LoRaWAN LiDAR ToF Distance Sensor User Manual

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Image Version: v1.0

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1.1	Clarify Interrupt Pin	2021-Jul-9

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1. Introduction

1.1What is LoRaWAN LiDAR ToF Distance Sensor

The Dragino LLDS12 is a **LoRaWAN LiDAR ToF (Time of Flight) Distance Sensor** for Internet of Things solution. It is capable to measure the distance to an object as close as 10 centimeters (+/- 5cm up to 6m) and as far as 12 meters (+/-1% starting at 6m)!. The LiDAR probe uses laser induction technology for distance measurement.

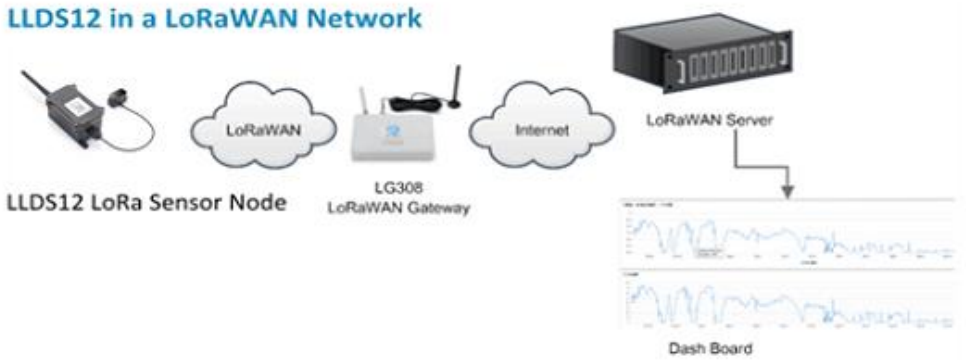
The LLDS12 can be applied to scenarios such as horizontal distance measurement, parking management system, object proximity and presence detection, intelligent trash can management system, robot obstacle avoidance, automatic control, sewer, etc.

It detects the distance between the measured object and the sensor, and uploads the value via wireless to LoRaWAN IoT Server.

The LoRa wireless technology used in LLDS12 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.

LLDS12 is powered by **8500mAh Li-SOCI2 battery**, it is designed for long term use up to 5 years.

Each LLDS12 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.



1.2Features

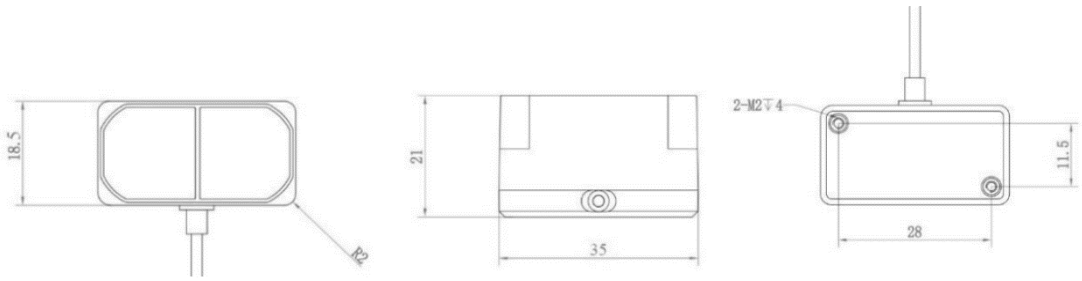
- ✧ LoRaWAN 1.0.3 Class A
- ✧ Ultra-low power consumption
- ✧ Laser technology for distance detection
- ✧ Operating Range - 0.1m~12m①
- ✧ Accuracy - ±5cm@(0.1-6m), ±1%@(6m-12m)
- ✧ Monitor Battery Level

- 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

1.3Probe Specification

- Storage temperature：-20℃~75℃
- Operating temperature - -20℃~60℃
- Operating Range - 0.1m~12m①
- Accuracy - ±5cm@(0.1-6m), ±1%@(6m-12m)
- Distance resolution - 5mm
- Ambient light immunity - 70klux
- Enclosure rating - IP65
- Light source - LED
- Central wavelength - 850nm
- FOV - 3.6°
- Material of enclosure - ABS+PC
- Wire length - 25cm

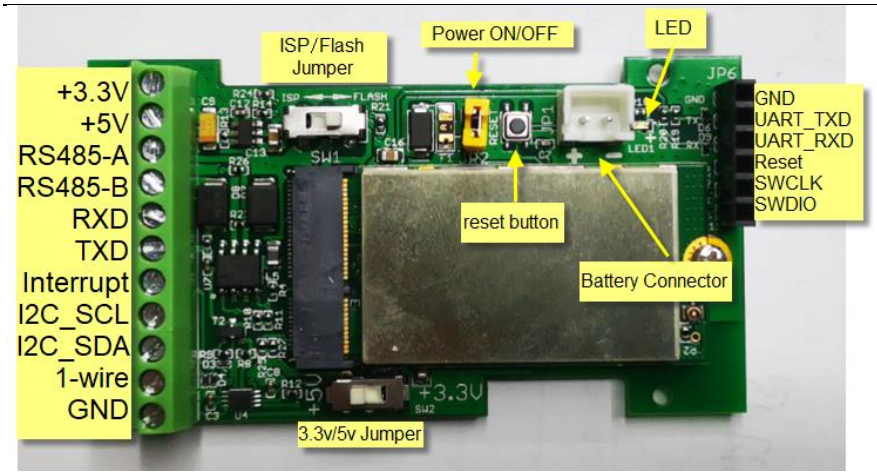
1.4Probe Dimension



1.5Applications

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

1.6Pin mapping and power on



2. Configure LLDS12 to connect to LoRaWAN network

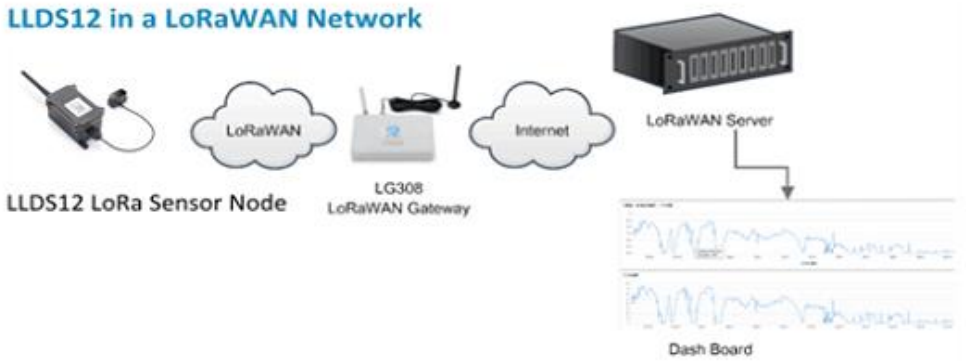
2.1 How it works

The LLDS12 is configured as LoRaWAN OTAA Class A mode by default. It has OTAA keys to join LoRaWAN network. To connect a local LoRaWAN network, you need to input the OTAA keys in the LoRaWAN IoT server and power on the LLDS12. It will automatically join the network via OTAA and start to send the sensor value. The default uplink interval is 20 minutes.

In case you can't set the OTAA keys in the LoRaWAN OTAA server, and you have to use the keys from the server, you can use AT Commands to set the keys in the LLDS12.

2.2Quick guide to connect to LoRaWAN server (OTAA)

Following is an example for how to join the TTN v3 LoRaWAN Network. Below is the network structure; we use the LG308 as a LoRaWAN gateway in this example.

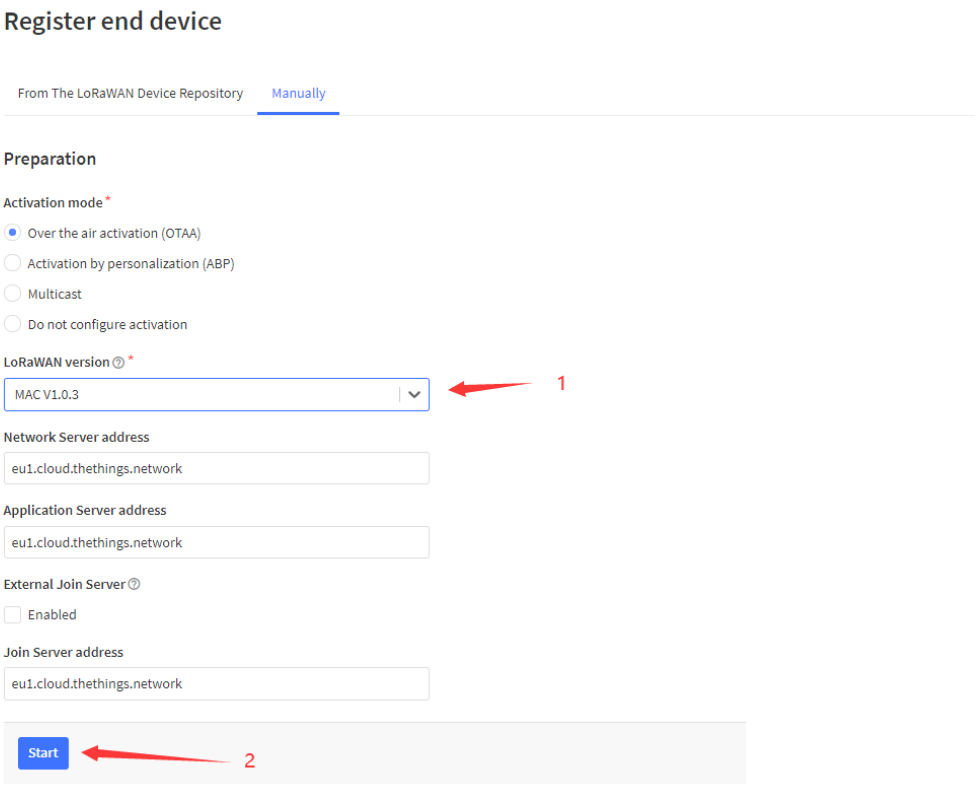


The LG308 is already set to connected to TTN network , so what we need to now is configure the TTN server.

