LMDS120 - LoRaWAN Microwave Radar Distance Sensor User Manual

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on 2023/04/26 08:56

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1. Introduction

1.1 What is LMDS120 Microwave Radar DistanceSensor

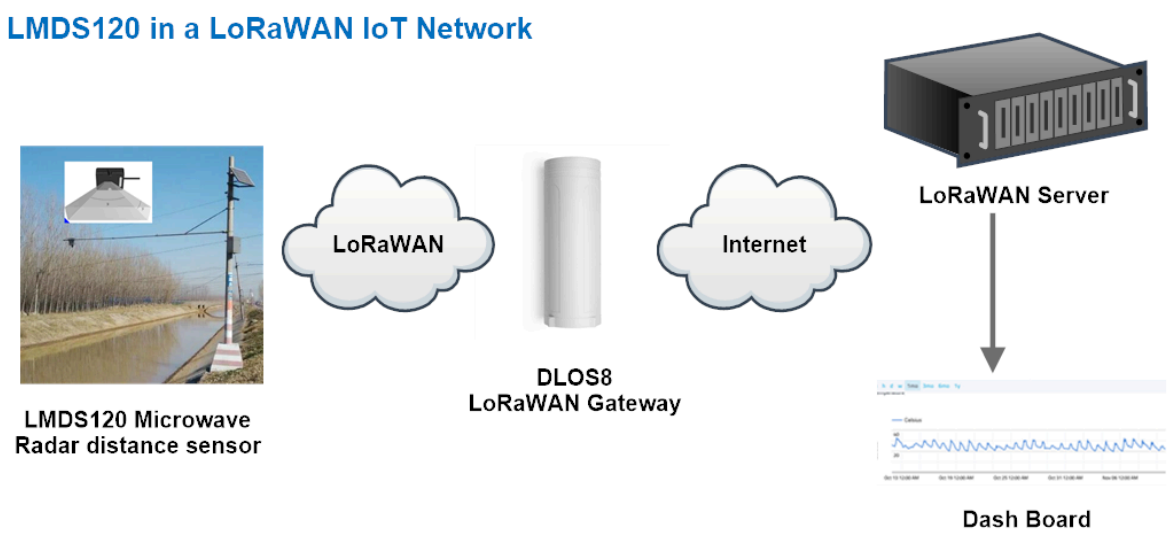
The Dragino LMDS120 is a **LoRaWAN Microwave Radar distance sensor**. It uses use Microwave Radar to detect the distance between sensor and different objects. Different from ultrosonic or Lidar measurement. Microwave Radar is **more reliable for condensation / dusty environment**. It can sense correct distance even there is water or think dust on top of the sensor.

The LMDS120 can be applied to scenarios such as horizontal distance measurement, parking management system, object proximity and presence detection, intelligent trash can management system, robot obstacle avoidance, automatic control, sewer, etc.

The LoRa wireless technology used in LMDS120 allows device to send data and reach extremely long ranges at low data-rates. It provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption.

LMDS120 is powered by **8500mAh Li-SOCI2 battery**, it is designed for long term use up to 5 years.

Each LMDS120 is pre-load with a set of unique keys for LoRaWAN registrations, register these keys to local LoRaWAN server and it will auto connect after power on.



1.2 Features

- LoRaWAN 1.0.3 Class A
- Ultra-low power consumption
- 60Ghz Microwave Radar for distance detection
- Monitor Battery Level
- Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865
- AT Commands to change parameters
- Uplink on periodically
- Downlink to change configure
- 8500mAh Battery for long term use
- Wall Mountable
- Outdoor Use

1.3 Radar probe specification

- Measuring Method: FMCW
- Frequency: 60 GHz
- Measure Range : 15cm ~ 1200cm
- Accuracy: ± (3mm + S*0.2%). S: Measure Value
- Resolution: 0.01m
- Measurement Angle : 25 degrees horizontal and 23 degrees vertical

1.4 Storage & Operation Temperature

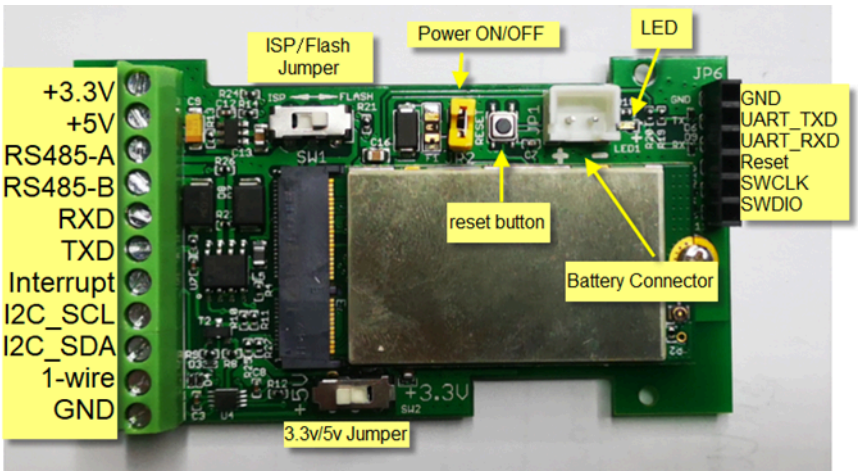
-15°C to +65°C

1.5 Applications

- Horizontal distance measurement
- Liquid level measurement
- Parking management system
- Object proximity and presence detection
- Intelligent trash can management system
- Robot obstacle avoidance
- Automatic control
- Sewer

- Bottom water level monitoring

1.6 Pin mapping and power on



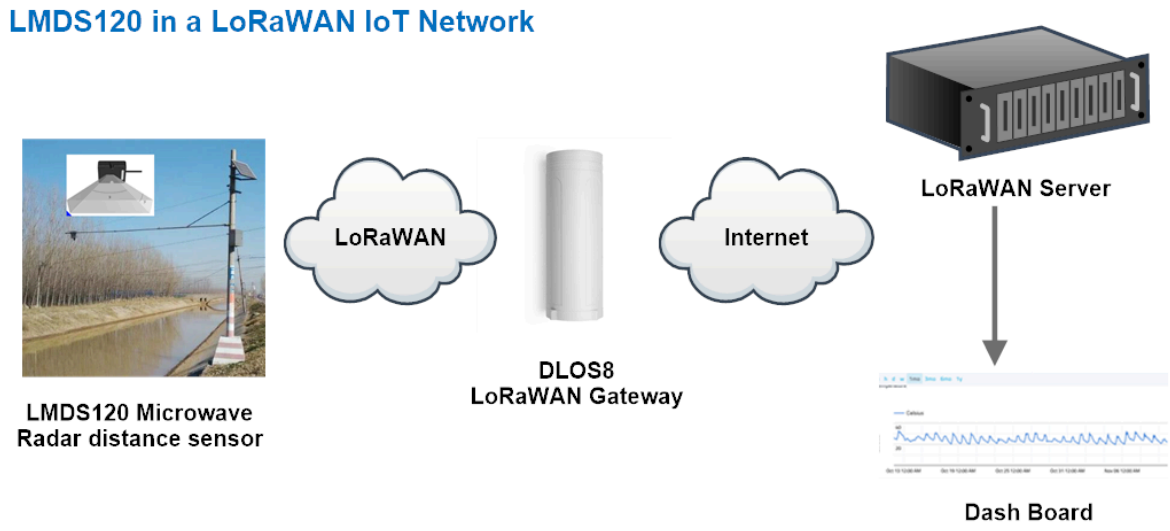
2. Operation Mode

2.1 How it works

Each LMDS120 is shipped with a worldwide unique set of OTAA keys. To use LMDS120 in a LoRaWAN network, user needs to input the OTAA keys in the LoRaWAN network server. So LMDS120 can join the LoRaWAN network and start to transmit sensor data.

2.2 Example to use for LoRaWAN network

Following is an example for how to join the TTN v3 LoRaWAN Network. Below is the network structure; we use the DLOS8 as a LoRaWAN gateway in this example.

