



AgroSense_Ultrasonic Ranger Sensor

LoRaWAN® Manual

V1.0

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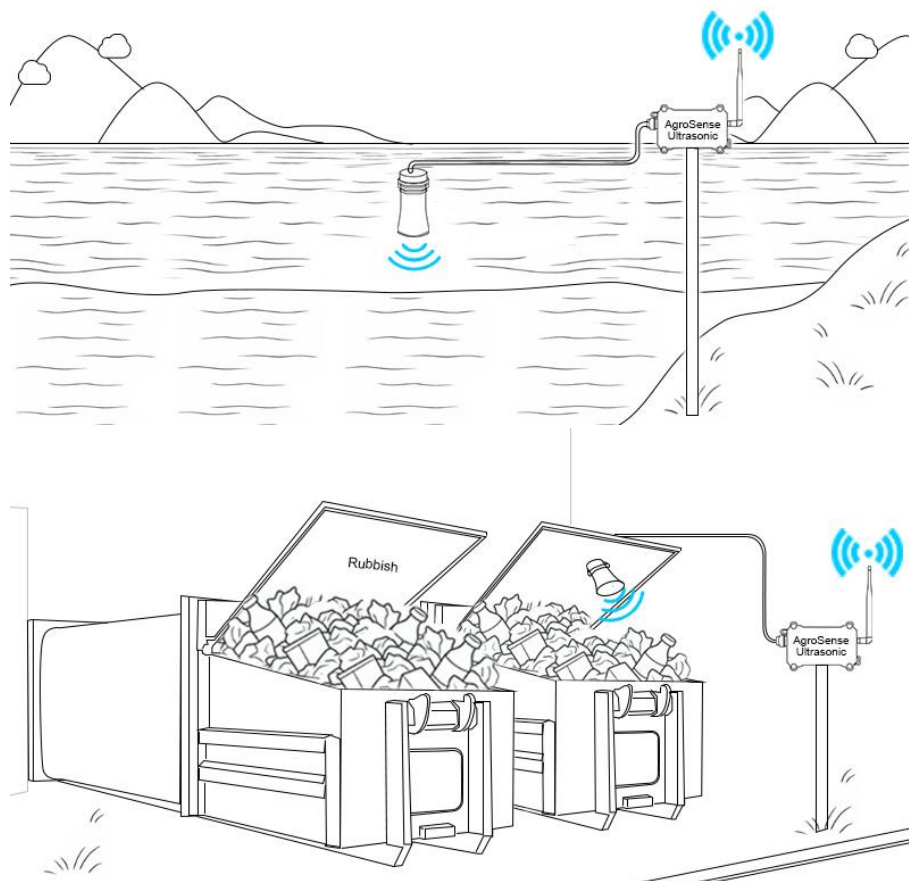
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1 Product Description

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

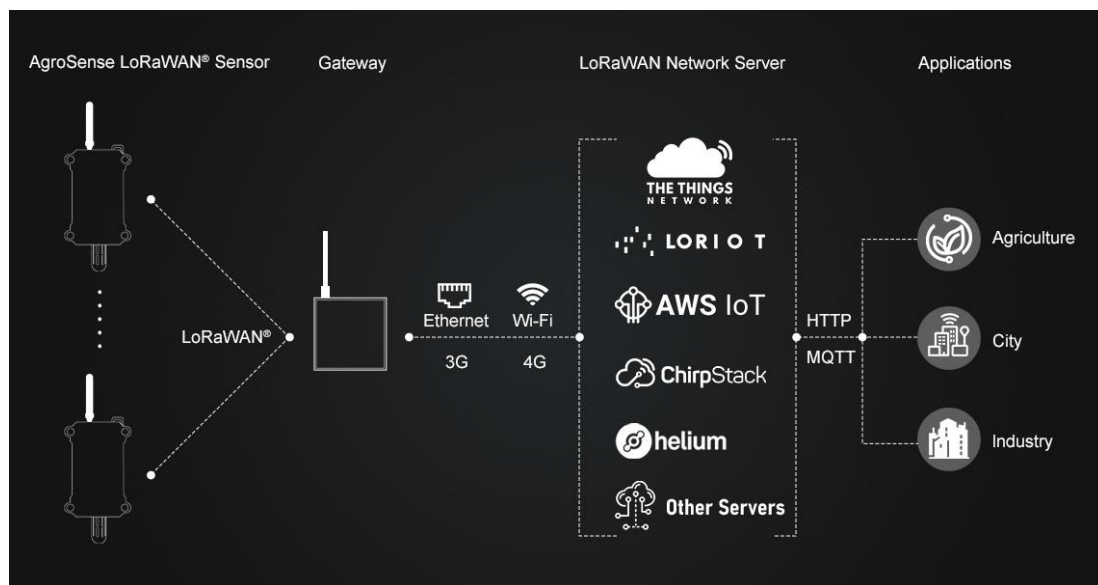
Power Supply	1 x 18650 3.7V Lion batteries
Operating Temperature	-15°C ~ 60°C
Protection Class	IP68
Dimensions	131 × 62.7 × 27.5 mm
Mounting	Wall Mounting

2 Technical route

2.1 System Framework

AgroSense_Ultrasonic Ranger Sensor uses LoRAWAN technology, and its 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.