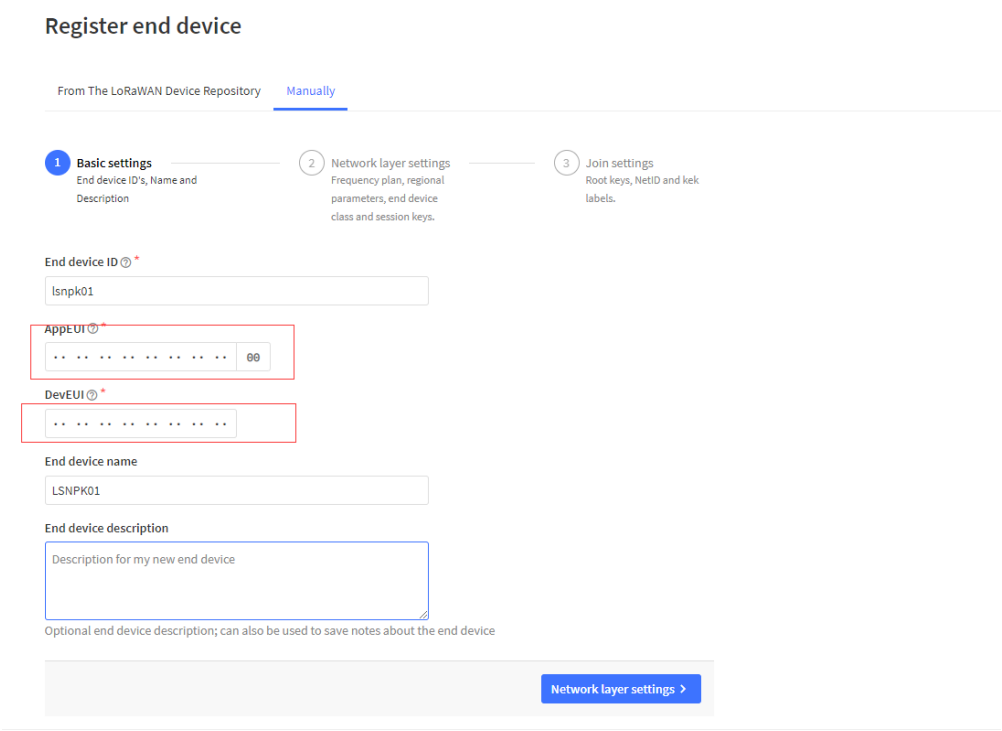
Step 1: Create a device in TTN with the OTAA keys from LLDS12.
Each LLDS12 is shipped with a sticker with the default device EUI as below:

You can enter this key in the LoRaWAN Server portal. Below is TTN screen shot:

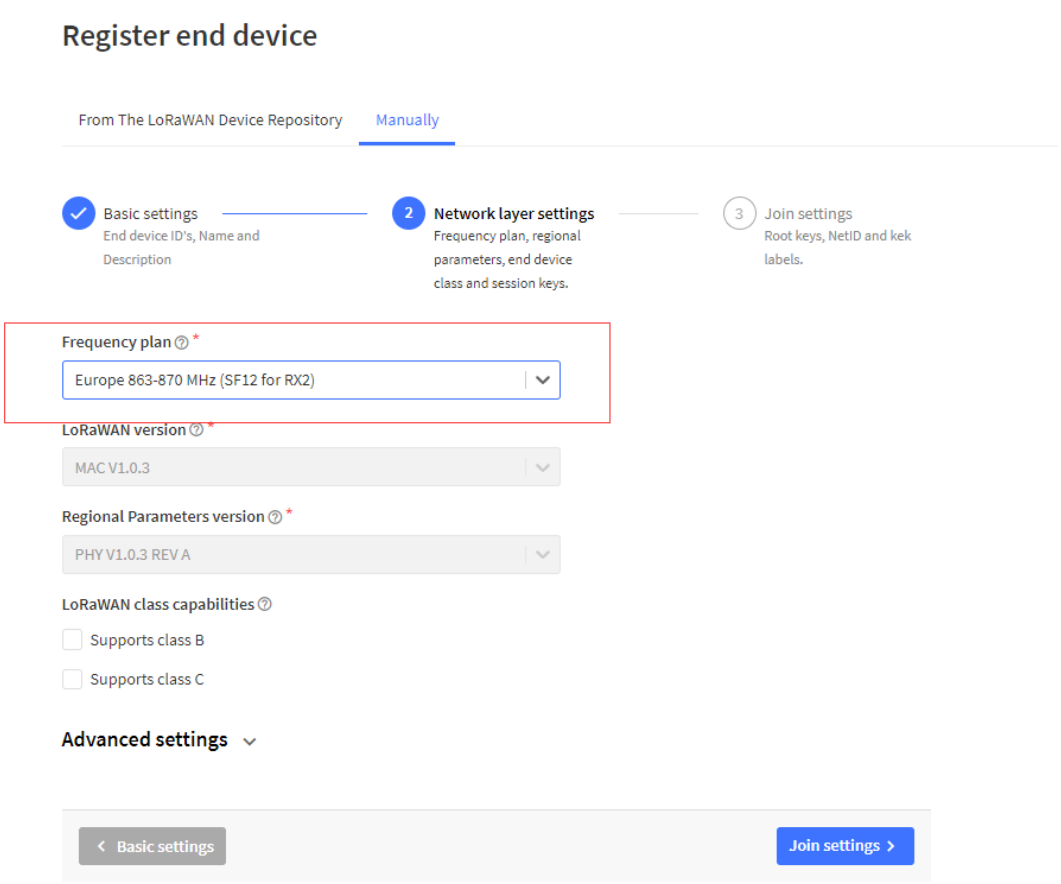
Register the device



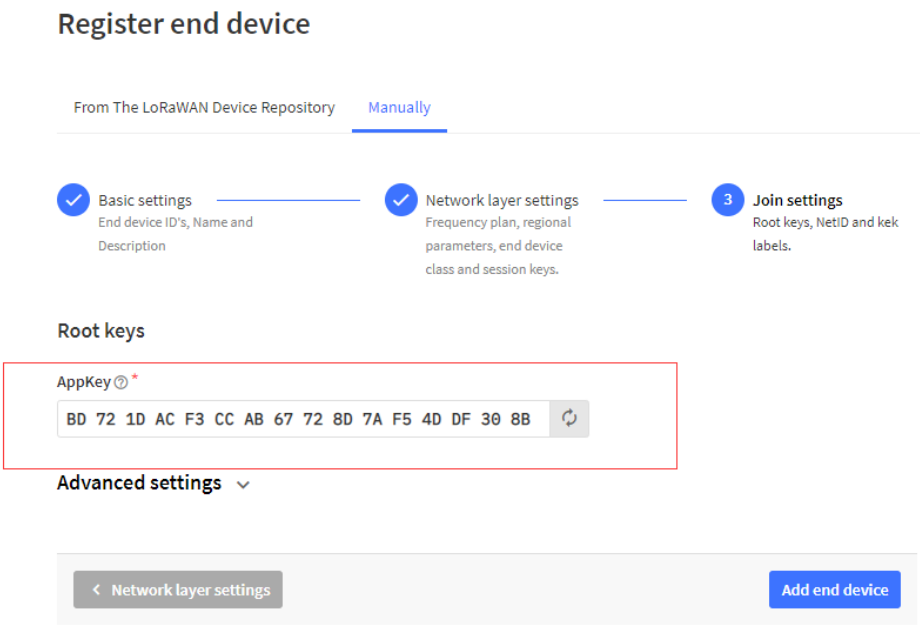
Add APP EUI and DEV EUI



Add APP EUI in the application



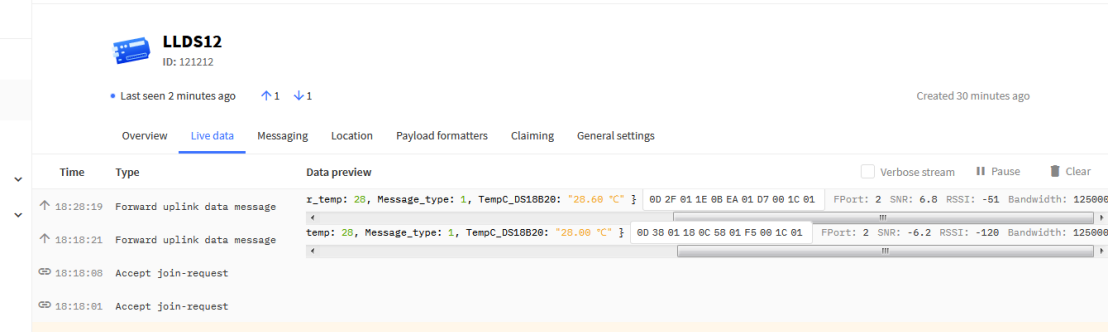
Add APP KEY


Register end device
From The LoRaWAN Device Repository
Manually
Basic settings
End device ID's, Name and Description
Network layer settings
Frequency plan, regional parameters, end device class and session keys.
3
Join settings
Root keys, NetID and kek labels.
Root keys
AppKey *
BD 72 1D AC F3 CC AB 67 72 8D 7A F5 4D DF 30 8B
Advanced settings
Network layer settings
Add end device

Step 2: Power on LLDS12

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

Step 3: The LLDS12 will auto join to the TTN network. After join success, it will start to upload messages to TTN and you can see the messages in the panel.

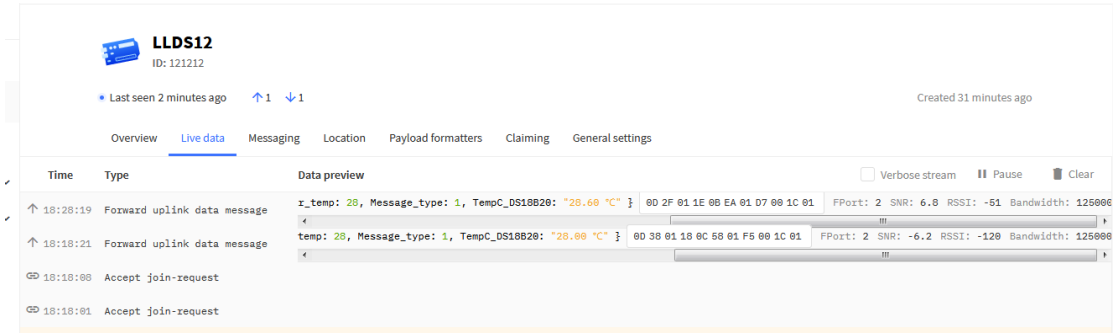


2.3Uplink Payload

LLDS12 will uplink payload via LoRaWAN with below payload format:

Uplink payload includes in total 11 bytes.

Size (bytes)	2	2	2	2	1	1	1
Value	BAT	Temperature DS18B20	Distance	Distance signal strength	Interrupt_flag	LiDAR temp	Message Type



2.3.1 Battery Info

Check the battery voltage for LLDS12.
Ex1: 0x0B45 = 2885mV
Ex2: 0x0B49 = 2889mV

2.3.2 DS18B20 Temperature sensor

This is optional, user can connect external DS18B20 sensor to the +3.3v, 1-wire and GND pin . and this field will report temperature.

Example:
If payload is: 0105H: (0105 & FC00 == 0), temp = 0105H /10 = 26.1 degree
If payload is: FF3FH : (FF3F & FC00 == 1) , temp = (FF3FH - 65536)/10 = -19.3 degrees.

2.3.3 Distance

Represents the distance value of the measurement output, the default unit is cm, and the value range parsed as a decimal number is 0-1200. In actual use, when the signal strength value Strength.

Example:
If the data you get from the register is 0x0B 0xEA, the distance between the sensor and the measured object is
0BEA(H) = 3050 (D)/10 = 305cm.

2.3.4 Distance signal strength

Refers to the signal strength, the default output value will be between 0-65535. When the distance measurement gear is fixed, the farther the distance measurement is, the lower the signal strength; the lower the target reflectivity, the lower the signal strength. When Strength is greater than 100 and not equal to 65535, the measured value of Dist is considered credible.

Example:
If payload is: 01D7(H)=471(D), distance signal strength=471, 471>100,471≠65535, the measured value of Dist is considered credible.
Customers can judge whether they need to adjust the environment based on the signal strength.

2.3.5 Interrupt Pin

This data field shows if this packet is generated by **Interrupt Pin** or not. Click here for the hardware and software set up. Note: The Internet Pin is a separate pin in the screw terminal. See pin mapping.

Example:

0x00: Normal uplink packet.
0x01: Interrupt Uplink Packet.

2.3.6 LiDAR temp

Characterize the internal temperature value of the sensor.

Example:
If payload is: 1C(H) <<24>>24=28(D),LiDAR temp=28℃.
If payload is: F2(H) <<24>>24=-14(D),LiDAR temp=-14℃.

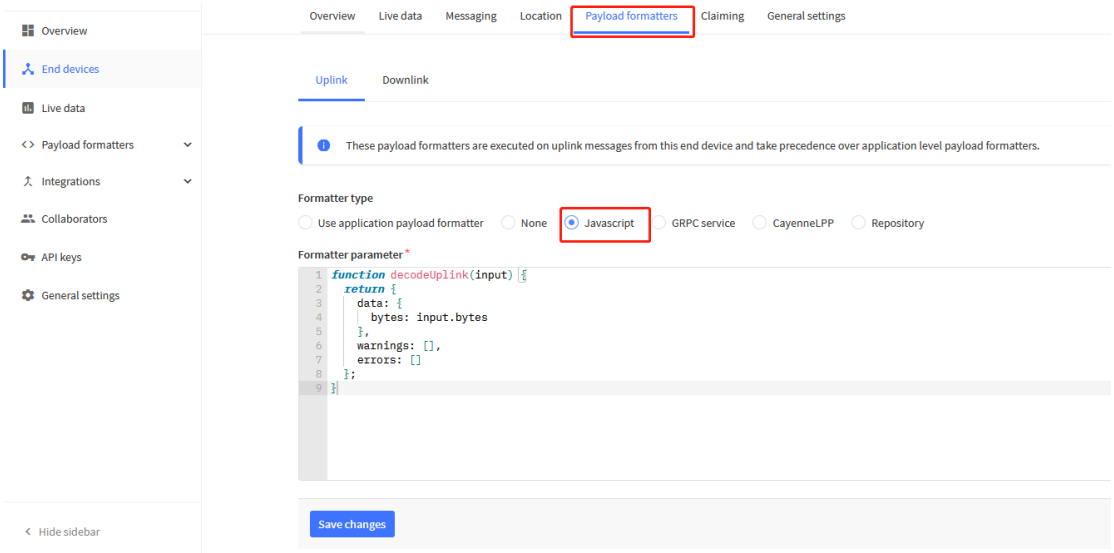
2.3.7 Message Type

For a normal uplink payload, the message type is always 0x01.
Valid Message Type:

Message Type Code	Description	Payload
0x01	Normal Uplink	Normal Uplink Payload
0x02	Reply configures info	Configure Info Payload

2.3.8 Decode payload in The Things Network

While using TTN network, you can add the payload format to decode the payload.



The payload decoder function for TTN is here:
LLDS12 TTN Payload Decoder:
https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LLDS12/Decoder/