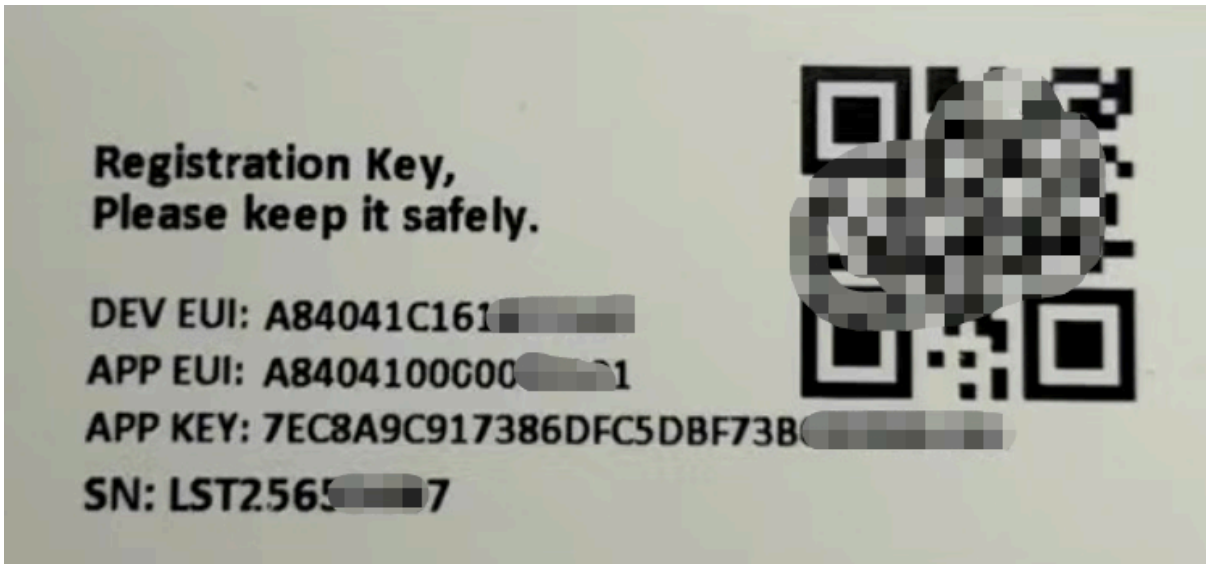


- In this user case, the LMDS120 is installed on top of river to detect the water level and send the level info to the LoRaWAN server. The LMDS120 will uplink different types of messages to the LoRaWAN server. See Uplink payload for detail.

Assume the LoRaWAN Gateway DLOS8 is already set to connect to the TTN V3 network . We need to add the LMDS120 device in TTN V3:

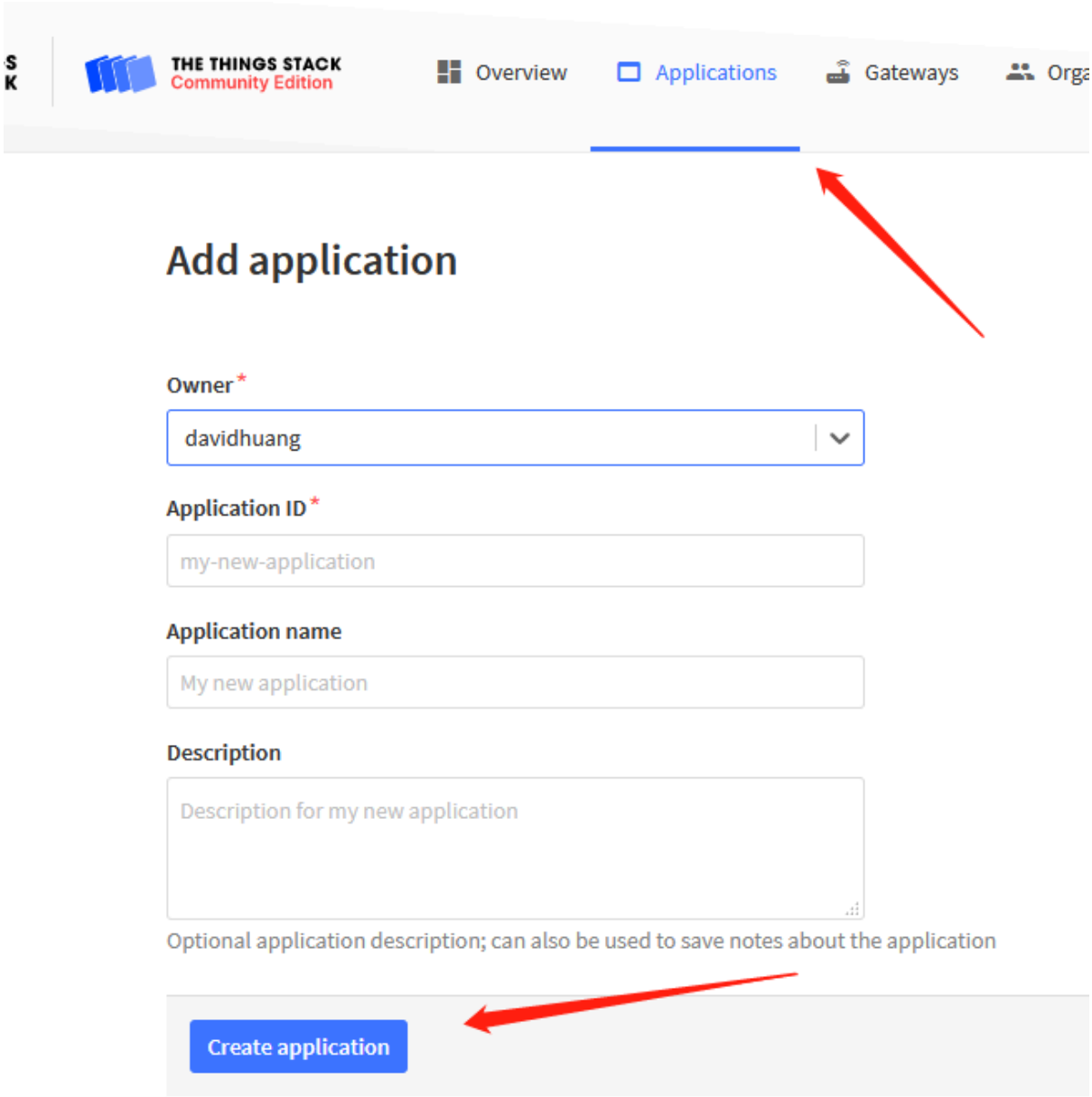
Step 1: Create a device in TTN with the OTAA keys from LMDS120.

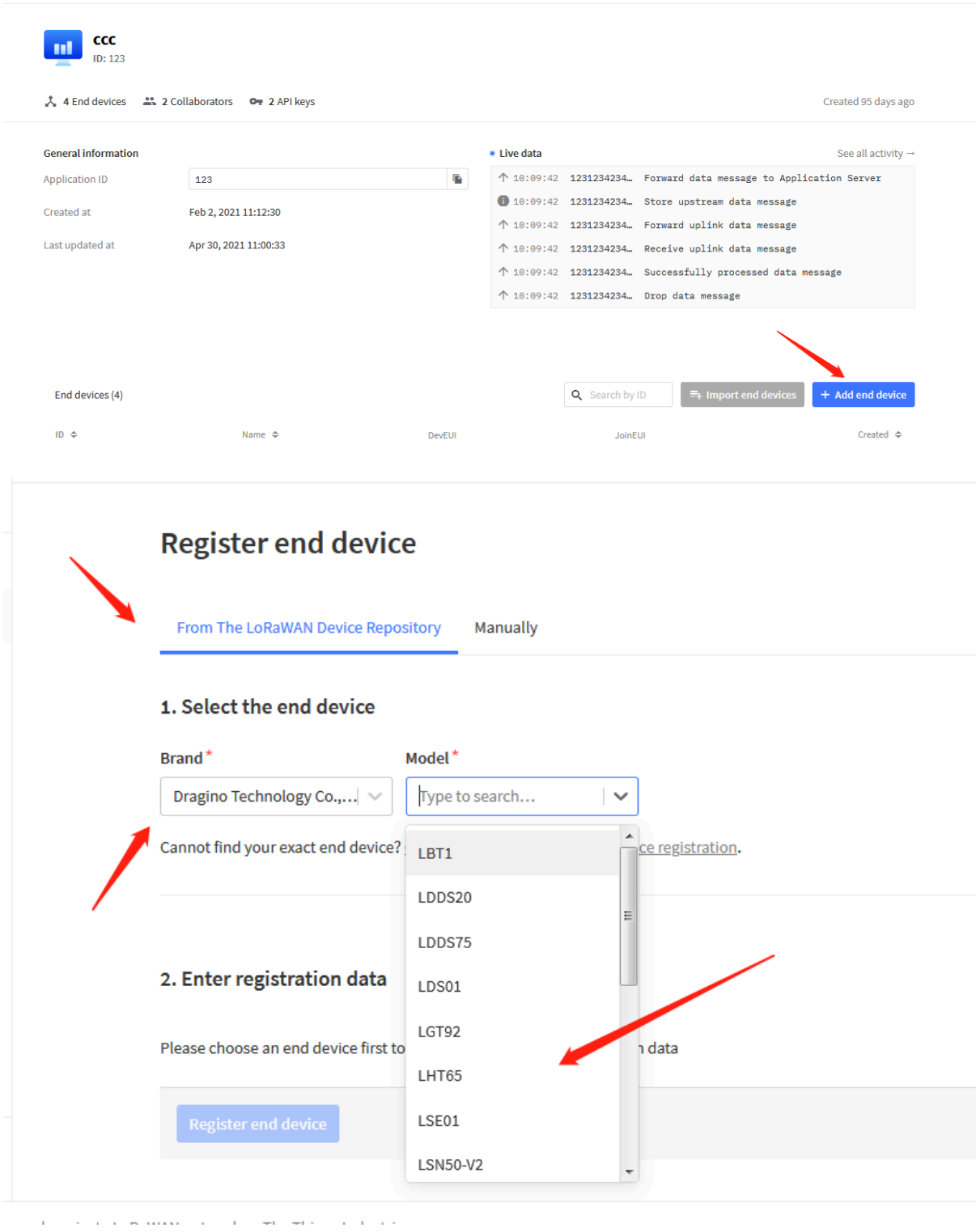
Each LMDS120 is shipped with a sticker with the default device keys, user can find this sticker in the box. it looks like below.