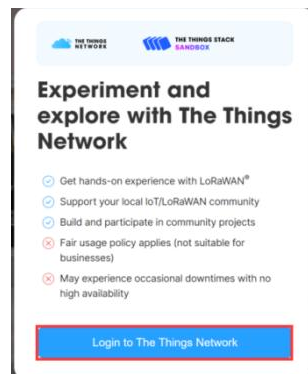
DEV EUI	Unique identification of device, authorized by IEEE
APP EUI	Unique identification of application
APP Key	One of the join network parameters on OTAA mode, calculated by DE EUI

- 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)

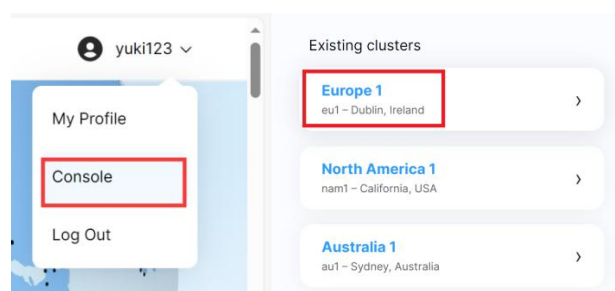
3.1 TTN and ThingSpeak

3.1.1 Network Server configuration

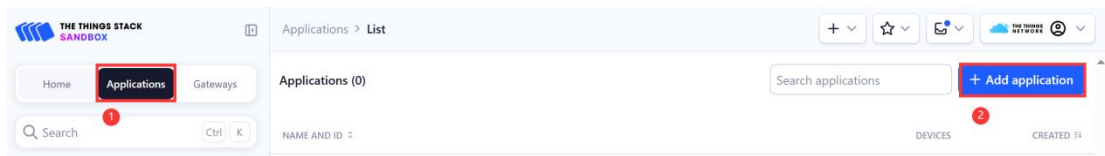
- Open The Things Network in your browser and login it. (Or register an account)



- 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”.

Application ID *

agrosense-sensor

Application name

My new application

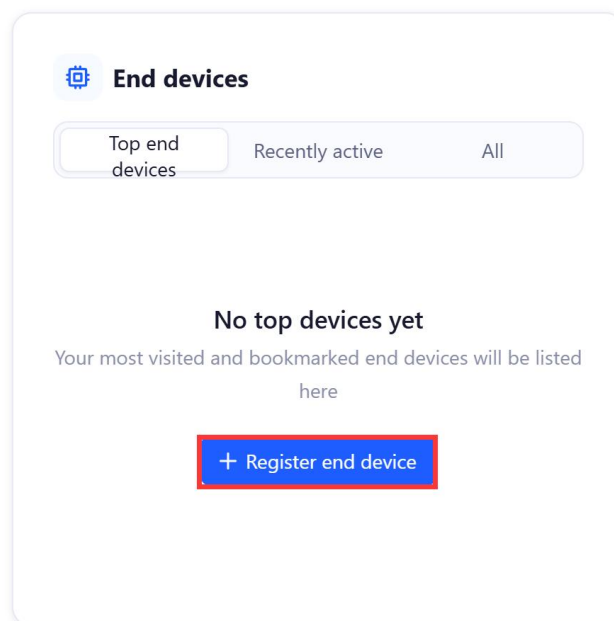
Description

Description for my new application

Optional application description; can also be used to save notes about the :

Create application

- Click “+ Register and device”.



- Following 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.

End device type

Input method ⓘ

☐ Select the end device in the LoRaWAN Device Repository

☒ Enter end device specifics manually 1

Frequency plan ⓘ *

Europe 863-870 MHz (SF9 for RX2 - recommended) | v

LoRaWAN version ⓘ *

LoRaWAN Specification 1.0.3 | v

Regional Parameters version ⓘ *

RP001 Regional Parameters 1.0.3 revision A | v 2

[Show advanced activation, LoRaWAN class and cluster settings](#)

Provisioning information

JoinEUI ⓘ *

48 FF 00 00 00 00 01 65

Confirm

3 Continue, please enter the JoinEUI 4 and device so we can determine onboarding options

Provisioning information

JoinEUI ⓘ *

48 FF 00 00 00 00 01 65 Reset

This end device can be registered on the network

DevEUI ⓘ *

48 E6 63 FF FE 30 01 65 Generate 0/50 used

AppKey ⓘ *

4A 35 62 6B 95 AB 5B 4D 3F 3B DE 12 71 B1 6F 2A Generate

End device ID ⓘ *

eui-48e663ffe300165

This value is automatically prefilled using the DevEUI

After registration

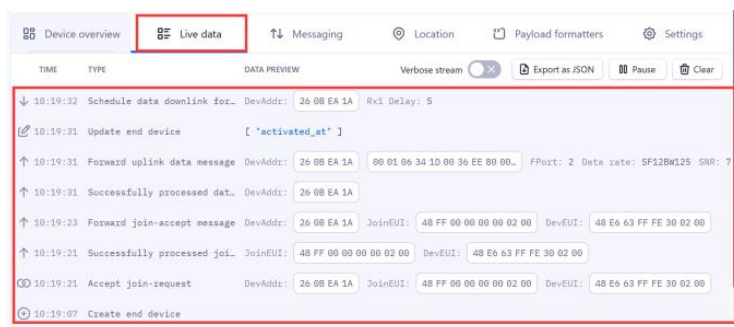
☒ View registered end device

☐ Register another end device of this type

Register end device

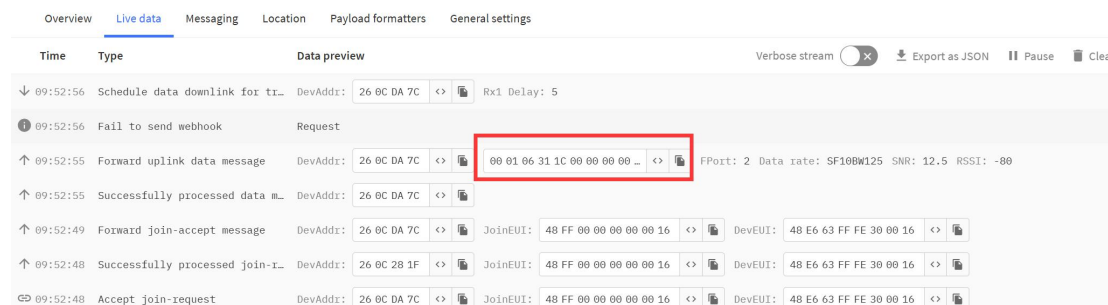


- Plug the battery and press RES button, you can see the device is connected successfully in the TTN.



