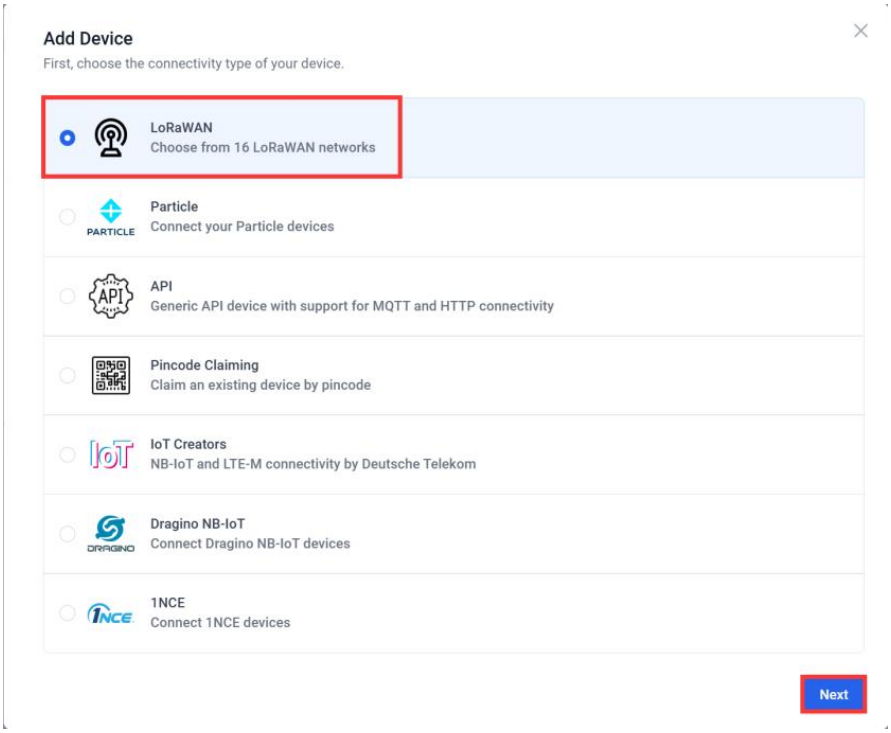
1、Login datacake or Create Account



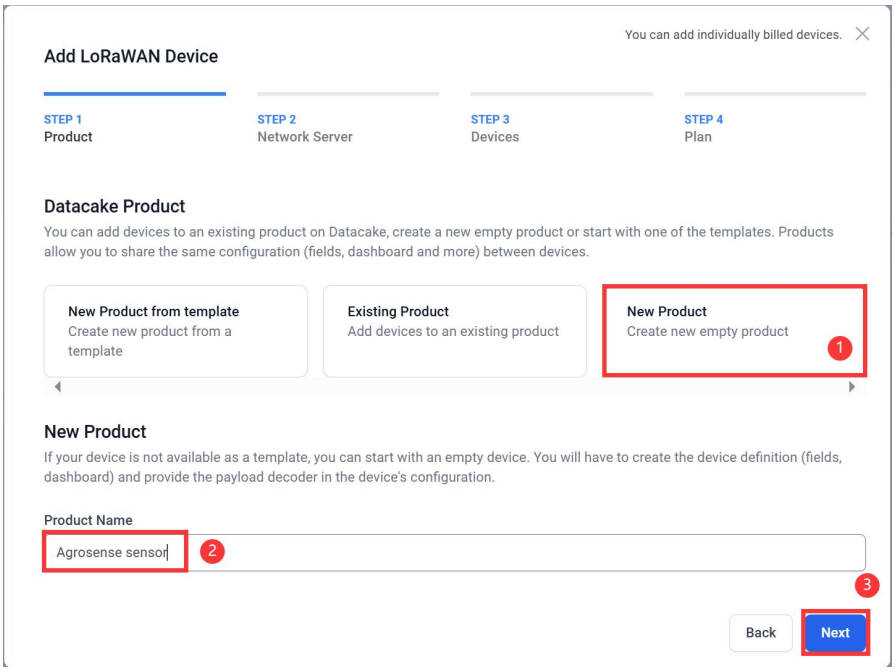
2、Click “Add Device”



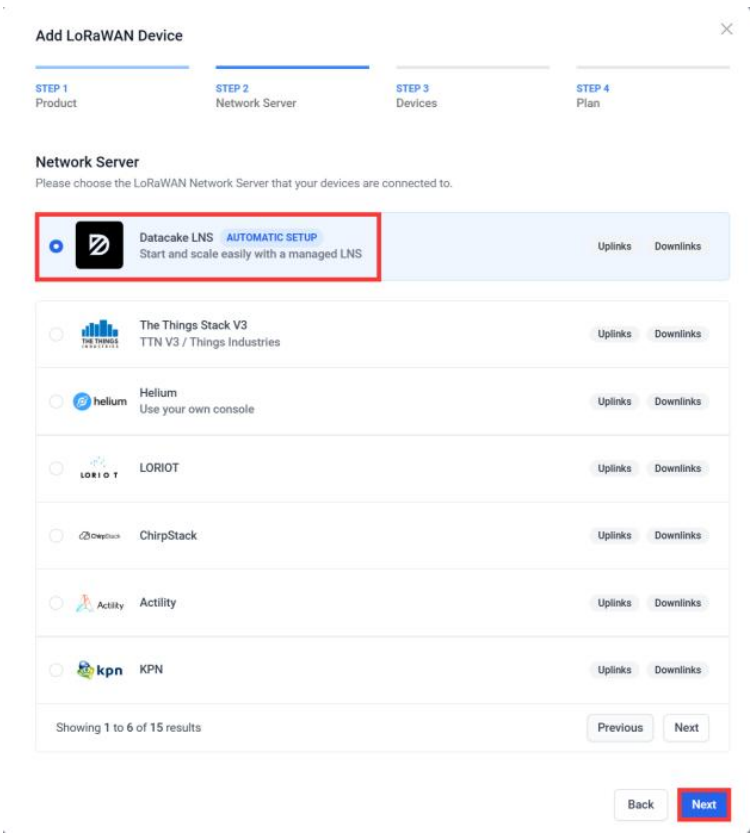
3、Select LoRaWAN and click “Next”



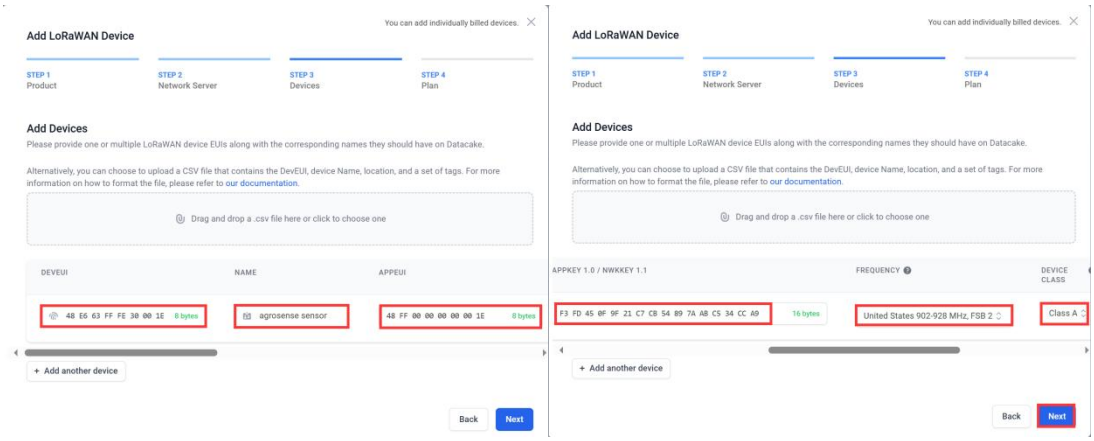