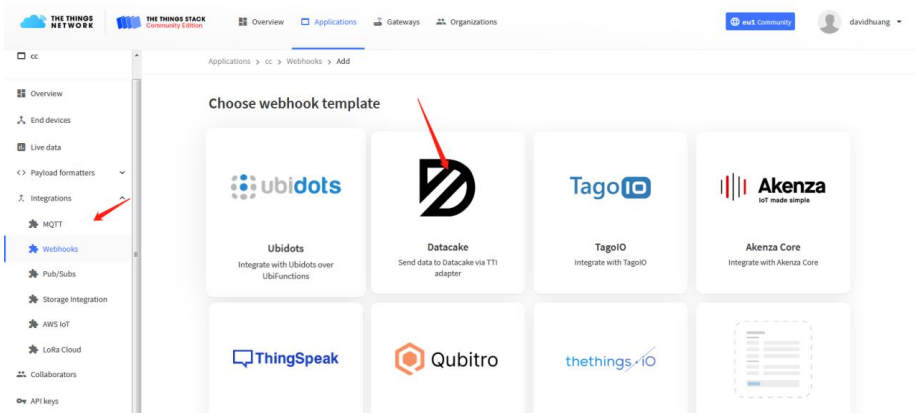
2.4Uplink Interval

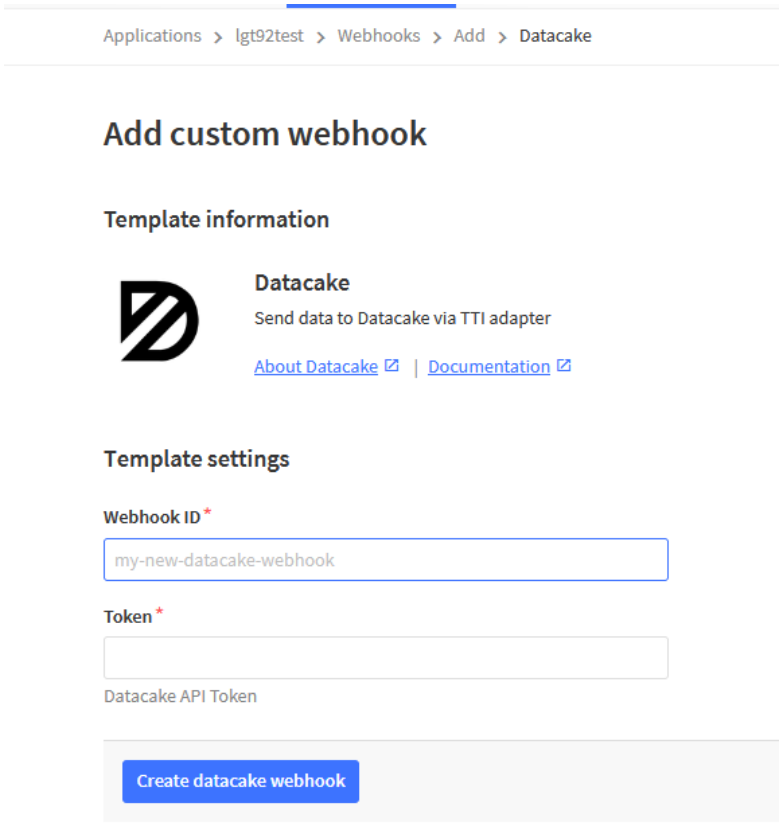
The LLDS12 by default uplink the sensor data every 20 minutes. User can change this interval by AT Command or LoRaWAN Downlink Command. See this link:
http://wiki.dragino.com/index.php?title=End_Device_AT_Commands_and_Downlink_Commands#Change_Uplink_Interval

2.5Show Data in DataCake IoT Server

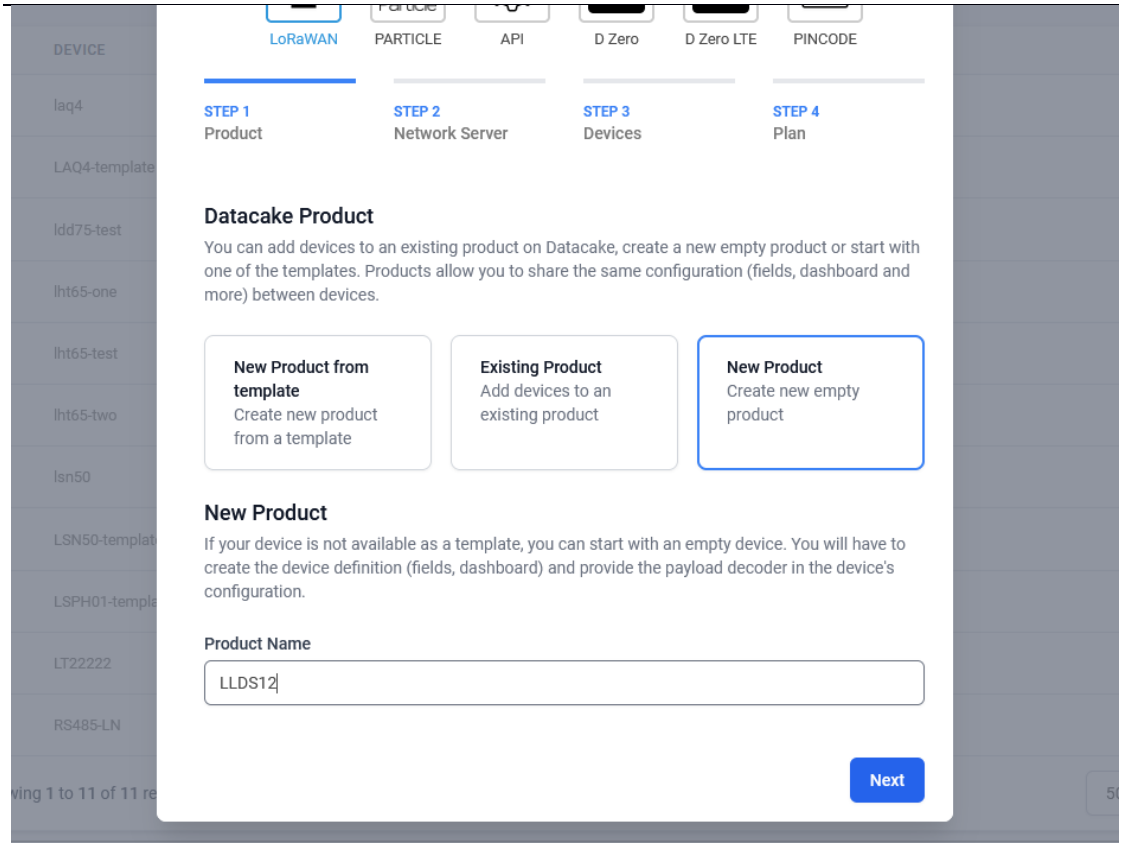
DATACAKE provides a human friendly interface to show the sensor data, once we have data in TTN, we can use DATACAKE to connect to TTN and see the data in DATACAKE. Below are the steps:

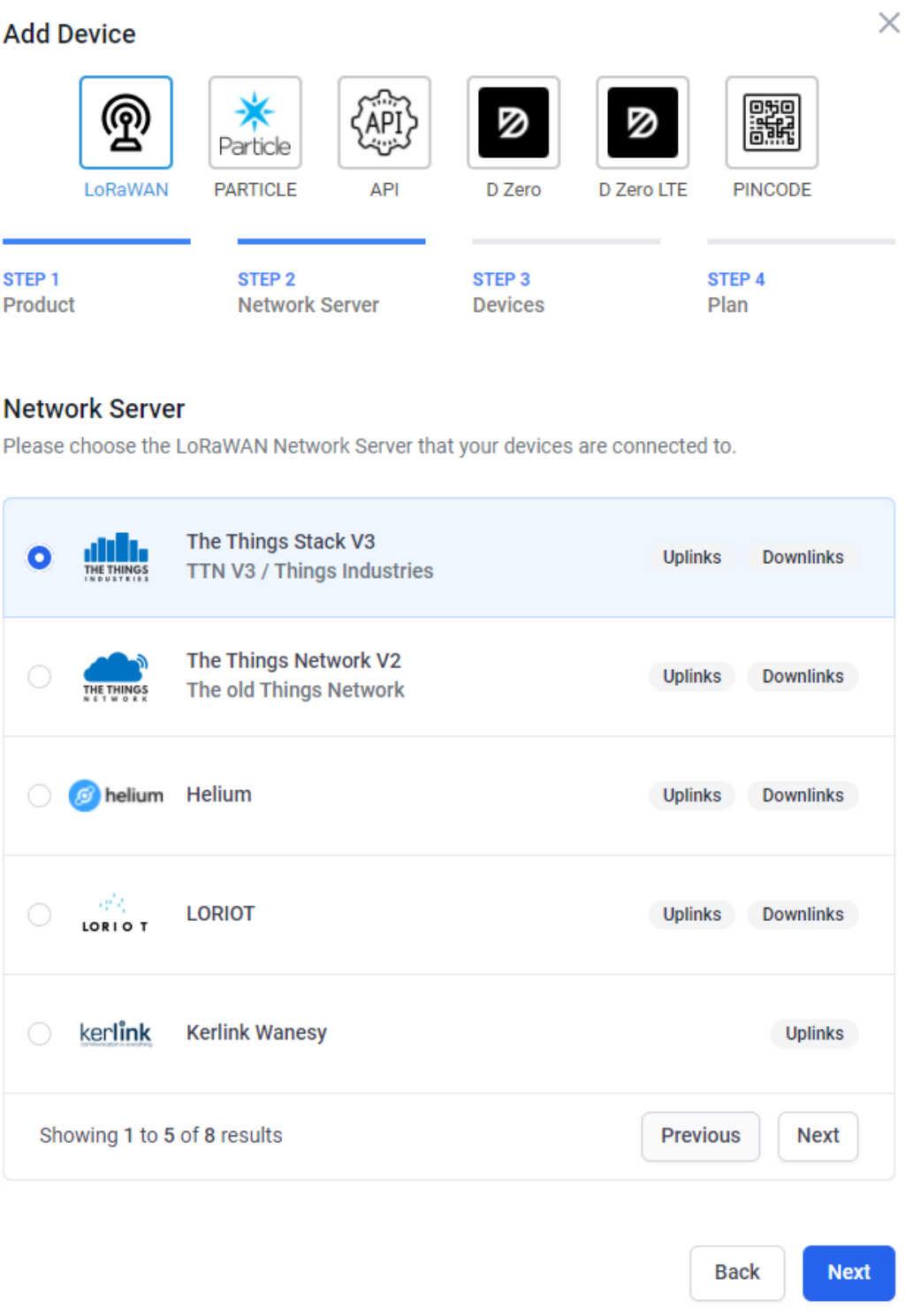
Step 1: Be sure that your device is programmed and properly connected to the network at this time.
Step 2: To configure the Application to forward data to DATACAKE you will need to add integration. To add the DATACAKE integration, perform the following steps:

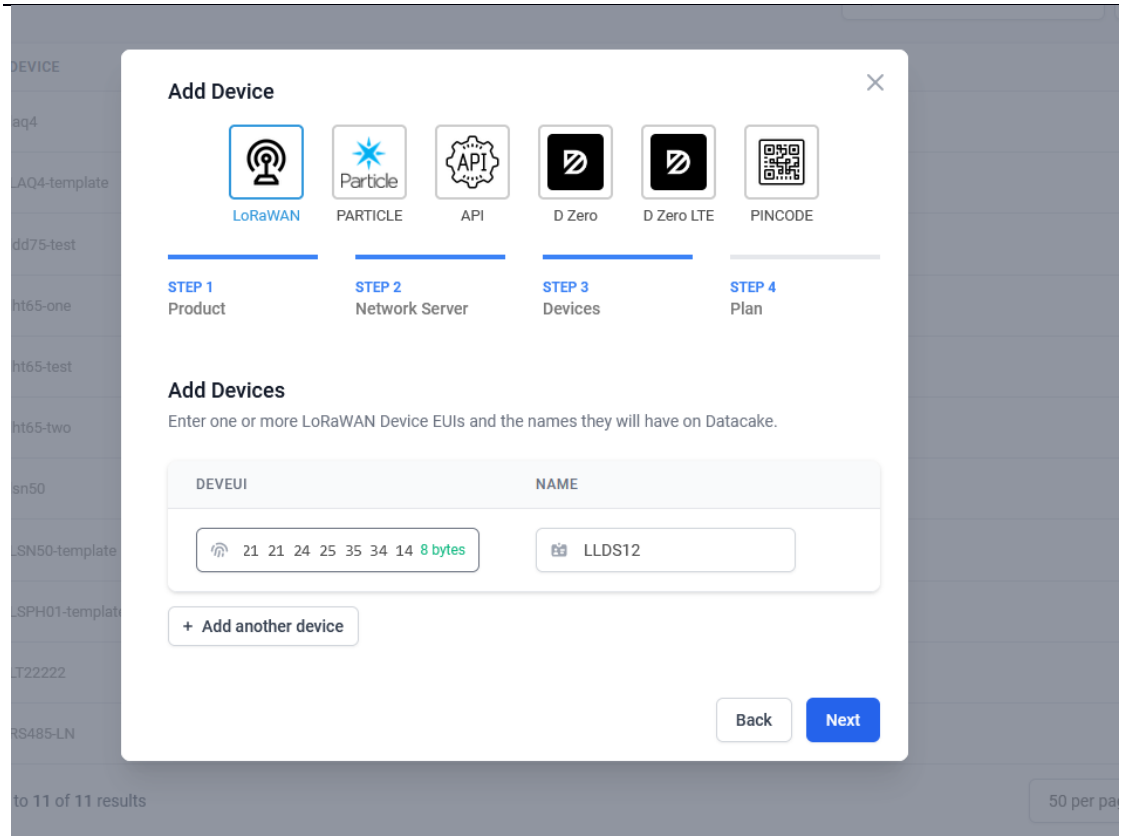




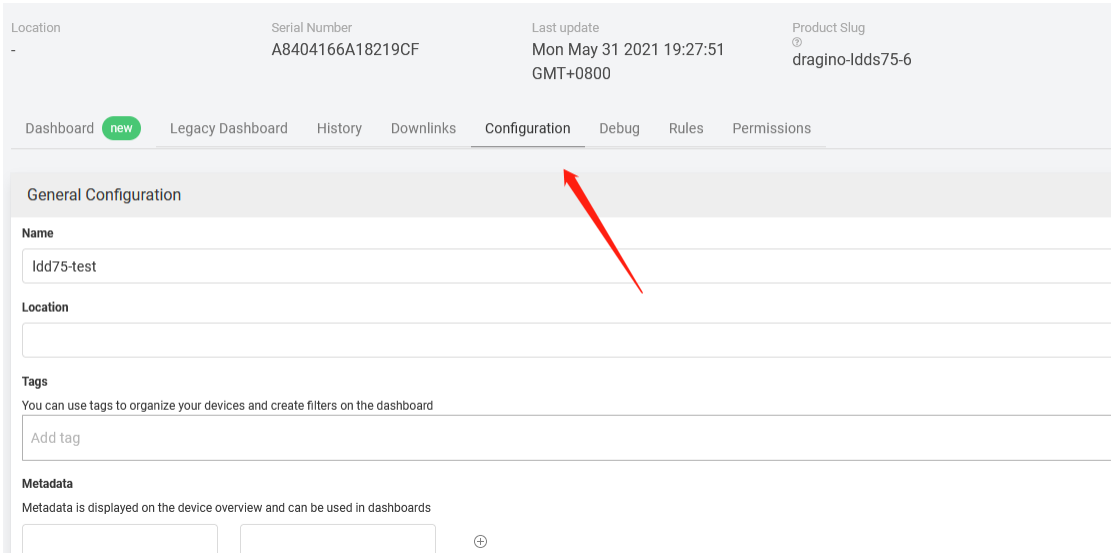
Step 3: Create an account or log in Datacake.
Step 4: Create LLDS12 product.

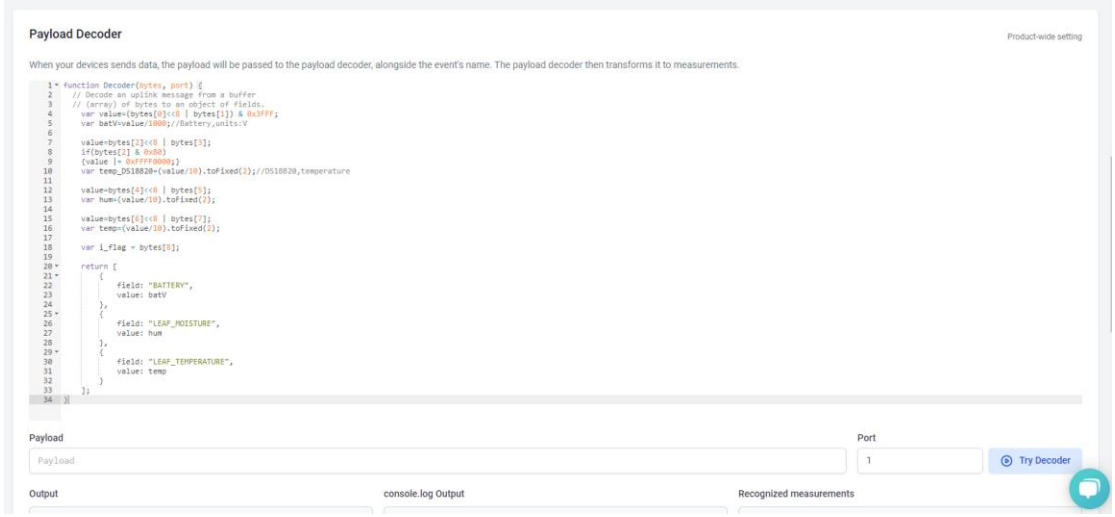

DEVICE
laq4
LAQ4-template
ldd75-test
lht65-one
lht65-test
lht65-two
lsn50
LSN50-templat
LSPH01-templa
LT22222
RS485-LN
LoRaWAN
PARTICLE
API
D Zero
D Zero LTE
PINCODE
STEP 1
Product
STEP 2
Network Server
STEP 3
Devices
STEP 4
Plan
Datacake Product
You can add devices to an existing product on Datacake, 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
LLDS12
Next


Add Device
LoRaWAN
PARTICLE
API
D Zero
D Zero LTE
PINCODE
STEP 1
Product
STEP 2
Network Server
STEP 3
Devices
STEP 4
Plan
Network Server
Please choose the LoRaWAN Network Server that your devices are connected to.
The Things Stack V3
TTN V3 / Things Industries
Uplinks
Downlinks
The Things Network V2
The old Things Network
Uplinks
Downlinks
Helium
Uplinks
Downlinks
LORIOT
Uplinks
Downlinks
Kerlink Wanesy
Uplinks
Showing 1 to 5 of 8 results
Previous
Next
Back
Next