3.1.2 Decoder

- Now, we need to decode 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.

Device overview Live data Messaging Location **Payload formatters**

Uplink Downlink

Setup

Formatter type*
Custom Javascript formatter

Formatter code*

```

1 function decodeUplink(input) {
2
3   // var num = input.bytes[0] * 256 + input.bytes[1]
4   var bat = input.bytes[2] / 10.0
5   var range = (input.bytes[3] * 256 + input.bytes[4])
6   var interval = (input.bytes[5] * 16777216 + input.bytes[6] * 65536 + input.bytes[7] * 256 + input.bytes[8]) / 1000
7
8   return {
9     data: {
10      field1: bat,
11      field2: range,
12      field3: interval,
13    },
14  };
15 }

```

Save changes

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)

MathWorks®

Email

No account? [Create one!](#)

By signing in, you agree to our [privacy policy](#).

Next

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

ThingSpeak™

My Channels

New Channel

Name: AgroSense_Ultrasonic Ranger Sensor

Description:

Field 1: Bat ☒

Field 2: Range ☒

Save Channel

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

Channel ID: 2599652
 Author: mwa0000034232775
 Access: Private

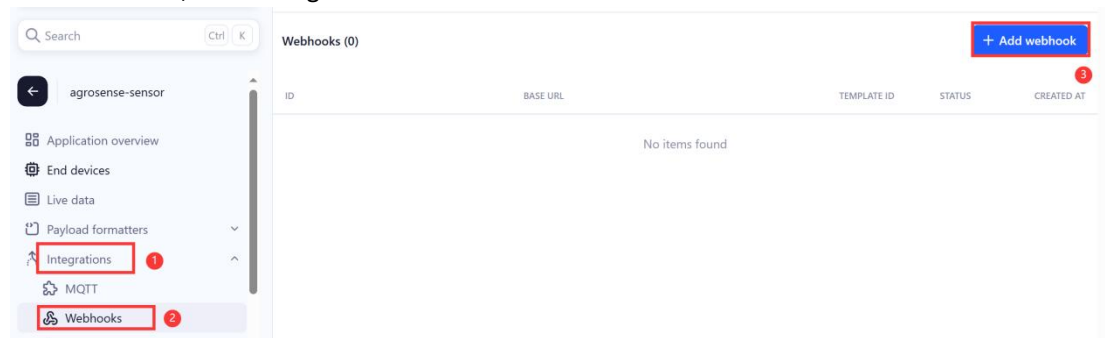
Private View Public View Channel Settings Sharing API Keys

Write API Key

Key N9IBFTBI3J36T779

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”.