4、Select a Product based on your needs, take "Create new empty product" as an example.



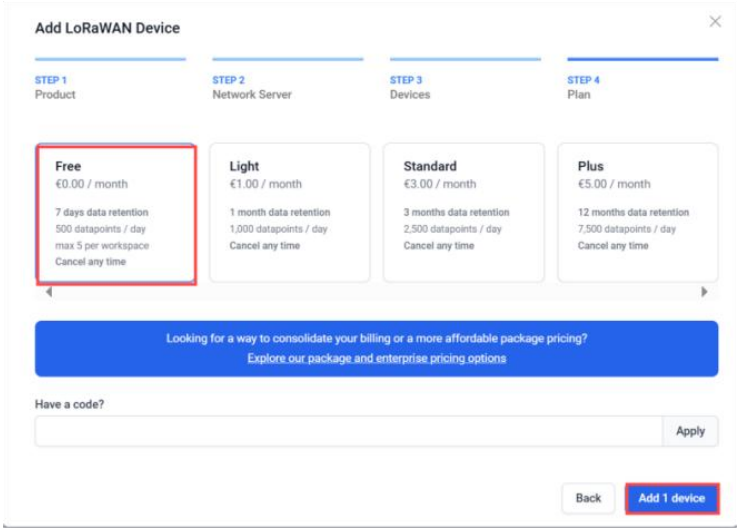
5、Select “Datacake LNS”



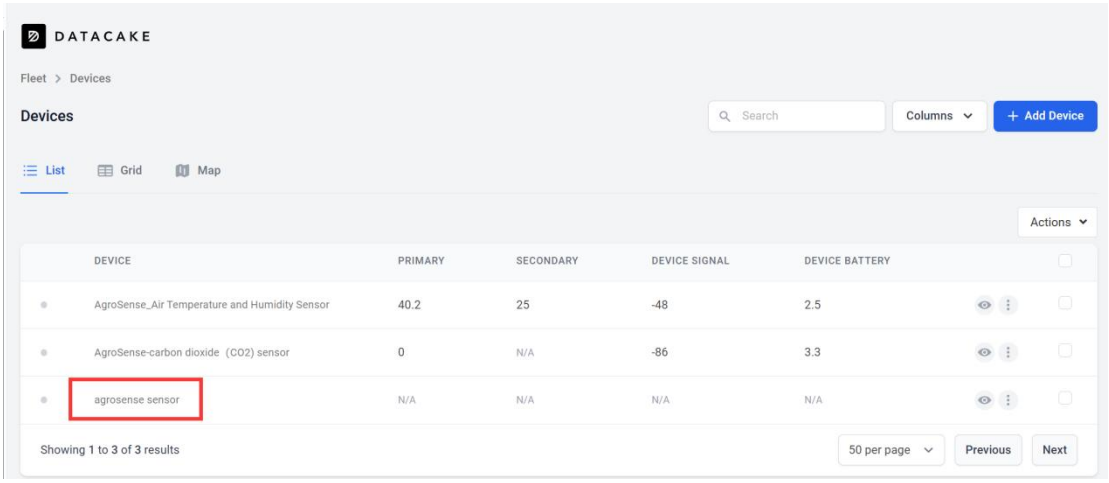
6、Enter DEVEUI、APPEUI、APPKEY、FREQUENCY(take 915 for example) and DEVICE CLASS.