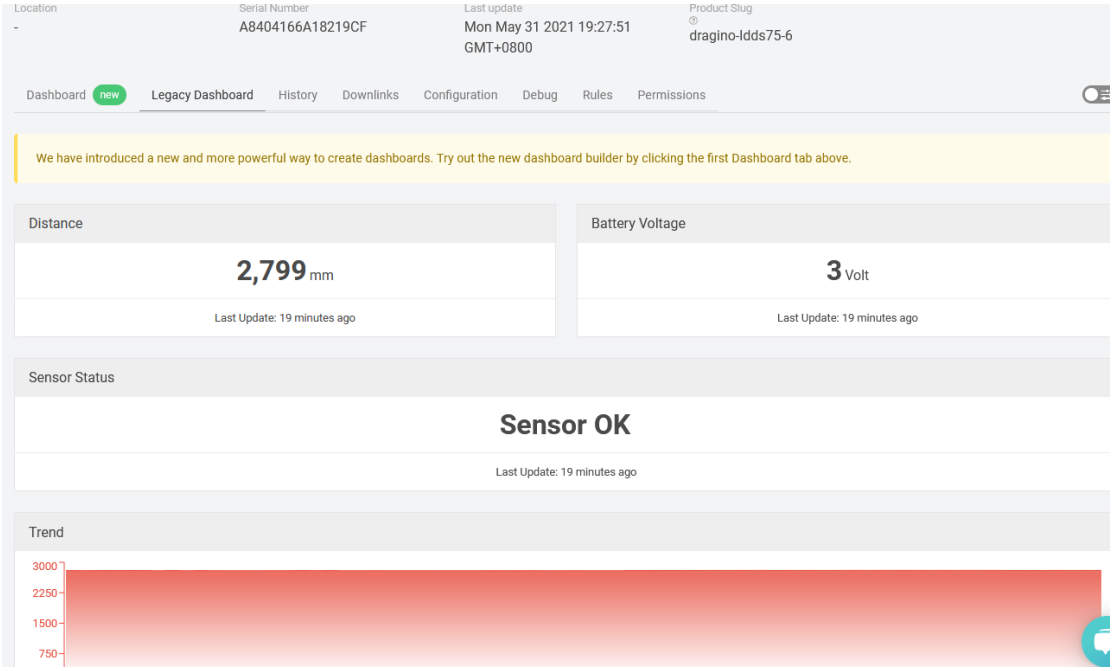


Step 5: add payload decode





After added, the sensor data arrive TTN, it will also arrive and show in Datacake.



2.6 Frequency Plans

The LLDS12 uses OTAA mode and below frequency plans by default. If user want to use it with different frequency plan, please refer the AT command sets.

2.6.1 EU863-870 (EU868)

Uplink:
868.1 - SF7BW125 to SF12BW125
868.3 - SF7BW125 to SF12BW125 and SF7BW250
868.5 - SF7BW125 to SF12BW125
867.1 - SF7BW125 to SF12BW125
867.3 - SF7BW125 to SF12BW125
867.5 - SF7BW125 to SF12BW125
867.7 - SF7BW125 to SF12BW125
867.9 - SF7BW125 to SF12BW125
868.8 - FSK

Downlink:
Uplink channels 1-9 (RX1)
869.525 - SF9BW125 (RX2 downlink only)

2.6.2 US902-928(US915)

Used in USA, Canada and South America. Frequency band as per definition in LoRaWAN 1.0.3 Regional document.

To make sure the end node supports all sub band by default. In the OTAA Join process, the end node will use frequency 1 from sub-band1, then frequency 1 from sub-band2, then frequency 1 from sub-band3, etc to process the OTAA join.

After Join success, the end node will switch to the correct sub band by:

- Check what sub-band the LoRaWAN server ask from the OTAA Join Accept message and switch to that sub-band
- Use the Join successful sub-band if the server doesn't include sub-band info in the OTAA Join Accept message (TTN v2 doesn't include)

2.6.3 CN470-510 (CN470)

Used in China, Default use CHE=1
Uplink:
486.3 - SF7BW125 to SF12BW125
486.5 - SF7BW125 to SF12BW125
486.7 - SF7BW125 to SF12BW125
486.9 - SF7BW125 to SF12BW125
487.1 - SF7BW125 to SF12BW125
487.3 - SF7BW125 to SF12BW125
487.5 - SF7BW125 to SF12BW125
487.7 - SF7BW125 to SF12BW125

Downlink:
506.7 - SF7BW125 to SF12BW125
506.9 - SF7BW125 to SF12BW125
507.1 - SF7BW125 to SF12BW125

507.3 - SF7BW125 to SF12BW125
507.5 - SF7BW125 to SF12BW125
507.7 - SF7BW125 to SF12BW125
507.9 - SF7BW125 to SF12BW125
508.1 - SF7BW125 to SF12BW125
505.3 - SF12BW125 (RX2 downlink only)

2.6.4 AU915-928(AU915)

Frequency band as per definition in LoRaWAN 1.0.3 Regional document.

To make sure the end node supports all sub band by default. In the OTAA Join process, the end node will use frequency 1 from sub-band1, then frequency 1 from sub-band2, then frequency 1 from sub-band3, etc to process the OTAA join.

After Join success, the end node will switch to the correct sub band by:

- Check what sub-band the LoRaWAN server ask from the OTAA Join Accept message and switch to that sub-band
- Use the Join successful sub-band if the server doesn't include sub-band info in the OTAA Join Accept message (TTN v2 doesn't include)

2.6.5 AS920-923 & AS923-925 (AS923)

Default Uplink channel:
923.2 - SF7BW125 to SF10BW125
923.4 - SF7BW125 to SF10BW125

Additional Uplink Channel:
(OTAA mode, channel added by JoinAccept message)

AS920~AS923 for Japan, Malaysia, Singapore:
922.2 - SF7BW125 to SF10BW125
922.4 - SF7BW125 to SF10BW125
922.6 - SF7BW125 to SF10BW125
922.8 - SF7BW125 to SF10BW125
923.0 - SF7BW125 to SF10BW125
922.0 - SF7BW125 to SF10BW125

AS923 ~ AS925 for Brunei, Cambodia, Hong Kong, Indonesia, Laos, Taiwan, Thailand, Vietnam:
923.6 - SF7BW125 to SF10BW125
923.8 - SF7BW125 to SF10BW125
924.0 - SF7BW125 to SF10BW125
924.2 - SF7BW125 to SF10BW125
924.4 - SF7BW125 to SF10BW125
924.6 - SF7BW125 to SF10BW125

Downlink:
Uplink channels 1-8 (RX1)
923.2 - SF10BW125 (RX2)

2.6.6 KR920-923 (KR920)

Default channel:
922.1 - SF7BW125 to SF12BW125
922.3 - SF7BW125 to SF12BW125
922.5 - SF7BW125 to SF12BW125

Uplink: (OTAA mode, channel added by JoinAccept message)
922.1 - SF7BW125 to SF12BW125
922.3 - SF7BW125 to SF12BW125
922.5 - SF7BW125 to SF12BW125
922.7 - SF7BW125 to SF12BW125
922.9 - SF7BW125 to SF12BW125
923.1 - SF7BW125 to SF12BW125
923.3 - SF7BW125 to SF12BW125

Downlink:
Uplink channels 1-7(RX1)
921.9 - SF12BW125 (RX2 downlink only; SF12BW125 might be changed to SF9BW125)

2.6.7 IN865-867 (IN865)

Uplink:
865.0625 - SF7BW125 to SF12BW125
865.4025 - SF7BW125 to SF12BW125
865.9850 - SF7BW125 to SF12BW125

Downlink:
Uplink channels 1-3 (RX1)
866.550 - SF10BW125 (RX2)

2.7 LED Indicator

The LLDS12 has an internal LED which is to show the status of different state.

- The sensor is detected when the device is turned on, and it will flash 4 times quickly when it is detected.
- Blink once when device transmit a packet.

2.8Firmware Change Log

Firmware download link:
http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LLDS12/Firmware/

Firmware Upgrade Method:
http://wiki.dragino.com/index.php?title=Firmware_Upgrade_Instruction_for_STM32_base_products#Introduction

3. LiDAR ToF Measurement

3.1Principle of Distance Measurement

The LiDAR probe is based on TOF, namely, Time of Flight principle. To be specific, the product emits modulation wave of near infrared ray on a periodic basis, which will be reflected after contacting object. The product obtains the time of flight by measuring round-trip phase difference and then calculates relative range between the product and the detection object, as shown below.