Webhook ID *

my-new-thingspeak-webhook

Channel ID *

2599652

ThingSpeak Channel ID

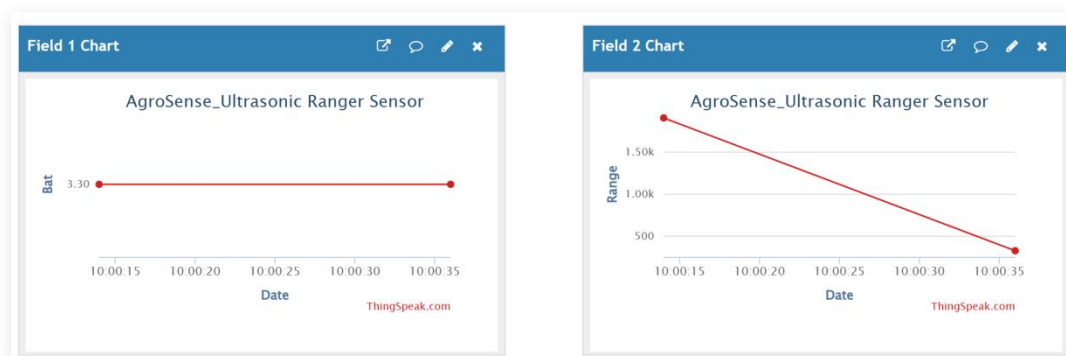
API Key *

N9IBFTBI3J36T779

ThingSpeak Write API Key

Create ThingSpeak webhook

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



3.1.5 Downlink

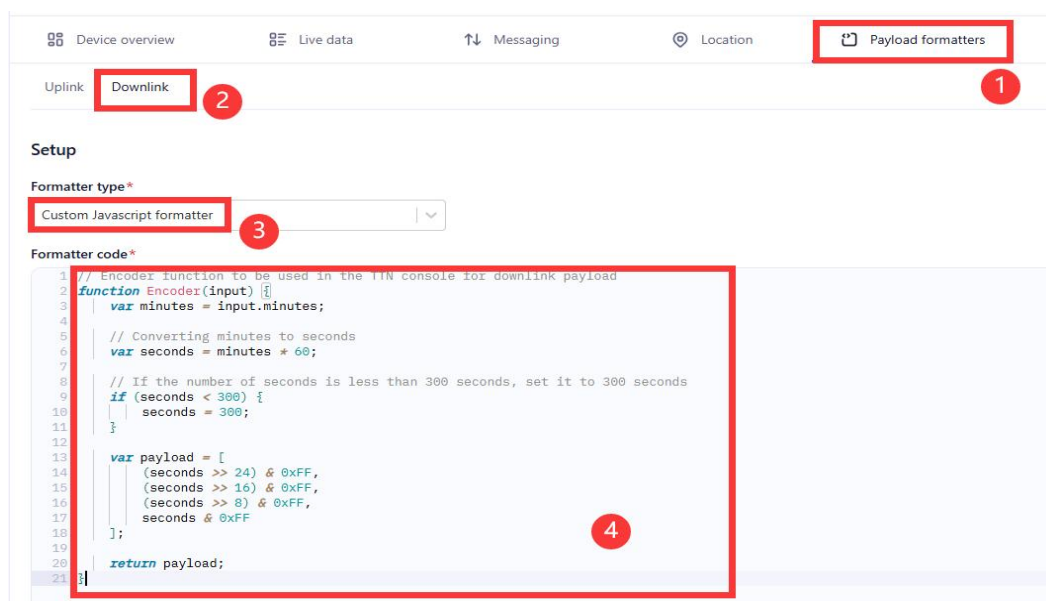
The downlink has two functions:

- Modification time interval (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
}
```

Device overview

Live data

Messaging

Schedule downlink

Simulate uplink

Schedule downlink

Insert Mode

☒ Replace downlink queue

☐ Push to downlink queue (append)

FPort*

1

Payload type

☐ Bytes ☒ JSON

Payload