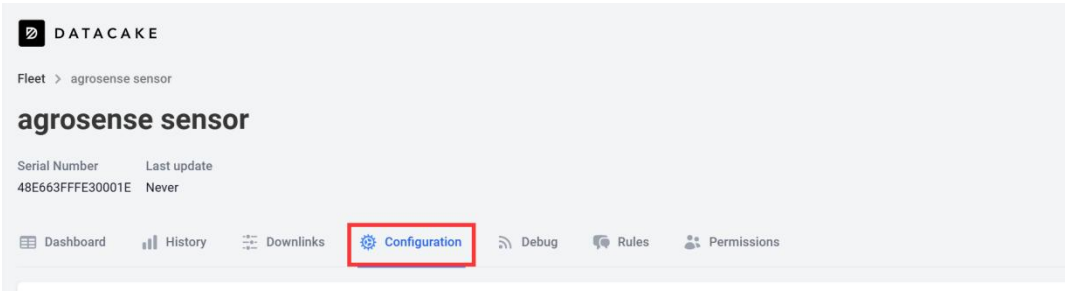
7、Choose the type according to your needs, and click “Add 1 device”.

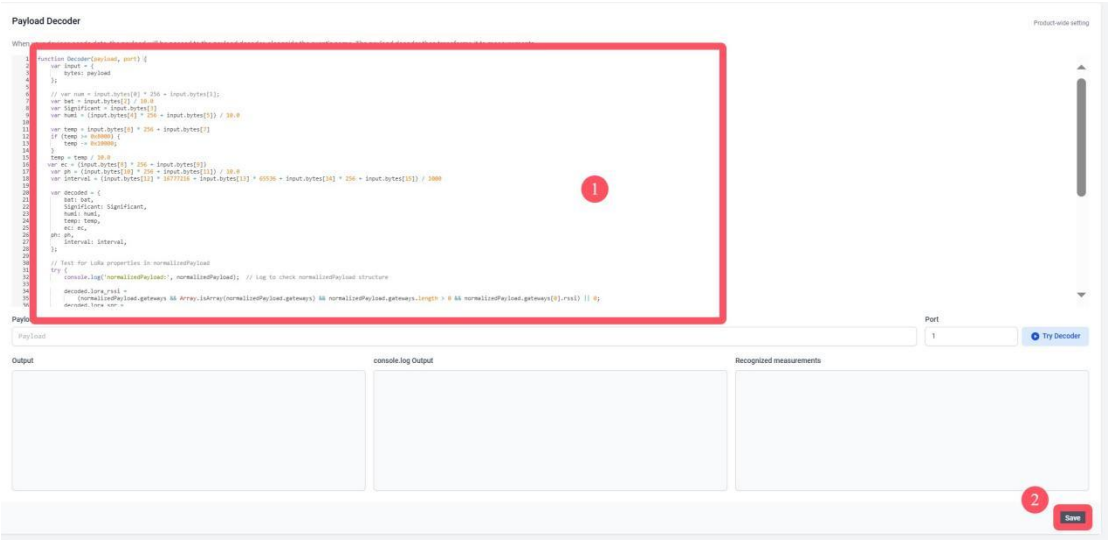


8、Click to go to the device you just added.