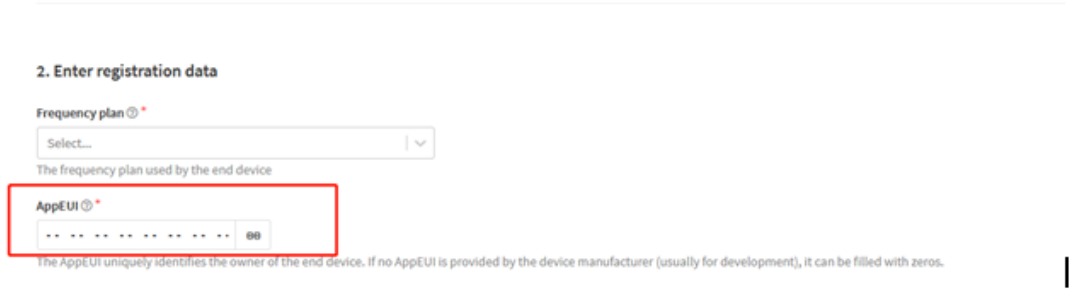


Users can enter these keys in the LoRaWAN Server portal. Below is the TTN V3 screenshot:

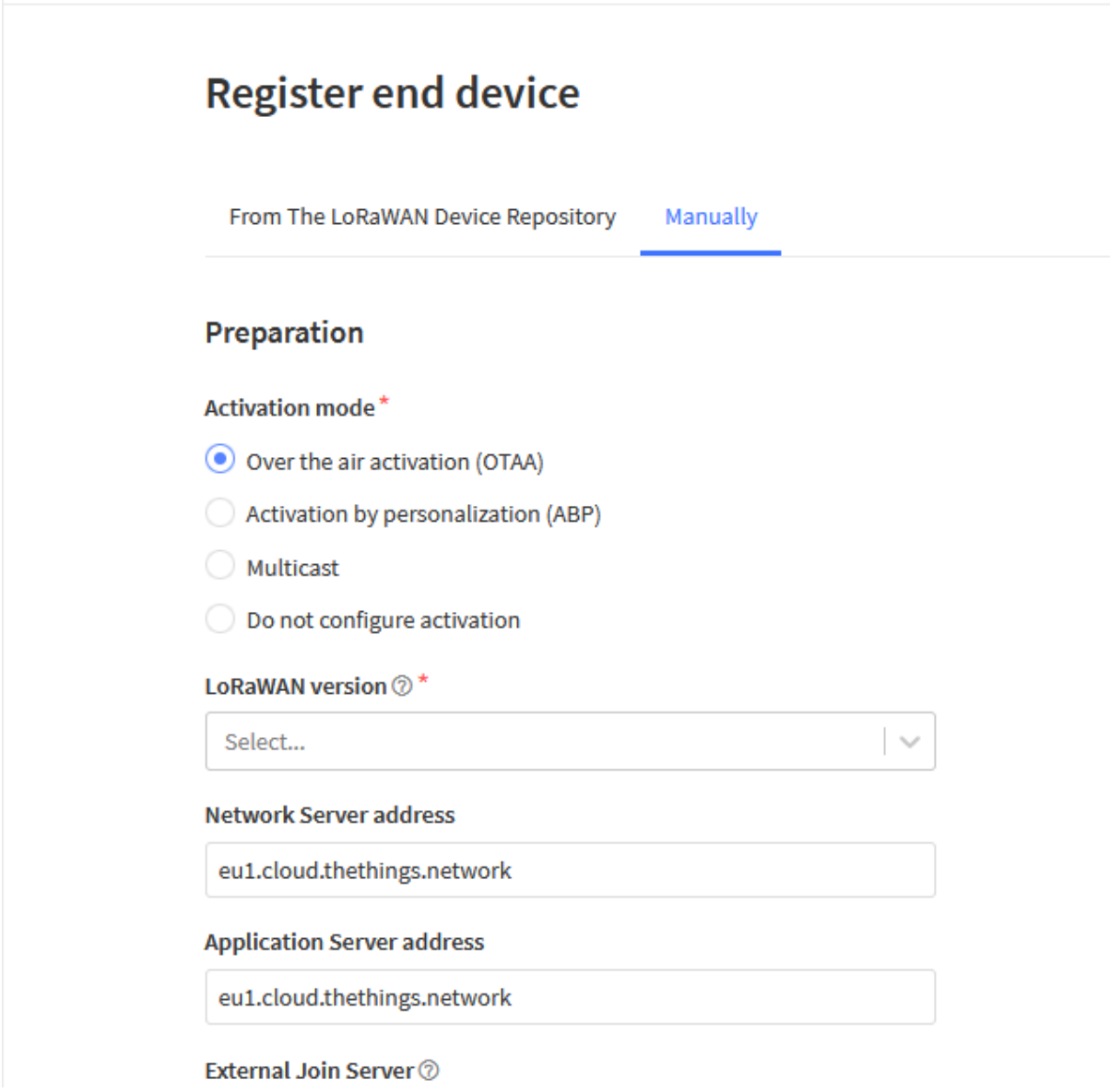
Add APP EUI in the application.


THE THINGS STACK
Community Edition
Overview
Applications
Gateways
Add application
Owner *
davidhuang
Application ID *
my-new-application
Application name
My new application
Description
Description for my new application
Optional application description; can also be used to save notes about the application
Create application


ccc
ID: 123
4 End devices
2 Collaborators
2 API keys
Created 95 days ago
General information
Application ID
123
Created at
Feb 2, 2021 11:12:30
Last updated at
Apr 30, 2021 11:00:33
Live data
See all activity →
10:09:42 1231234234… Forward data message to Application Server
10:09:42 1231234234… Store upstream data message
10:09:42 1231234234… Forward uplink data message
10:09:42 1231234234… Receive uplink data message
10:09:42 1231234234… Successfully processed data message
10:09:42 1231234234… Drop data message
End devices (4)
Search by ID
Import end devices
+ Add end device
ID
Name
DevEUI
JoinEUI
Created
Register end device
From The LoRaWAN Device Repository
Manually
1. Select the end device
Brand*
Dragino Technology Co.,...
Model*
Type to search...
Cannot find your exact end device?
ce registration.
LBT1
LDDS20
LDDS75
LDS01
LGT92
LHT65
LSE01
LSN50-V2
2. Enter registration data
Please choose an end device first to
data
Register end device



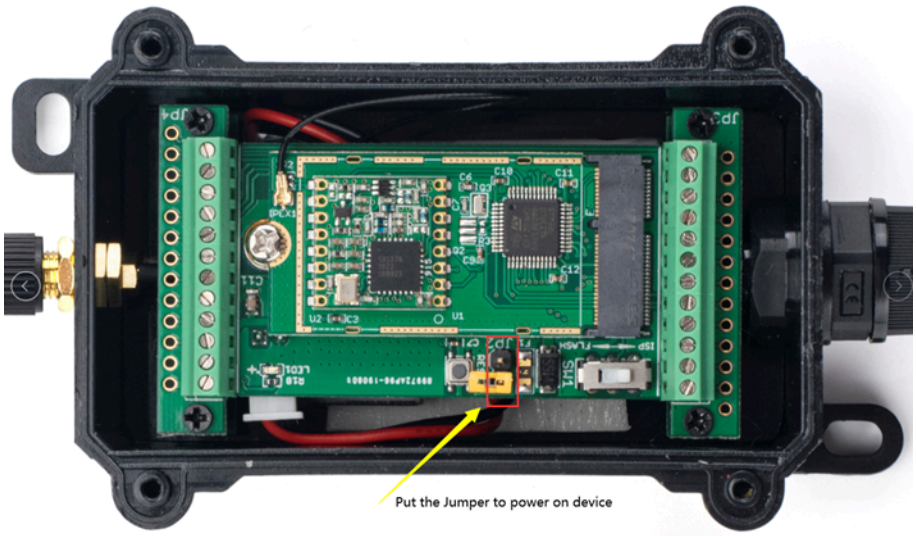
You can also choose to create the device manually.