```
1 {  
2   "minutes": 5  
3 }
```

The decoded payload of the downlink message

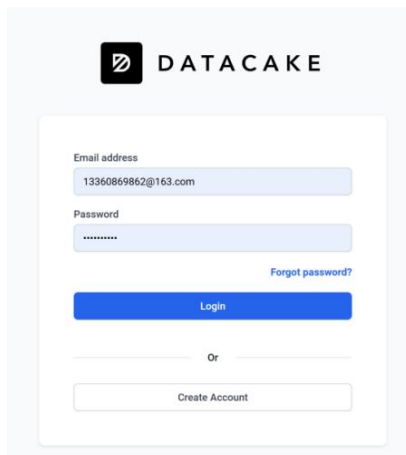
☐ Confirmed downlink

Schedule downlink

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

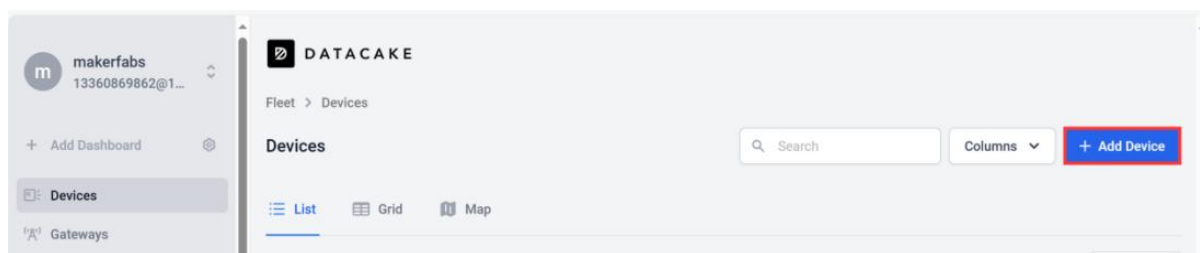
3.2 Datacake

1、Login datacake or Create Account

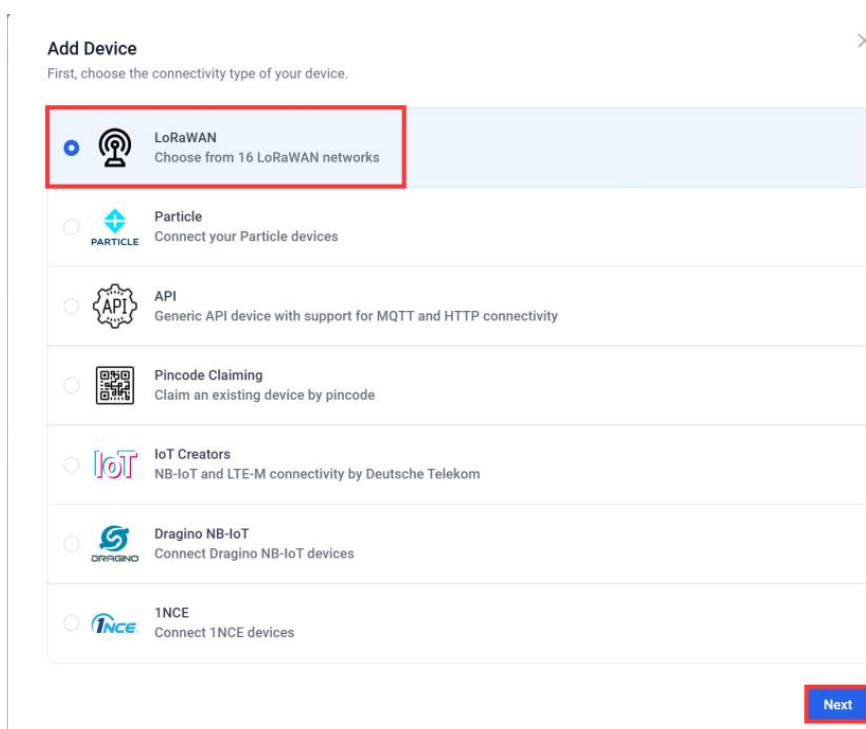


The image shows the Datacake login and registration interface. At the top is the Datacake logo. Below it is a form with two input fields: 'Email address' (containing '13360869862@163.com') and 'Password' (containing '*****'). There is a 'Forgot password?' link next to the password field. Below the password field is a blue 'Login' button. Underneath the login button is an 'Or' separator, followed by a 'Create Account' button.

2、Click “Add Device”



3、Select LoRaWAN and click “Next”



The image shows the 'Add Device' dialog box. It has a title 'Add Device' and a subtitle 'First, choose the connectivity type of your device.' Below this is a list of connectivity options, each with a radio button and an icon. The 'LoRaWAN' option is selected and highlighted with a red box. The other options are: Particle, API, Pincode Claiming, IoT Creators, Dragino NB-IoT, and 1NCE. At the bottom right of the dialog is a blue 'Next' button.

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

Add LoRaWAN Device

You can add individually billed devices.

STEP 1

STEP 2

STEP 3

STEP 4

Product

Network Server

Devices

Plan

Datacake Product

You can add devices to an existing product on Datacake, create a new empty product or start with one of the templates. Products allow you to share the same configuration (fields, dashboard and more) between devices.

New Product from template
Create new product from a template

Existing Product
Add devices to an existing product

New Product
Create new empty product

New Product

If your device is not available as a template, you can start with an empty device. You will have to create the device definition (fields, dashboard) and provide the payload decoder in the device's configuration.

Product Name

Agrosense sensor

Back

Next

5、Select "Datacake LNS"

Add LoRaWAN Device

STEP 1

STEP 2

STEP 3

STEP 4

Product

Network Server

Devices

Plan

Network Server

Please choose the LoRaWAN Network Server that your devices are connected to.

Datacake LNS

AUTOMATIC SETUP

Start and scale easily with a managed LNS

Uplinks

Downlinks

The Things Stack V3

TTN V3 / Things Industries

Uplinks

Downlinks

Helium

Use your own console

Uplinks

Downlinks

LORIoT

Uplinks

Downlinks

ChirpStack

Uplinks

Downlinks

Activity

Uplinks

Downlinks

KPN

Uplinks

Downlinks

Showing 1 to 6 of 15 results

Previous

Next

Back

Next