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

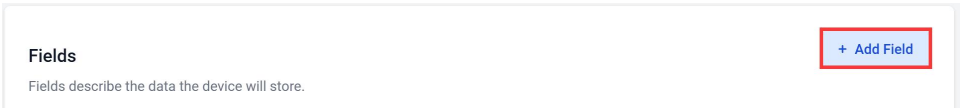


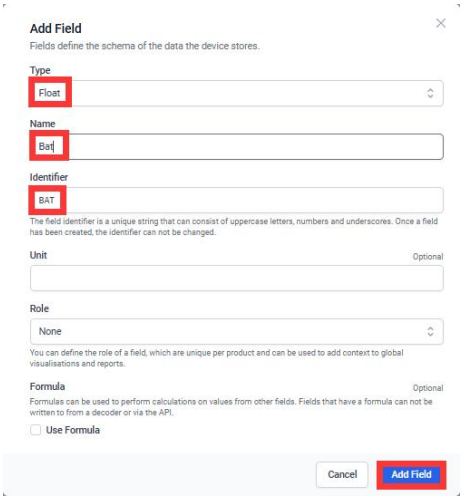


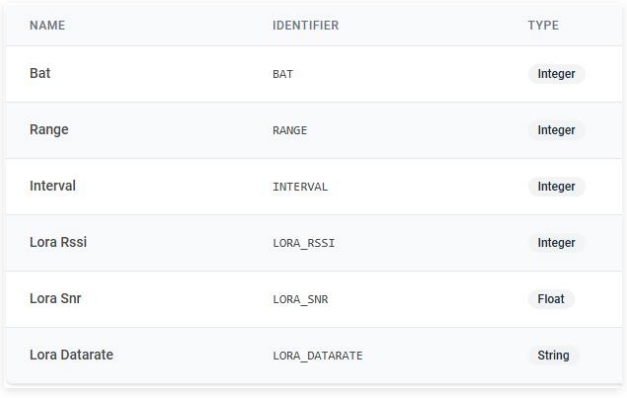

```
function Decoder(payload, port) {
    var input = {
        bytes: payload
    };

    var bat = input.bytes[2] / 10.0
    var range = (input.bytes[3] * 256 + input.bytes[4])
    var interval = (input.bytes[5] * 16777216 + input.bytes[6] * 65536 + input.bytes[7] * 256 + input.bytes[8]) /
1000

    var decoded =
    {
      bat:bat,
      range:range,
        interval:interval,
    };

    // Test for LoRa properties in normalizedPayload
 try {

   if (normalizedPayload.gateways && normalizedPayload.gateways.length > 0) {
     decoded.lora_rssi = normalizedPayload.gateways[0].rssi || 0;
```

```
    decoded.lora_snr = normalizedPayload.gateways[0].snr || 0;
  } else {
    decoded.lora_rssi = 0;
    decoded.lora_snr = 0;
  }
  decoded.lora_datarate = normalizedPayload.spreading_factor
                        || normalizedPayload.data_rate
                        || (normalizedPayload.networks && normalizedPayload.networks.lora &&