Add APP KEY and DEV EUI

Step 2: Power on LMDS120

Put a Jumper on JP2 to power on the device. (The Switch must be in FLASH position).



Put the jumper to power on LMDS120 and it will auto-join to the TTN V3 network. After join success, it will start to upload sensor data to TTN V3 and the user can see it in the panel.

2.3 Uplink Payload

Uplink payloads have two types:

- Distance Value: Use FPORT=2
- Other control commands: Use other FPORT fields.

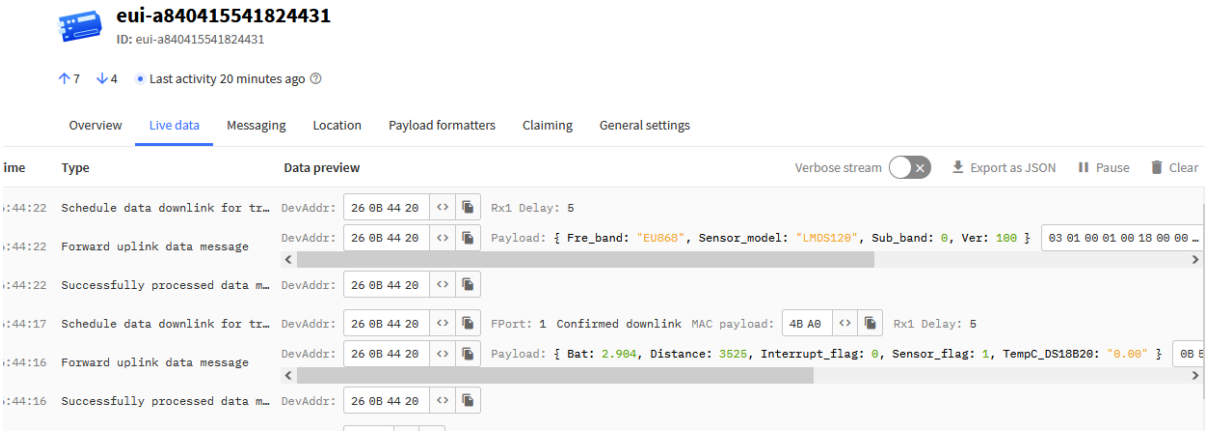
The application server should parse the correct value based on FPORT settings.

2.3.1 Device Status, FPORT=5

Include device configure status. Once LMDS120 Joined the network, it will uplink this message to the server.

Users can also use the downlink command (0x26 01) to ask LMDS120 to resend Device Status.

Device Status (FPORT=5)				
Size(bytes)	**1**	**2**	**1**	**1**
Value	Sensor Model	Firmware Version	Frequency Band	Sub-band



- **Sensor Model:** For LMDS120, this value is 0x18
- **Firmware Version:** 0x0100, Means: v1.0.0 version
- **Frequency Band:**

*0x01: EU868

*0x02: US915

*0x03: IN865

*0x04: AU915

*0x05: KZ865

*0x06: RU864

*0x07: AS923

*0x08: AS923-1

*0x09: AS923-2

*0x0a: AS923-3

*0x0b: AS923-4

- **Sub-Band:**
  - AU915 and US915:value 0x00 ~ 0x08
  - CN470: value 0x0B ~ 0x0C
  - Other Bands: Always 0x00

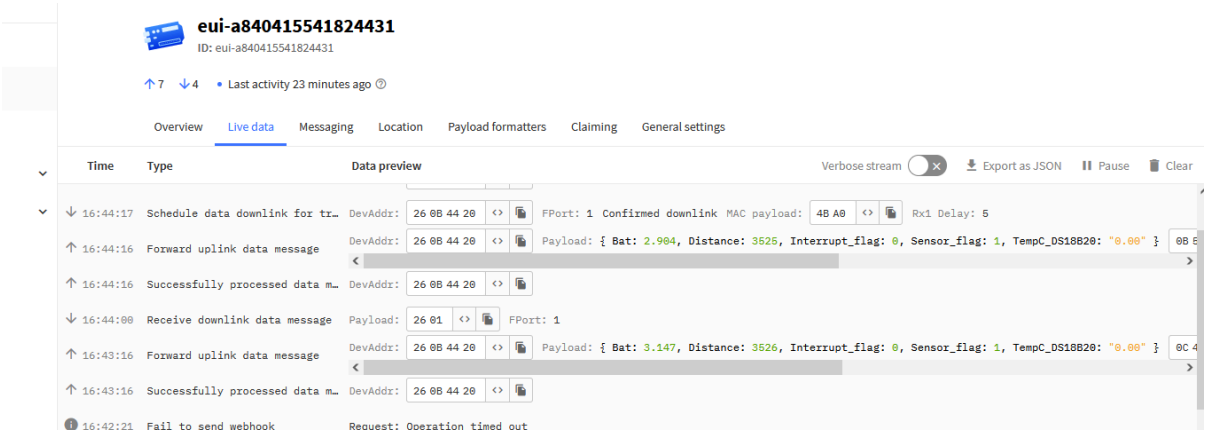
2.3.2 Distance, Uplink FPORT=2

LMDS120 will send this uplink **after** Device Status once join the LoRaWAN network successfully. And LMDS120 will:

1. periodically send this uplink every 20 minute (TDC time), this interval can be changed.
2. send this uplink while there is interrupt event.

Uplink Payload totals 11 bytes.

Distance Value, FPORT=2					
Size(bytes)	**2**	**2**	**1**	**2**	**1**
Value	BAT	Distance	interrupt	DS18B20 temperature	Sensor flag



Distance:

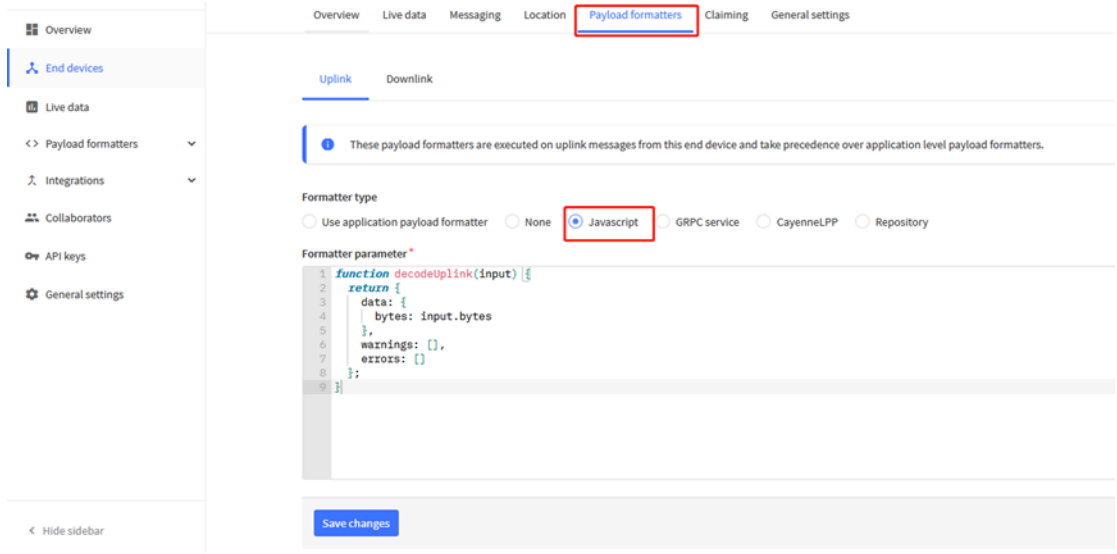
Distance between sensor probe to the first object. (unit: cm)

For example, if the data you get from the register is **0x0D 0xC6**, the distance between the sensor and the measured object is **0DC6(H) = 115 (D) = 115 cm.**

Notice: The distance has a special value :

0x3FFF: Reading Invalid (exceed the valid range of the probe) or Probe not detected.