16

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

Add LoRaWAN Device

STEP 1 Product | STEP 2 Network Server | **STEP 3 Devices** | STEP 4 Plan

Add Devices
Please provide one or multiple LoRaWAN device EUIs along with the corresponding names they should have on Datacake.
Alternatively, you can choose to upload a CSV file that contains the DevEUI, device Name, location, and a set of tags. For more information on how to format the file, please refer to [our documentation](#).

Drag and drop a .csv file here or click to choose one

DEVEUI	NAME	APPEUI	APPKEY 1.0 / NWKEY 1.1	FREQUENCY	DEVICE CLASS
48 55 63 FF FE 30 00 1E	agrosense sensor	48 FF 00 00 00 00 1E	F3 FD 45 8F 9F 21 C7 C8 54 89 7A 48 C5 34 CC A9	United States 902.928 MHz, FSB 2	Class A

+ Add another device

Back Next

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

Add LoRaWAN Device

STEP 1 Product | STEP 2 Network Server | STEP 3 Devices | **STEP 4 Plan**

Free	Light	Standard	Plus
€0.00 / month	€1.00 / month	€3.00 / month	€5.00 / month
7 days data retention 500 datapoints / day max 5 per workspace Cancel any time	1 month data retention 1,000 datapoints / day Cancel any time	3 months data retention 2,500 datapoints / day Cancel any time	12 months data retention 7,500 datapoints / day Cancel any time

Looking for a way to consolidate your billing or a more affordable package pricing?
[Explore our package and enterprise pricing options](#)

Have a code?

Back **Add 1 device**

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

DATA CAKE

Fleet > Devices

Devices

Search Columns + Add Device

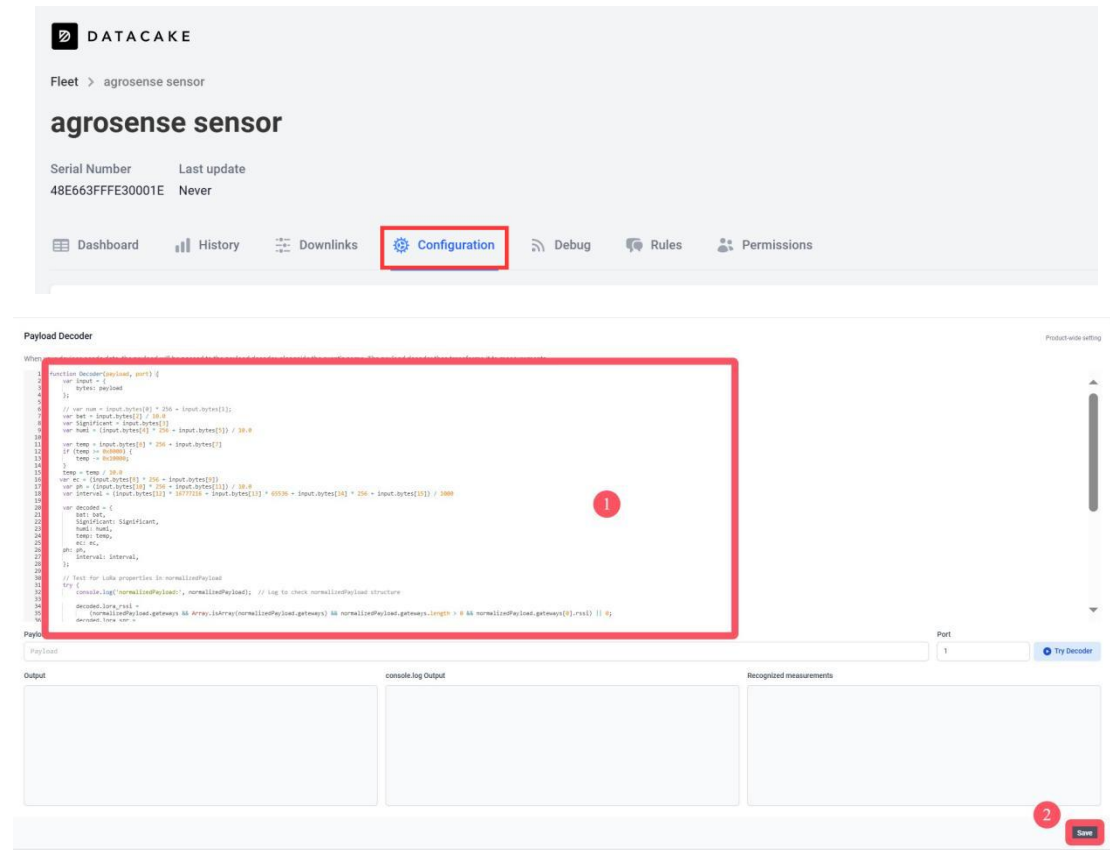
List Grid Map

DEVICE	PRIMARY	SECONDARY	DEVICE SIGNAL	DEVICE BATTERY	Actions
AgroSense_Air Temperature and Humidity Sensor	40.2	25	-48	2.5	
AgroSense-carbon dioxide (CO2) sensor	0	N/A	-86	3.3	
agrosense sensor	N/A	N/A	N/A	N/A	

Showing 1 to 3 of 3 results

50 per page Previous Next

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)

Fields
+ Add Field

Fields describe the data the device will store.

Add Field

Fields define the schema of the data the device stores.

Type

Float

Name

Bat

Identifier

BAT

The field identifier is a unique string that can consist of uppercase letters, numbers and underscores. Once a field has been created, the identifier can not be changed.

Unit

Optional

Role

None

You can define the role of a field, which are unique per product and can be used to add context to global visualisations and reports.

Formula

Formulas can be used to perform calculations on values from other fields. Fields that have a formula can not be written to from a decoder or via the API.

☐ Use Formula

Cancel
Add Field

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.