normalizedPayload.networks.lora.dr)
                        || "unknown";

} catch (error) {
  console.log('LoRa property parsing error:', error);
  decoded.lora_rssi = 0;
  decoded.lora_snr = 0;
  decoded.lora_datarate = "unknown";
}

return [
  { field: "bat", value: decoded.bat },
  { field: "range", value: decoded.range },
  { field: "interval", value: decoded.interval },
  { 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)

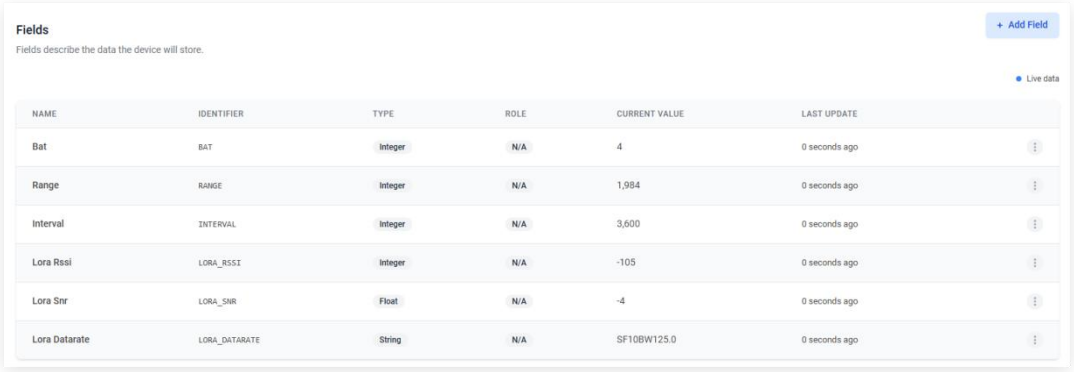






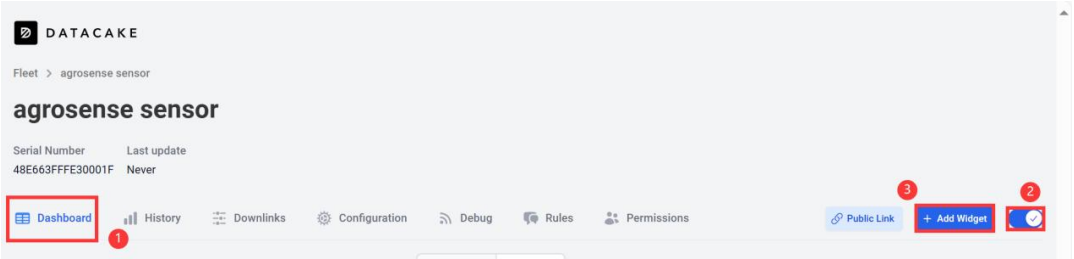
NAME	IDENTIFIER	TYPE
Bat	BAT	Integer
Range	RANGE	Integer
Interval	INTERVAL	Integer
Lora Rssi	LORA_RSSI	Integer
Lora Snr	LORA_SNR	Float
Lora Datarate	LORA_DATARATE	String

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

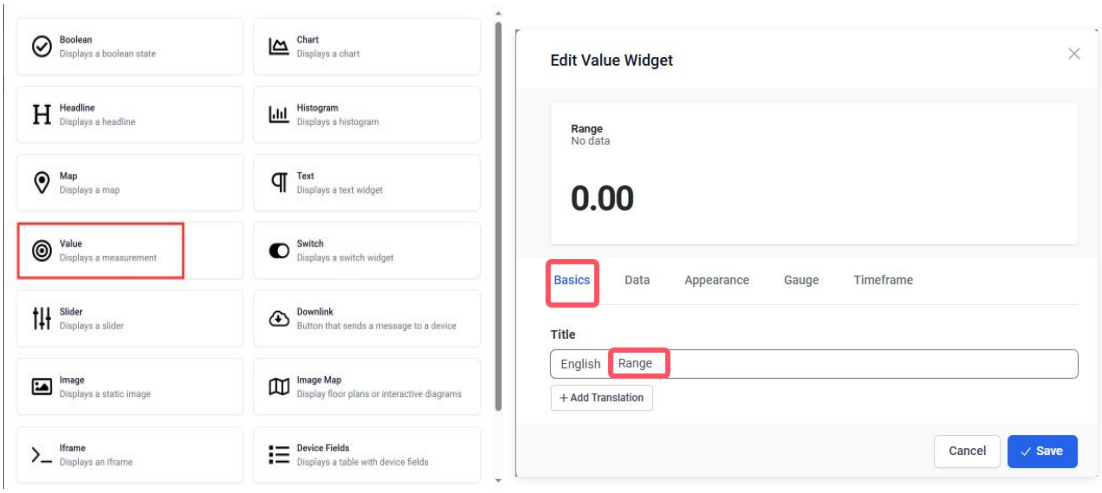


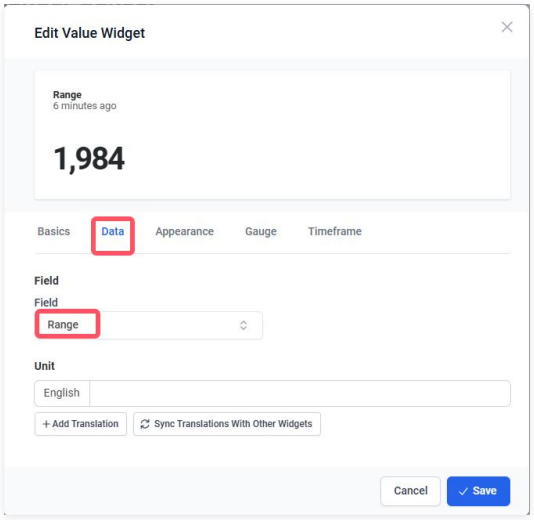
12、To get a better look at the data, we can add widget.

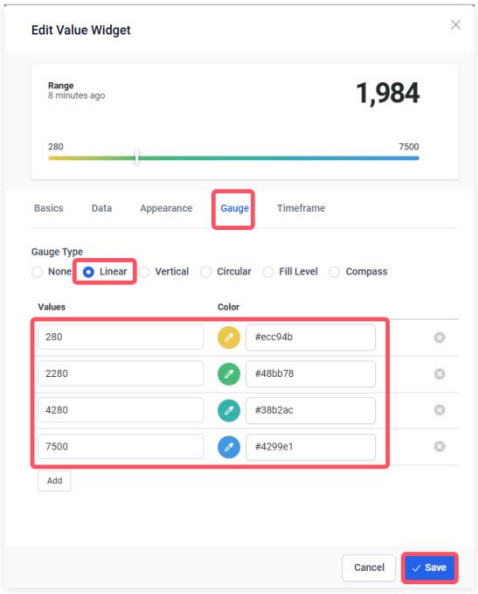
Click “Dashboard-->switch-->+ Add Widget”.



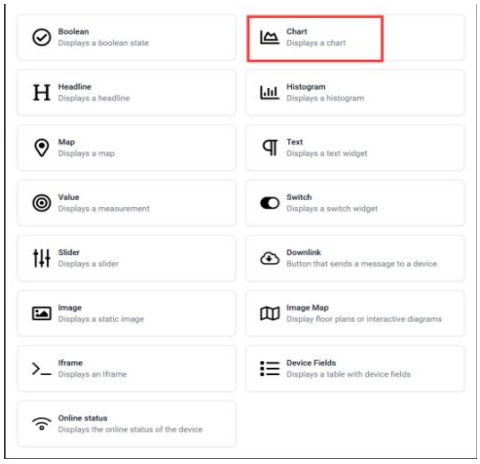
13、Select “Value” and set Title, Field and presentation form as well as the interval color.