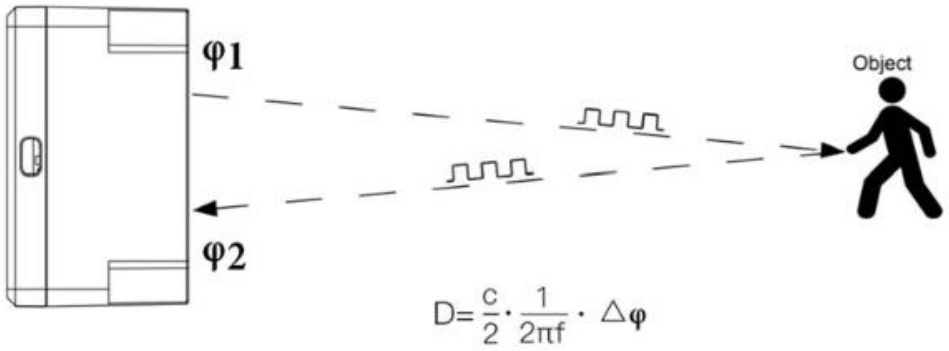


Figure 1 Schematics of TOF Principle

3.2 Distance Measurement Characteristics

With optimization of light path and algorithm, The LiDAR probe has minimized influence from external environment on distance measurement performance. Despite that, the range of distance measurement may still be affected by the environment illumination intensity and the reflectivity of detection object. As shown in below:

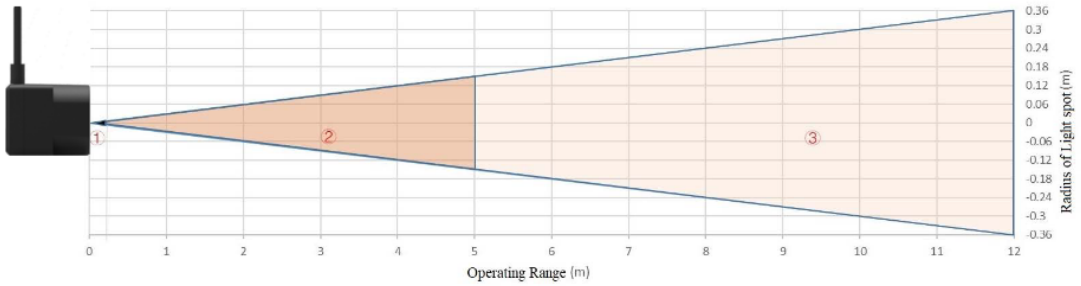


Figure 2 Schematic diagram of size of light spot

①Represents the detection blind zone of The LiDAR probe, 0-10cm, within which the output data is unreliable.
②Represents the operating range of The LiDAR probe detecting black target with 10% reflectivity, 0.1-5m.
③Represents the operating range of The LiDAR probe detecting white target with 90% reflectivity, 0.1-12m.

Vertical Coordinates: Represents the radius of light spot for The LiDAR probe at the different distances. The diameter of light spot depends on the FOV of The LiDAR probe (the term of FOV generally refers to the smaller value between the receiving angle and the transmitting

angle), which is calculated as follows:

$$d = D \cdot \tan\beta$$

In the formula above, d is the diameter of light spot; D is detecting range; β is the value of the receiving angle of The LiDAR probe, 3.6°. Correspondence between the diameter of light spot and detecting range is given in Table below.

Table 2 the Minimum side length of effective detection corresponding to Detecting Range

Detecting range	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m
Minimum side length	6cm	12cm	18cm	24cm	30cm	36cm	42cm	48cm	54cm	60cm	66cm	72cm

If the light spot reaches two objects with different distances, as shown in Figure 3, the output distance value will be a value between the actual distance values of the two objects. For a high accuracy requirement in practice, the above situation should be noticed to avoid the measurement error.

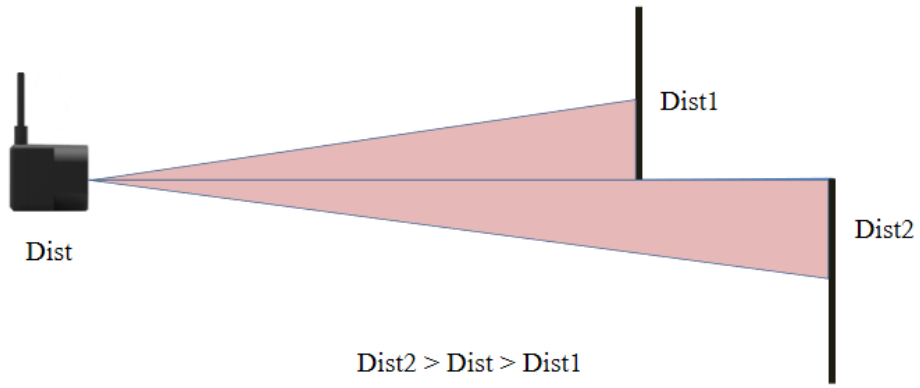


Figure 3 Distance Measurement in the case of Two Objects of Different Distances

3.3 Notice of usage:

Possible invalid /wrong reading for LiDAR ToF tech:

- Measure high reflectivity object such as: Mirror, Smooth ceramic tile, static milk surface, will have possible wrong readings.
- While there is transparent object such as glass, water drop between the measured object and the LiDAR sensor, the reading might wrong.
- The LiDAR probe is cover by dirty things; the reading might be wrong. In this case, need to clean the probe.
- The sensor window is made by Acrylic. Don't touch it with alcohol material. This will destroy the sensor window.

4. Configure LLDS12 via AT Command or LoRaWAN Downlink

Use can configure LLDS12 via AT Command or LoRaWAN Downlink.

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

http://wiki.dragino.com/index.php?title=Main_Page#Use_Note_for_Server

There are two kinds of commands to configure LLDS12, 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. These commands can be found on the wiki:

  http://wiki.dragino.com/index.php?title=End_Device_Downlink_Command

- **Commands special design for LLDS12**

  These commands only valid for LLDS12, as below:

4.1Set Transmit Interval Time

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

4.2Set Interrupt Mode

Feature, Set Interrupt mode for GPIO_EXIT.

AT 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 0- (Disable Interrupt), 1- (Trigger by rising and falling edge), 2- (Trigger by falling edge) 3- (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

4.3Get Firmware Version Info

Feature: use downlink to get firmware version.

Downlink Command: 0x26

Downlink Control Type	FPort	Type Code	Downlink payload size(bytes)
Get Firmware Version Info	Any	26	2

- Reply to the confirmation package: 26 01
- Reply to non-confirmed packet: 26 00

Device will send an uplink after got this downlink command. With below payload:

Configures info payload:

Size (bytes)	1	1	1	1	1	5	1
Value	Software Type	Frequency Band	Sub-band	Firmware Version	Sensor Type	Reserve	Message Type Always 0x02

Software Type: Always 0x03 for LLDS12

Frequency Band:

*0x01: EU868

*0x02: US915
*0x03: IN865
*0x04: AU915
*0x05: KZ865
*0x06: RU864
*0x07: AS923
*0x08: AS923-1
*0x09: AS923-2
*0xa0: AS923-3

Sub-Band: value 0x00 ~ 0x08

Firmware Version: 0x0100, Means: v1.0.0 version

Sensor Type:
0x01: LSE01
0x02: LDDS75
0x03: LDDS20
0x04: LLMS01
0x05: LSPH01
0x06: LSNPK01
0x07: LLDS12

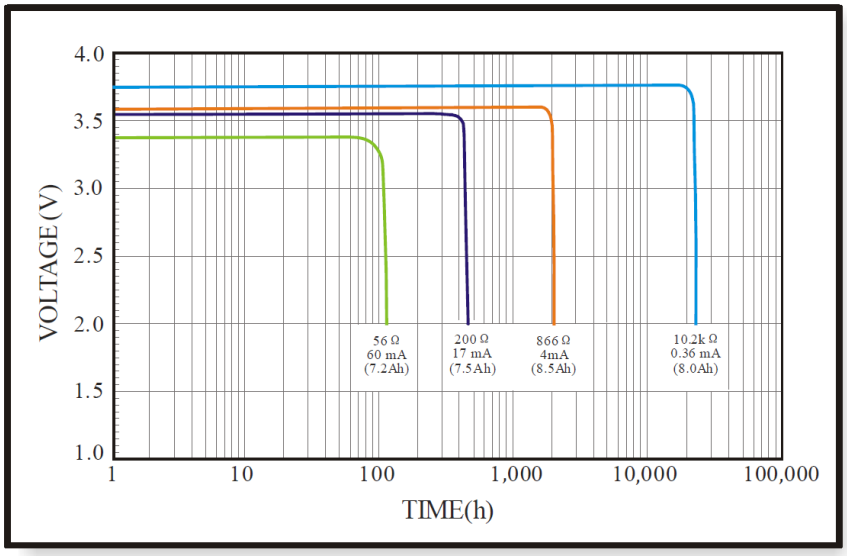
5. Battery & how to replace

5.1Battery Type

LLDS12 is equipped with a 8500mAH ER26500 Li-SOCI2 battery. The battery is un-rechargeable battery with low discharge rate targeting for 8~10 years use. This type of battery is commonly used in IoT target for long-term running, such as water meter.