Fields + Add Field

Fields describe the data the device will store.

Live data

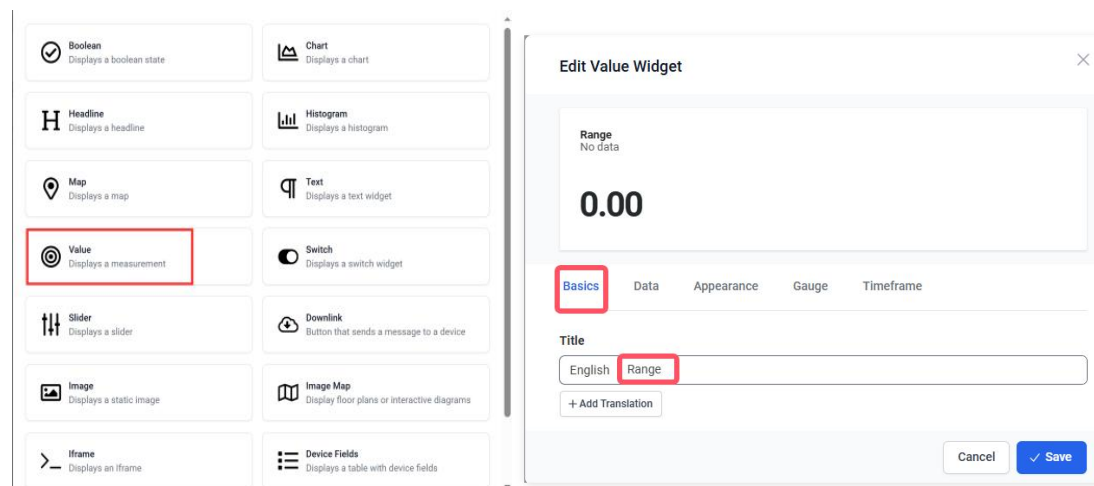
NAME	IDENTIFIER	TYPE	ROLE	CURRENT VALUE	LAST UPDATE
Bat	BAT	Integer	N/A	-4	0 seconds ago
Range	RANGE	Integer	N/A	1,984	0 seconds ago
Interval	INTERVAL	Integer	N/A	3,600	0 seconds ago
Lora Rssi	LORA_RSSI	Integer	N/A	-105	0 seconds ago
Lora Snr	LORA_SNR	Float	N/A	-4	0 seconds ago
Lora Datarate	LORA_DATARATE	String	N/A	SF10BW125.0	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.



Edit Value Widget

Range
6 minutes ago

1,984

Basics **Data** Appearance Gauge Timeframe

Field
Field
Range

Unit
English

+ Add Translation Sync Translations With Other Widgets

Cancel Save

Edit Value Widget

Range
6 minutes ago

1,984

280 7500

Basics Data Appearance **Gauge** Timeframe

Gauge Type
☐ None ☒ **Linear** ☐ Vertical ☐ Circular ☐ Fill Level ☐ Compass

Values	Color
280	#ecc94b
2280	#48b78
4280	#38b2ac
7500	#4299e1

Add

Cancel Save

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

Boolean
Displays a Boolean state

Chart
Displays a chart

Headline
Displays a headline

Histogram
Displays a histogram

Map
Displays a map

Text
Displays a text widget

Value
Displays a measurement

Switch
Displays a switch widget

Slider
Displays a slider

Downlink
Button that sends a message to a device

Image
Displays a static image

Image Map
Display floor plans or interactive diagrams

Iframe
Displays an Iframe

Device Fields
Displays a table with device fields

Online status
Displays the online status of the device

Edit Chart Widget

Range
No data

Basic **Data** Appearance Axes Timeframe Reference Lines Events

Title
English **Range**

+ Add Translation

Cancel Save

Edit Chart Widget

Range
11 minutes ago

1500
1000
500
0

2023/4/15 2023/4/15 2023/4/15 2023/4/16 2023/4/16 2023/4/16 2023/4/16 2023/4/16

Basic **Data** Appearance Axes Timeframe Reference Lines Events

Field
Range

Values
Absolute Change

Label
Range

Kind
☐ Line Chart ☒ **Area Chart** ☐ Bar Chart

Color
#ecc94b

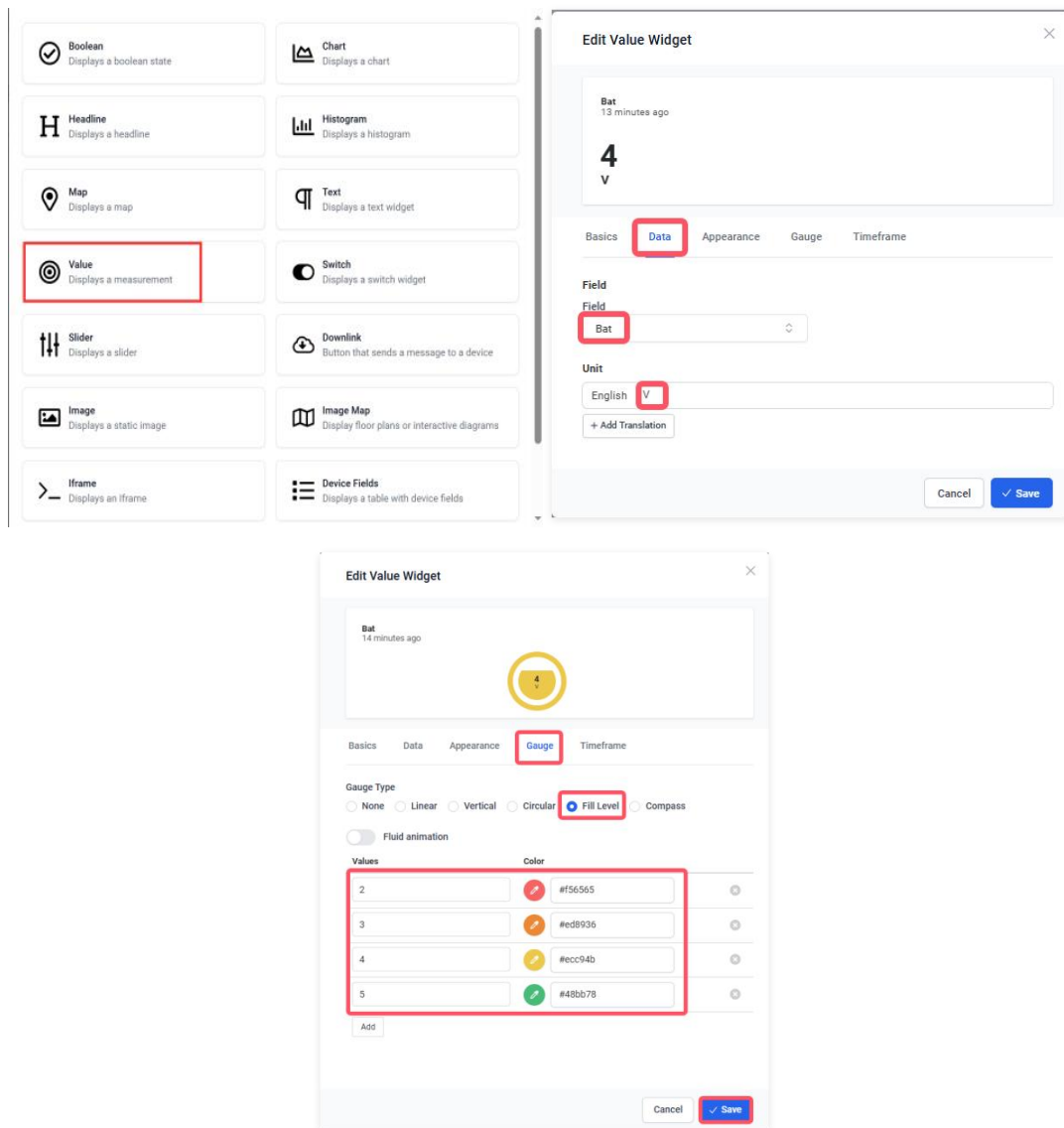
Interpolation Type
Linear

Y Axis
Axis 1

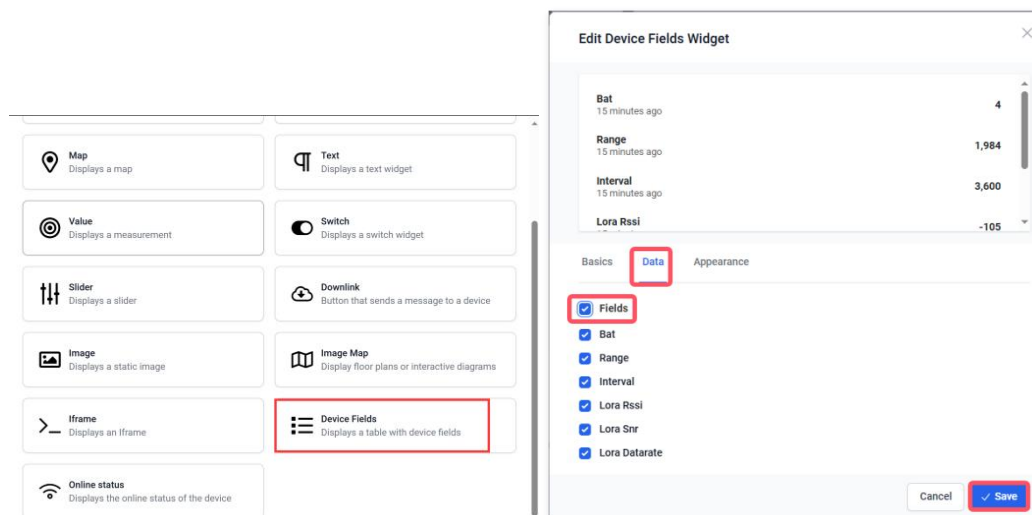
+ Add

Cancel Save

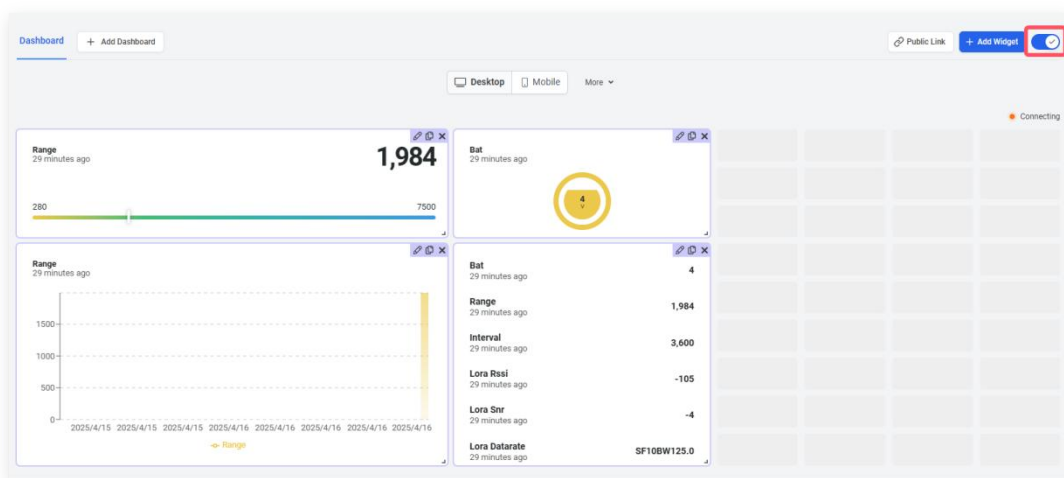
15、Select “Value” and set Title, Field and presentation form as well as the interval color.



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

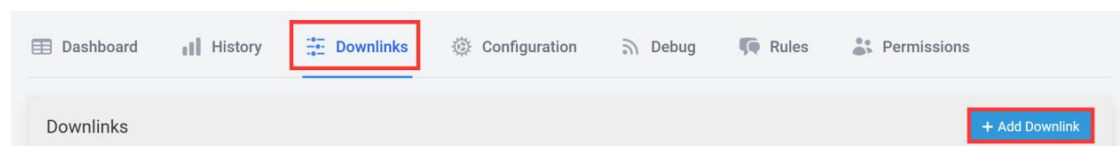
The downlink has two functions:

- Modification time interval (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](#).

Configure Downlink

Name
Set User-Defined Sending Time Interval

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

Fields used
SENDING_TIME_INTERVAL

Trigger on measurements
☐

Port
1

Payload Encoder