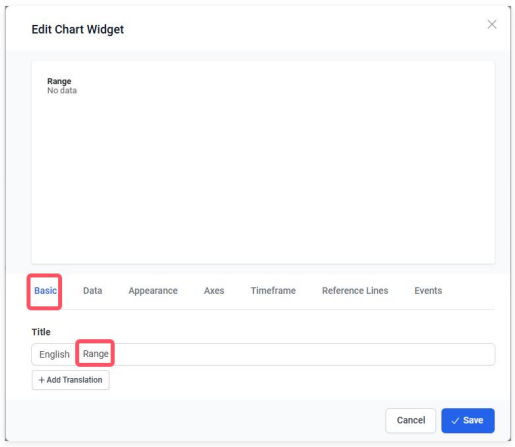


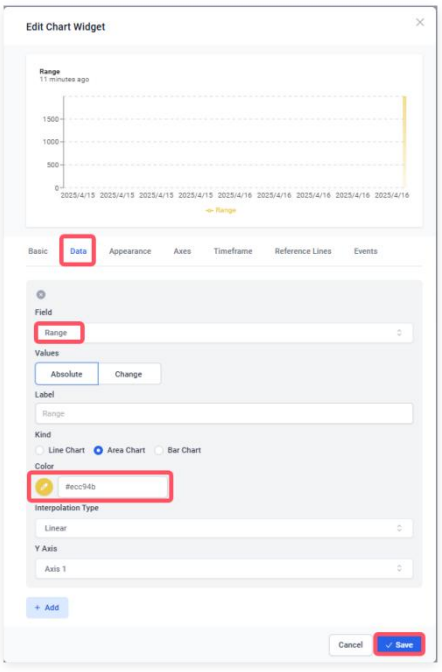




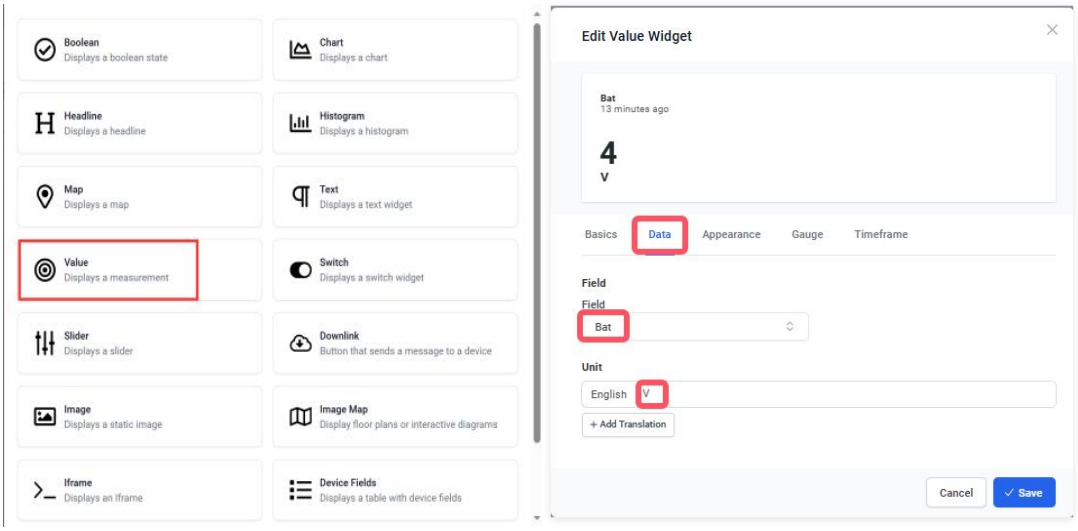
14、Select Chart and set Title, Field, Kind, Line Thickness and click “save”.