2.3.3 Decoder in TTN V3



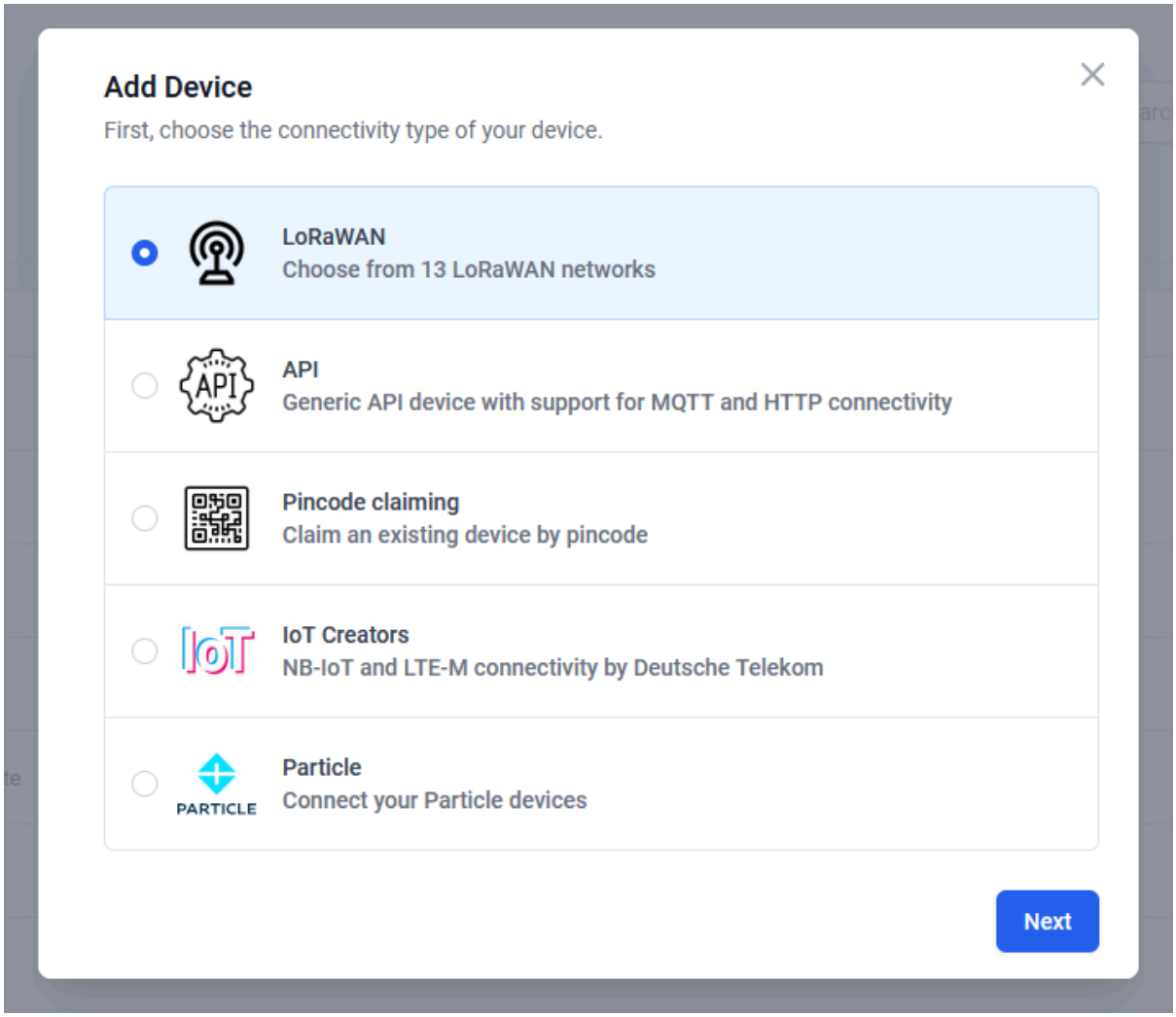
Please check the decoder from this link: https://github.com/dragino/dragino-end-node-decoder

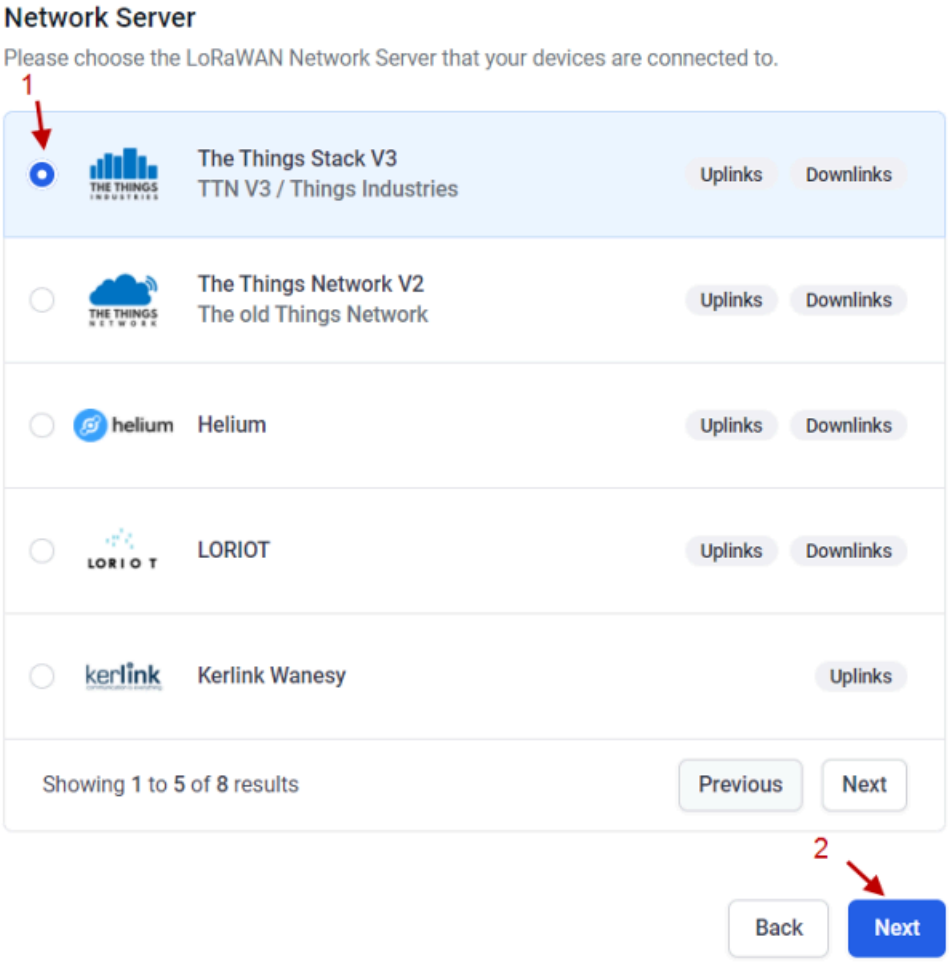
2.4 Show data on Datacake

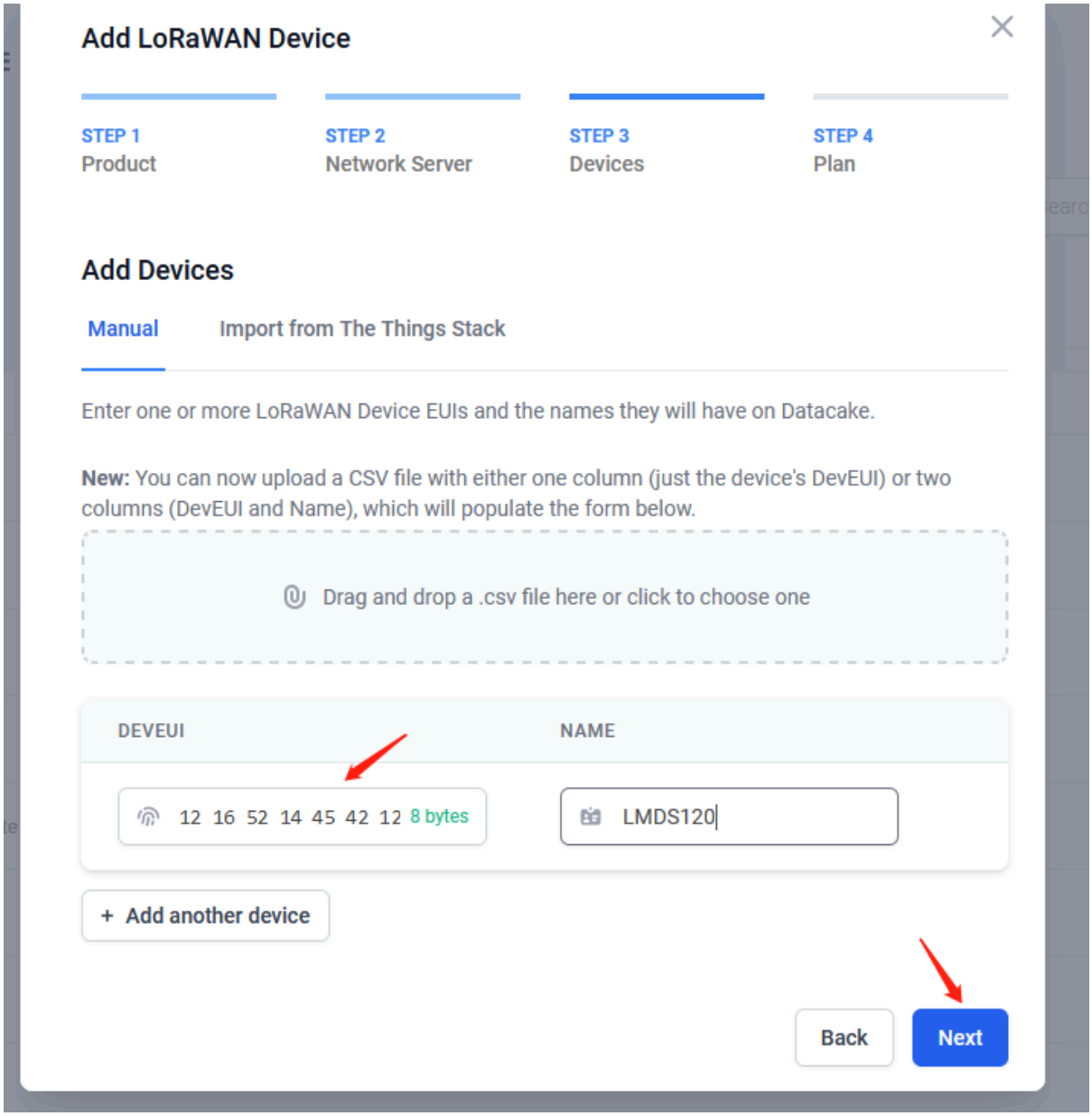
Datacake IoT platform provides a human-friendly interface to show the sensor data, once we have sensor data in TTN V3, we can use Datacake to connect to TTN V3 and see the data in Datacake. Below are the steps:

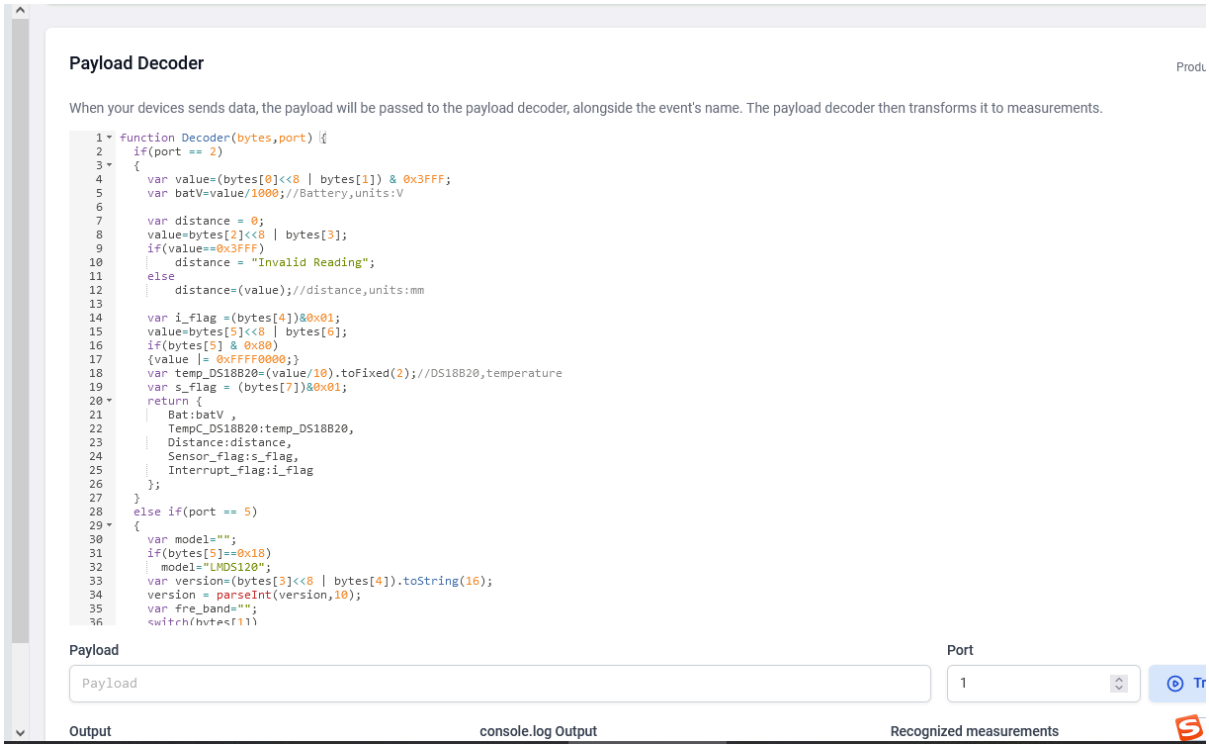
Step 1: Link TTNv3 to DATACAKE

Step 2: Configure LMDS120 in Datacake


Add Device
First, choose the connectivity type of your device.
LoRaWAN
Choose from 13 LoRaWAN networks
API
API
Generic API device with support for MQTT and HTTP connectivity
Pincode claiming
Claim an existing device by pincode
IoT Creators
NB-IoT and LTE-M connectivity by Deutsche Telekom
Particle
PARTICLE
Connect your Particle devices
Next


Network Server
Please choose the LoRaWAN Network Server that your devices are connected to.
1
The Things Stack V3
TTN V3 / Things Industries
Uplinks
Downlinks
The Things Network V2
The old Things Network
Uplinks
Downlinks
helium
Helium
Uplinks
Downlinks
LORIOT
Uplinks
Downlinks
kerlink
Kerlink Wanesy
Uplinks
Showing 1 to 5 of 8 results
Previous
Next
2
Back
Next


Add LoRaWAN Device
STEP 1
Product
STEP 2
Network Server
STEP 3
Devices
STEP 4
Plan
Add Devices
Manual
Import from The Things Stack
Enter one or more LoRaWAN Device EUIs and the names they will have on Datacake.
New: You can now upload a CSV file with either one column (just the device's DevEUI) or two columns (DevEUI and Name), which will populate the form below.
Drag and drop a .csv file here or click to choose one
DEVEUI
NAME
12 16 52 14 45 42 12 8 bytes
LMDS120
+ Add another device
Back
Next



Payload Decoder

When your devices sends data, the payload will be passed to the payload decoder, alongside the event's name. The payload decoder then transforms it to measurements.

```
function Decoder(bytes,port) {
  if(port == 2)
  {
    var value=(bytes[0]<<8 | bytes[1]) & 0x3FFF;
    var batV=value/1000;//Battery,units:V

    var distance = 0;
    value=bytes[2]<<8 | bytes[3];
    if(value==0x3FFF)
        distance = "Invalid Reading";
    else
        distance=(value);//distance,units:mm

    var i_flag =(bytes[4])&0x01;
    value=bytes[5]<<8 | bytes[6];
    if(bytes[5] & 0x80)
    {value |= 0xFFFF0000;}
    var temp_DS18B20=(value/10).toFixed(2);//DS18B20,temperature
    var s_flag = (bytes[7])&0x01;
    return {
       Bat:batV ,
       TempC_DS18B20:temp_DS18B20,
       Distance:distance,
       Sensor_flag:s_flag,
       Interrupt_flag:i_flag
    };
  }
  else if(port == 5)
  {
    var model="";
    if(bytes[5]==0x18)
      model="LMDS120";
    var version=(bytes[3]<<8 | bytes[4]).toString(16);
    version = parseInt(version,10);
    var fre_band="";
    switch(bytes[1])
```

Payload

Payload

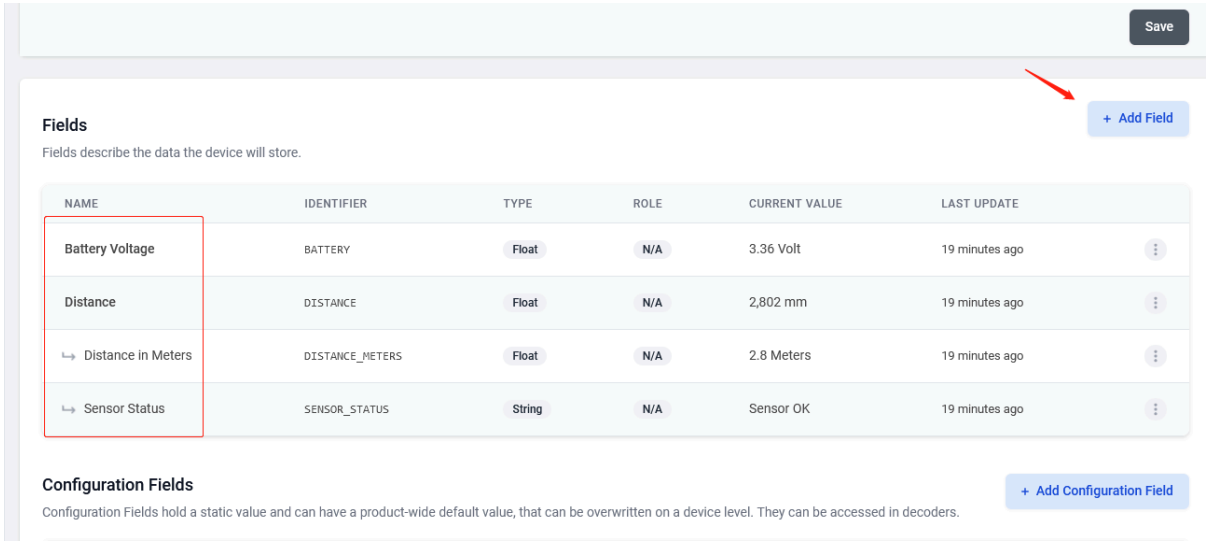
Port

1

Output

console.log Output

Recognized measurements



Save

Fields

Fields describe the data the device will store.