```

1 function Encoder(measurements, port) {
2   var interval = measurements["SENDING_TIME_INTERVAL"].value * 60;
3   if (interval < 300) {
4     interval = 300;
5     console.log("Interval < 300 Seconds / 5 Minutes not allowed!");
6   }
7   // Convert to hexadecimal only from interval
8   return interval.toString(16).padStart(4, '0').match(/.{2}/g).map(function(f) { return parseInt(f, 16);
9   });
10 }
11
12 /* String.prototype.padStart() polyfill
13 * https://github.com/uxitten/polyfill/blob/master/string.polyfill.js
14 * https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/String/padStart
15 */
16 if (!String.prototype.padStart) {
17   String.prototype.padStart = function padStart(targetLength,padString) {
18     targetLength = targetLength>0; //truncate if number or convert non-number to 0;
19     padString = String((typeof padString !== 'undefined' ? padString : ' '));
20     if (this.length > targetLength) {
21       return String(this);
22     }
23     else {
24       targetLength = targetLength-this.length;
25       if (targetLength > padString.length) {
26         padString += padString.repeat(targetLength/padString.length); //append to original to en

```

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

Select “Downlink” and setting as follow image.

Edit Downlink Widget

User-Defined Time Interval(5Min-1440Min)

Basics Data Appearance

Title
English User-Defined Time Interval(5Min-1440Min)
German

+ Add Translation

Cancel Save

Edit Downlink Widget

User-Defined Time Interval(5Min-1440Min)

Basics Data Appearance

Downlink
Set User-Defined Sending Time Interval

Additional Downlinks
+ Add

Cancel Save

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

User-Defined Time Interval(5Min-1440Min)

Sending Time Interval

1

Cancel

Save measurements and send downlink