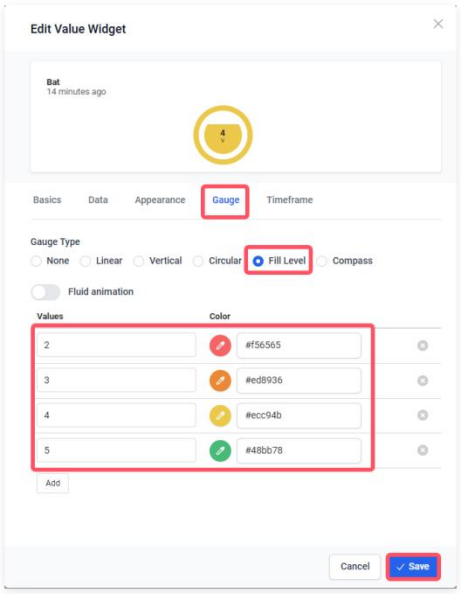




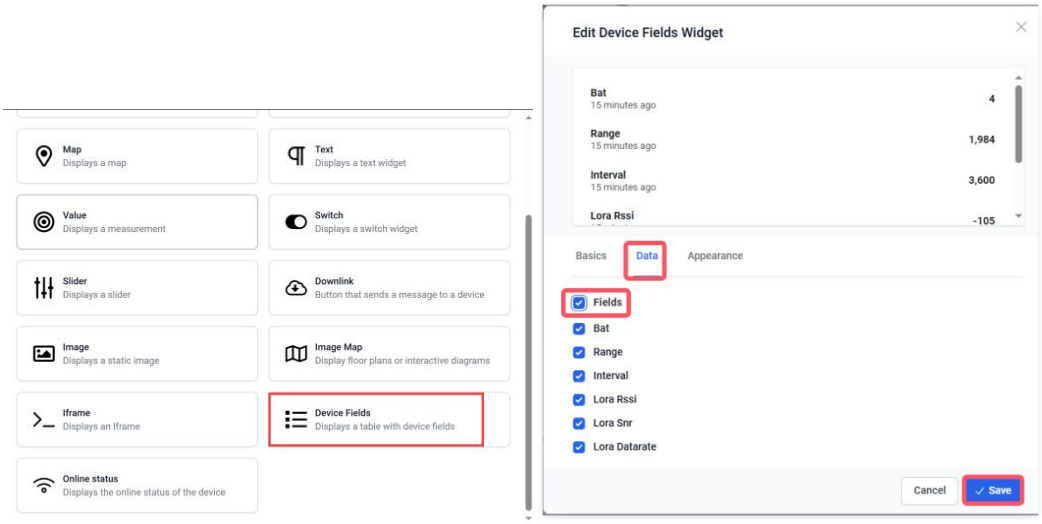


15、Select “Value” and set Title, Field and presentation form as well as the interval color.

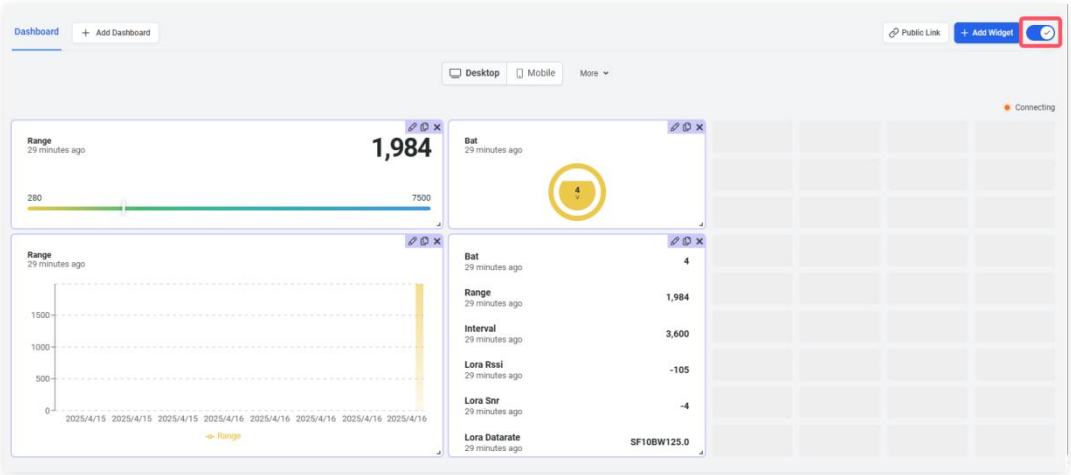




16、Select Device Fields, check “Fields” and click “Save”.



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



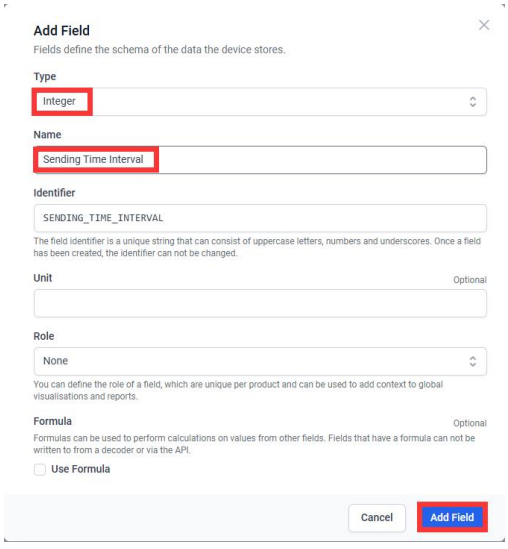
3.2.1 Downlink

The downlink has two functions:

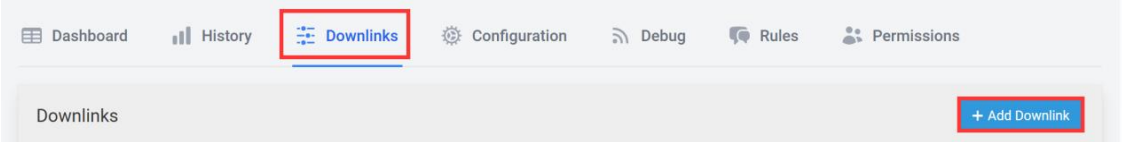
- Modification time interva (Fport1)

Modify the time interval for uploading data, the default is one hour.