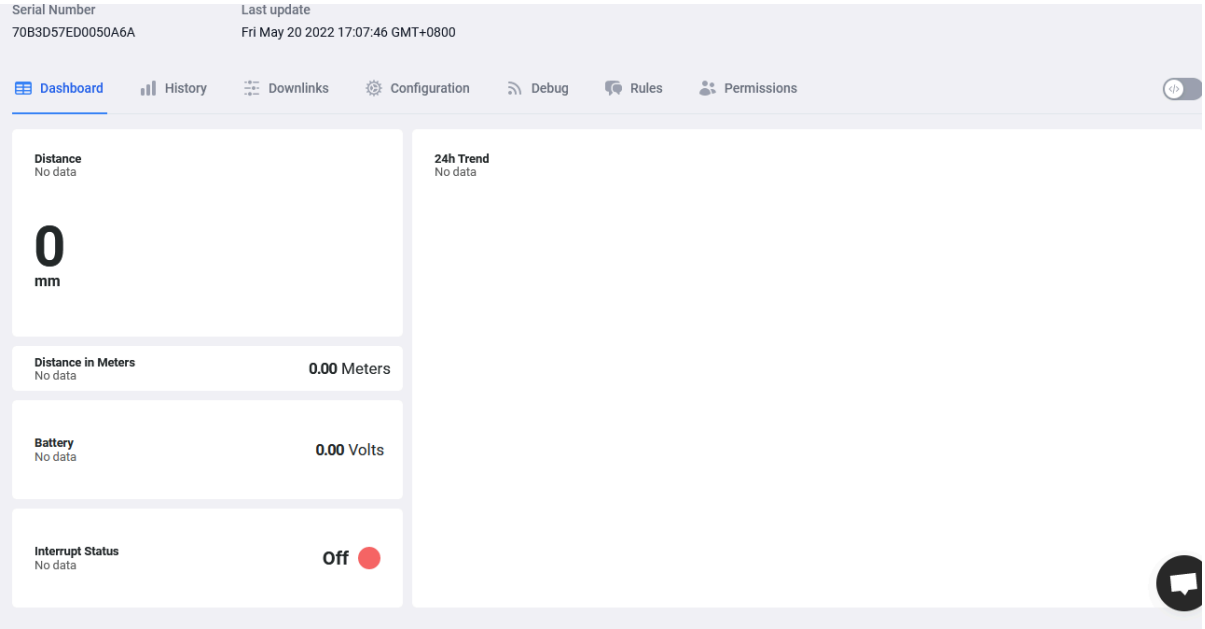
+ Add Field

NAME	IDENTIFIER	TYPE	ROLE	CURRENT VALUE	LAST UPDATE
Battery Voltage	BATTERY	Float	N/A	3.36 Volt	19 minutes ago
Distance	DISTANCE	Float	N/A	2,802 mm	19 minutes ago
↳ Distance in Meters	DISTANCE_METERS	Float	N/A	2.8 Meters	19 minutes ago
↳ Sensor Status	SENSOR_STATUS	String	N/A	Sensor OK	19 minutes ago

Configuration Fields

Configuration Fields hold a static value and can have a product-wide default value, that can be overwritten on a device level. They can be accessed in decoders.

+ Add Configuration Field



3. Configure LMDS120 via AT Command or LoRaWAN Downlink

Use can configure LMDS120 via AT Command or LoRaWAN Downlink.

- AT Command Connection: See FAQ.
- LoRaWAN Downlink instruction for different platforms: IoT LoRaWAN Server

There are two kinds of commands to configure LMDS120, they are:

- **General Commands**.

These commands are to configure:

- General system settings like: uplink interval.
- LoRaWAN protocol & radio related command.

They are same for all Dragino Device which support DLWS-005 LoRaWAN Stack**(Note**)**. These commands can be found on the wiki: End Device AT Commands and Downlink Command

- **Commands special design for LMDS120**

These commands only valid for LMDS120, as below:

3.1 Set Transmit Interval Time(0x01)

Feature: Change LoRaWAN End Node Transmit Interval.

AT Command: AT+TDC

Command Example	Function	Response

AT+TDC=?	Show current transmit Interval	30000 OK the interval is 30000ms = 30s
AT+TDC=60000	Set Transmit Interval	OK Set transmit interval to 60000ms = 60 seconds

Downlink Command: 0x01

Format: Command Code (0x01) followed by 3 bytes time value.

If the downlink payload=0100003C, it means set the END Node's Transmit Interval to 0x00003C=60(S), while type code is 01.

Example 1: Downlink Payload: 0100001E // Set Transmit Interval (TDC) = 30 seconds

Example 2: Downlink Payload: 0100003C // Set Transmit Interval (TDC) = 60 seconds

3.2 Set Interrupt Mode(0x06)

Feature, Set Interrupt mode for GPIO_EXIT.

Downlink Command: AT+INTMOD

Command Example	Function	Response
AT+INTMOD=?	Show current interrupt mode	0 OK the mode is 0 = No interruption
AT+INTMOD=2	Set Transmit Interval 1. (Disable Interrupt), 2. (Trigger by rising and falling edge) 3. (Trigger by falling edge) 4. (Trigger by rising edge)	OK

Downlink Command: 0x06

Format: Command Code (0x06) followed by 3 bytes.

This means that the interrupt mode of the end node is set to 0x000003=3 (rising edge trigger), and the type code is 06.

Example 1: Downlink Payload: 06000000 // Turn off interrupt mode

Example 2: Downlink Payload: 06000003 // Set the interrupt mode to rising edge trigger

4. Battery & Power Consumption

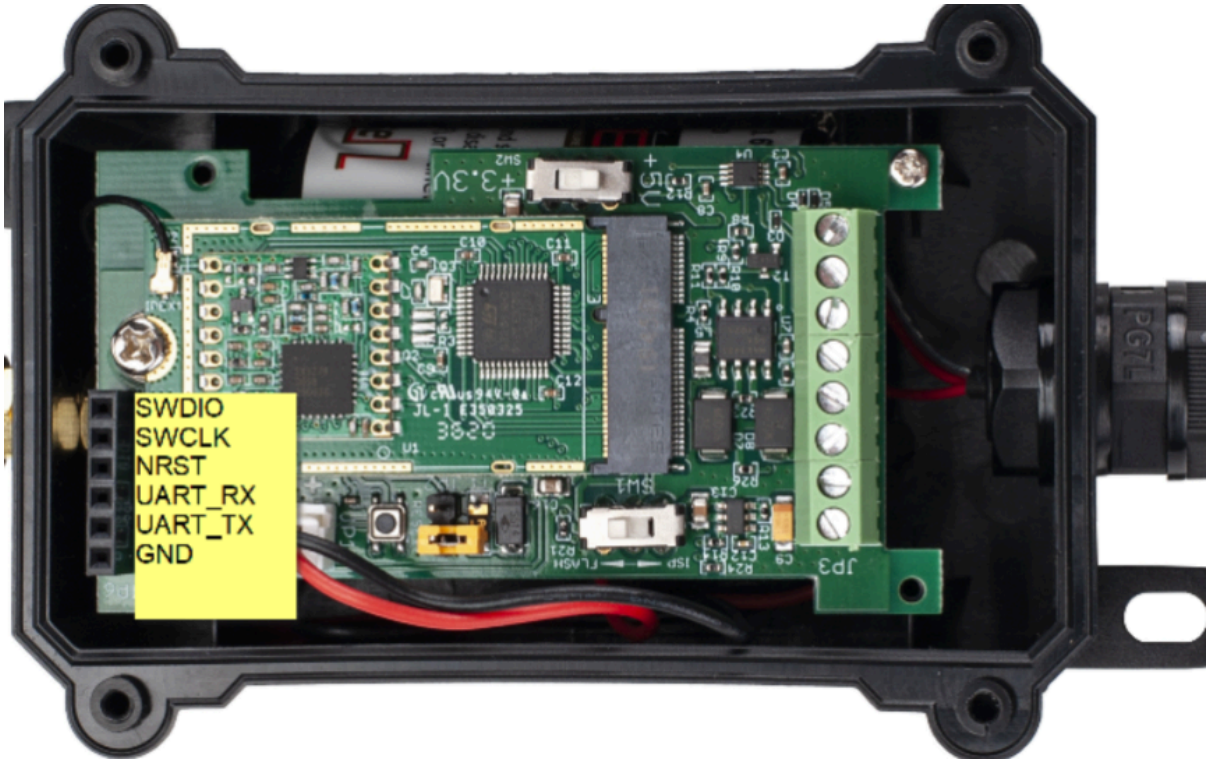
LMDS120 uses ER26500 + SPC1520 battery pack. See below link for detail information about the battery info and how to replace.