The discharge curve is not linear so can't simply use percentage to show the battery level. Below is the battery performance.

1. Typical discharge profile at +20℃ (Typical value)



Minimum Working Voltage for the LLDS12:
LLDS12: 2.45v ~ 3.6v

5.2Replace Battery

Any battery with range 2.45 ~ 3.6v can be a replacement. We recommend to use Li-SOCl2 Battery. And make sure the positive and negative pins match.

5.3Power Consumption Analyze

Dragino Battery powered product are all runs in Low Power mode. We have an update battery calculator which base on the measurement of the real device. User can use this calculator to check the battery life and calculate the battery life if want to use different transmit interval.

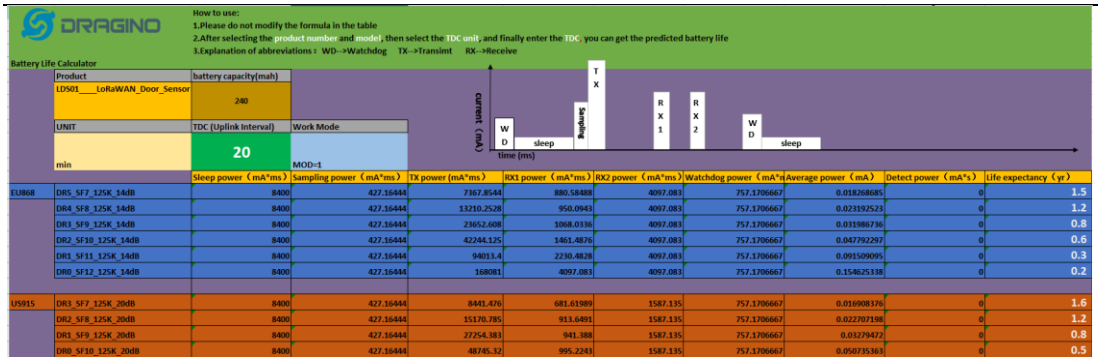
Instruction to use as below:

Step 1: Downlink the up-to-date DRAGINO_Battery_Life_Prediction_Table.xlsx from:
https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/Battery_Analyze/

Step 2: Open it and choose

- Product Model
- Uplink Interval
- Working Mode

And the Life expectation in difference case will be shown on the right.



Battery Life Calculator

How to use:
1.Please do not modify the formula in the table
2.After selecting the product number and model, then select the TDC unit, and finally enter the TDC, you can get the predicted battery life
3.Explanation of abbreviations： WD-->Watchdog TX-->Transimt RX-->Receive

Product	battery capacity(mah)
LDS01___LoRaWAN_Door_Sensor	240

UNIT	TDC (Uplink Interval)	Work Mode
min	20	MOD=1

		Sleep power （mA*ms）	Sampling power （mA*ms）	TX power (mA*ms)	RX1 power （mA*ms）	RX2 power （mA*ms）	Watchdog power （mA*ms）	Average power （mA）	Detect power （mA*s）	Life expectancy （yr）
EU868	DR5_SF7_125K_14dB	8400	427.16444	7367.8544	880.58488	4097.083	757.1706667	0.018268685	0	1.5
	DR4_SF8_125K_14dB	8400	427.16444	13210.2528	950.0943	4097.083	757.1706667	0.023192523	0	1.2
	DR3_SF9_125K_14dB	8400	427.16444	23652.608	1068.0336	4097.083	757.1706667	0.031986736	0	0.8
	DR2_SF10_125K_14dB	8400	427.16444	42244.125	1461.4876	4097.083	757.1706667	0.047792297	0	0.6
	DR1_SF11_125K_14dB	8400	427.16444	94013.4	2230.4828	4097.083	757.1706667	0.091509095	0	0.3
	DR0_SF12_125K_14dB	8400	427.16444	168081	4097.083	4097.083	757.1706667	0.154625338	0	0.2
US915	DR3_SF7_125K_20dB	8400	427.16444	8441.476	681.61989	1587.135	757.1706667	0.016908376	0	1.6
	DR2_SF8_125K_20dB	8400	427.16444	15170.785	913.6491	1587.135	757.1706667	0.022707198	0	1.2
	DR1_SF9_125K_20dB	8400	427.16444	27254.383	941.388	1587.135	757.1706667	0.03279472	0	0.8
	DR0_SF10_125K_20dB	8400	427.16444	48745.32	995.2243	1587.135	757.1706667	0.050735363	0	0.5

The battery related documents as below:

- Battery Dimension,
- Lithium-Thionyl Chloride Battery datasheet, Tech Spec
- Lithium-ion Battery-Capacitor datasheet, Tech Spec

5.3.1 Battery Note

The Li-SICO battery is designed for small current / long period application. It is not good to use a high current, short period transmit method. The recommended minimum period for use of this battery is 5 minutes. If you use a shorter period time to transmit LoRa, then the battery life may be decreased.

5.3.2 Replace the battery

You can change the battery in the LLDS12.The type of battery is not limited as long as the output is between 3v to 3.6v. On the main board, there is a diode (D1) between the battery and the main circuit. If you need to use a battery with less than 3.3v, please remove the D1 and shortcut the two pads of it so there won't be voltage drop between battery and main board.

The default battery pack of LLDS12 includes a ER26500 plus super capacitor. If user can't find this pack locally, they can find ER26500 or equivalence, which will also work in most case. The SPC can enlarge the battery life for high frequency use (update period below 5 minutes)

6. Use AT Command

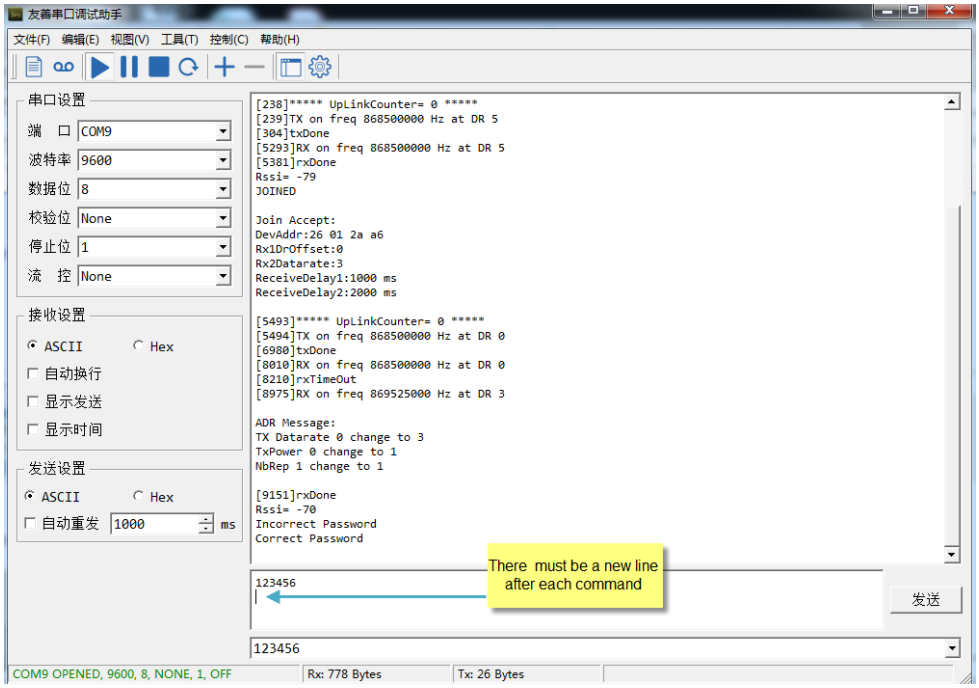
6.1 Access AT Commands

LLDS12 supports AT Command set in the stock firmware. You can use a USB to TTL adapter to connect to LLDS12 for using AT command, as below.

Connection:

USB TTL GND <----> GND
USB TTL TXD <----> UART_RXD
USB TTL RXD <----> UART_TXD

In the PC, you need to set the serial baud rate to **9600** to access the serial console for LLDS12. LLDS12 will output system info once power on as below:



Valid AT Command please check Configure Device.

7. FAQ

7.1How 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.

8. Trouble Shooting

8.1AT Commands 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.

8.2Significant error between the output distant value of LiDAR and actual distance

Cause ①： Due to the physical principles of The LiDAR probe, the above phenomenon is likely to occur if the detection object is the material with high reflectivity (such as mirror, smooth floor tile, etc.) or transparent substance (such as glass and water, etc.)
Troubleshooting: Please avoid use of this product under such circumstance in practice.

Cause ②: The IR-pass filters are blocked.
Troubleshooting: please use dry dust-free cloth to gently remove the foreign matter

9. Order Info

Part Number: **LLDS12-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

9. Packing Info

Package Includes:

- LLDS12 LoRaWAN LiDAR Distance Sensor x 1

Dimension and weight:

- Device Size: cm
- Device Weight: g
- Package Size / pcs : cm
- Weight / pcs : g

10. 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