1 、 If you need to change time Interval (Default 60 minutes), you can click “Configuration-->Fields-->+Add Field”



2、Click ”Downlink-->Add Downlink”.

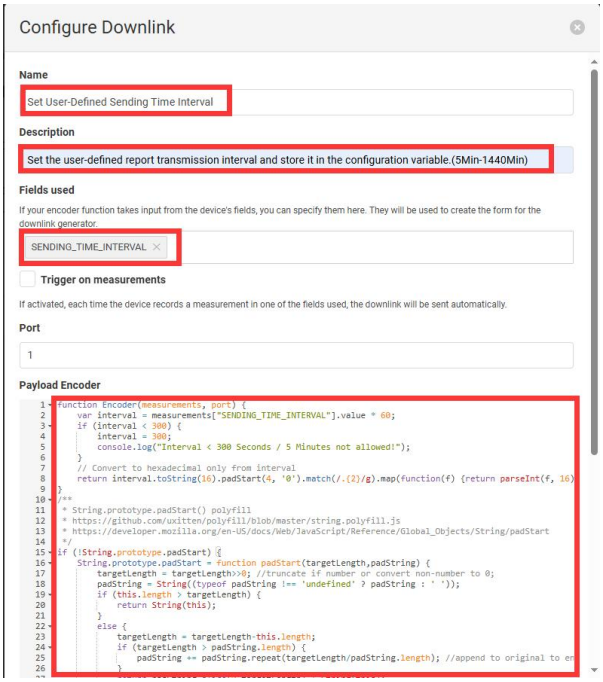


Enter name、description、fields used and payload encoder respectively.

Name: Set User-Defined Sending Time Interval

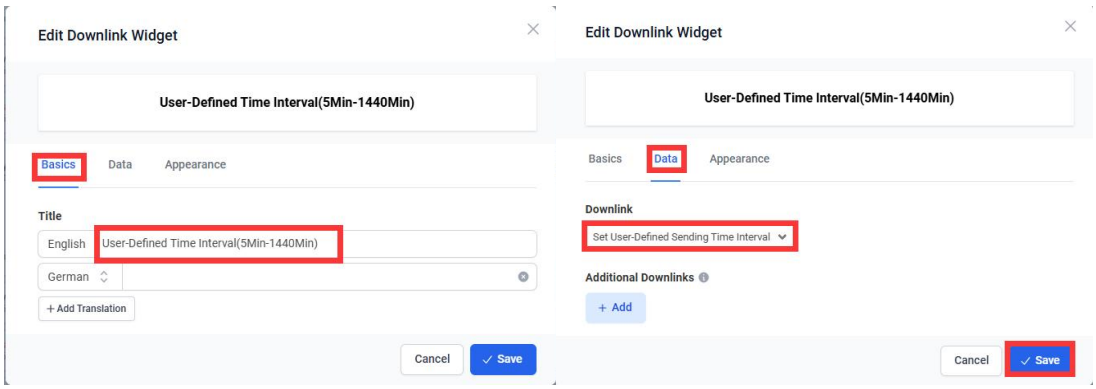
Description: Set the user-defined report transmission interval and store it in the configuration variable.(5Min-1440Min)

Payload Encoder: copy in Github.

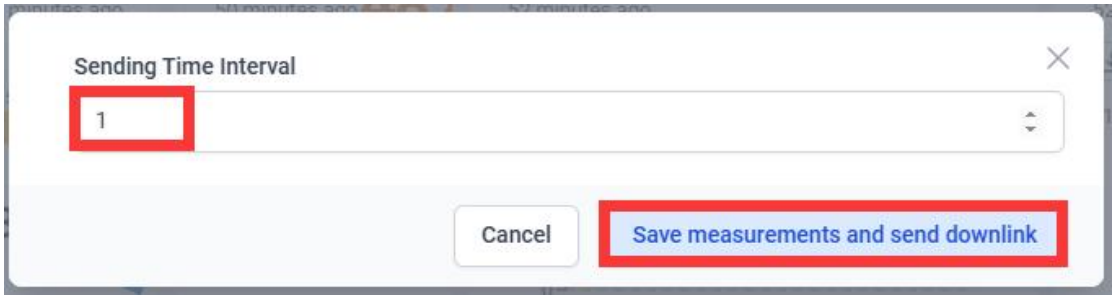


3、Click “Dashboard-->switch-->+ Add Widget”.

Select “Downlink” and setting as follow image.



4、Click the switch to save, and you can click to change your time Interval.


Sending Time Interval
1
Cancel
Save measurements and send downlink