Battery Info & Power Consumption Analyze .

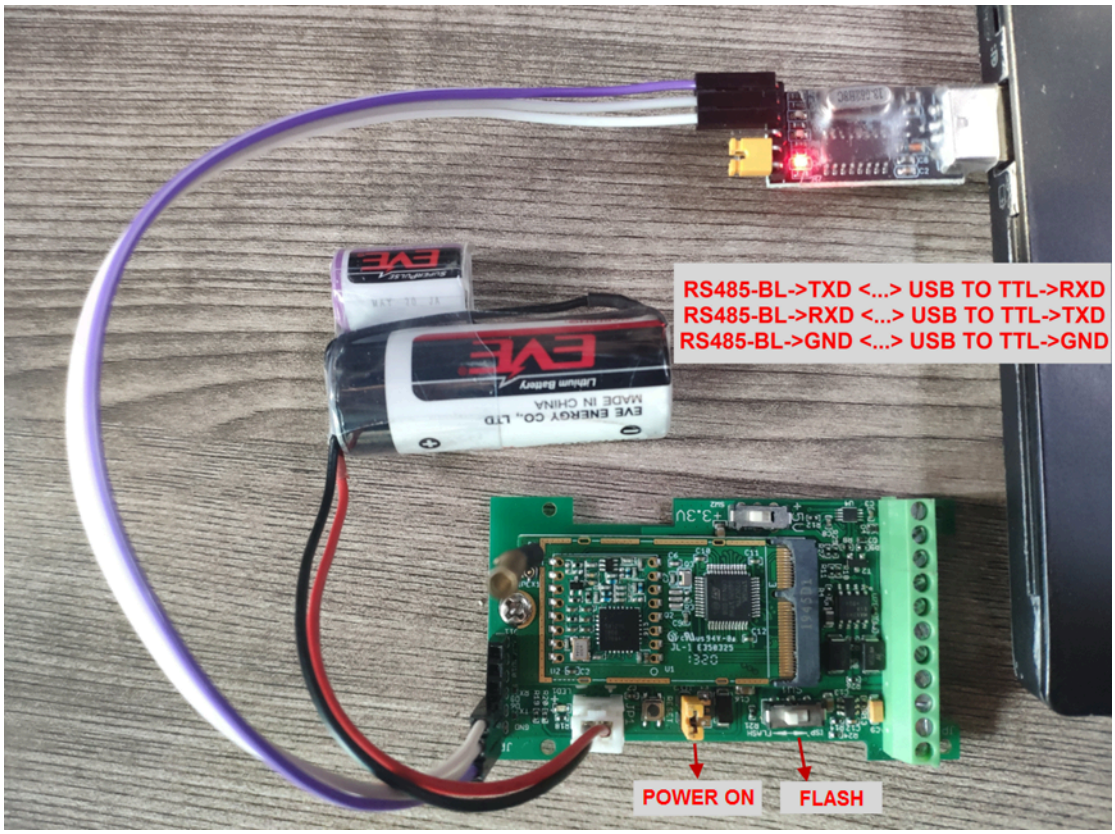
5. FAQ

5.1 How to use AT Command to configure LMDS120

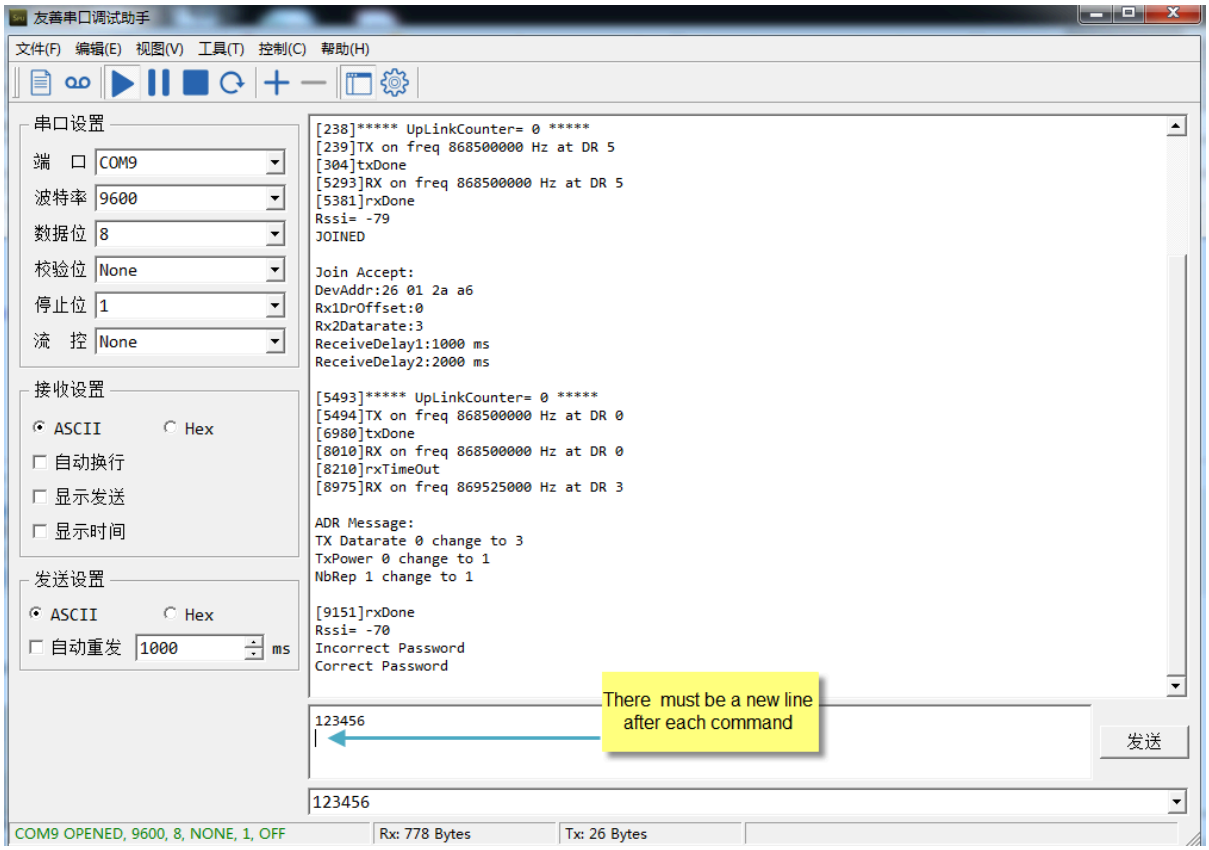
LMDS120 UART connection photo



LMDS120 supports AT Command set. User can use a USB to TTL adapter plus the 3.5mm Program Cable to connect to LMDS120 to use AT command, as below.



In the PC, you need to set the serial baud rate to **9600** to access the serial console for LMDS120. LMDS120 will output system info once power on as below:



5.2 How to upgrade the firmware?

A new firmware might be available for:

- Support new features
- For bug fix
- Change LoRaWAN bands.

Instruction for how to upgrade: http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20Upgrade%20Instruction%20for%20STM32%20base%20products/#H2.HardwareUpgradeMethodSupportList

Firmware location: https://www.dropbox.com/sh/vxhj7k0utq5dk4a/AAC-DW1UeeWSnSPeG-lHWg4da?dl=0

5.3 How to change the LoRa Frequency Bands/Region

You can follow the instructions for how to upgrade image.
When downloading the images, choose the required image file for download.

6. Trouble Shooting

6.1 AT Command input doesn't work

In the case if user can see the console output but can't type input to the device. Please check if you already include the **ENTER** while sending out the command. Some serial tool doesn't send **ENTER** while press the send key, user need to add ENTER in their string.

7. Order Info

Part Number **: LMDS120-XX**

XX: The default frequency band

- **AS923 :** LoRaWAN AS923 band
- **AU915 :** LoRaWAN AU915 band
- **EU433 :** LoRaWAN EU433 band
- **EU868 :** LoRaWAN EU868 band
- **KR920 :** LoRaWAN KR920 band
- **US915 :** LoRaWAN US915 band
- **IN865 :** LoRaWAN IN865 band
- **CN470 :** LoRaWAN CN470 band

8. Packing Info

Package Includes:

- LMDS120 LoRaWAN Microwave Radar Distance Sensor x 1

9. Support

- Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be answered as soon as possible in the before-mentioned schedule.
- Provide as much information as possible regarding your enquiry (product models, accurately describe your problem and steps to replicate it etc) and send a mail to support@dragino.com.