



## LoRaWAN LiDAR ToF Distance Sensor User Manual

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| Version | Description                                 | Date        |
|---------|---------------------------------------------|-------------|
| 1.0     | Release                                     | 2021-Jun-2  |
| 1.1     | Clarify Interrupt Pin                       | 2021-Jul-9  |
| 1.2     | Add 65534 special value for Signal Strenght | 2022-Apr-13 |
|         |                                             |             |
|         |                                             |             |

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## 1. Introduction

### 1.1 What 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.

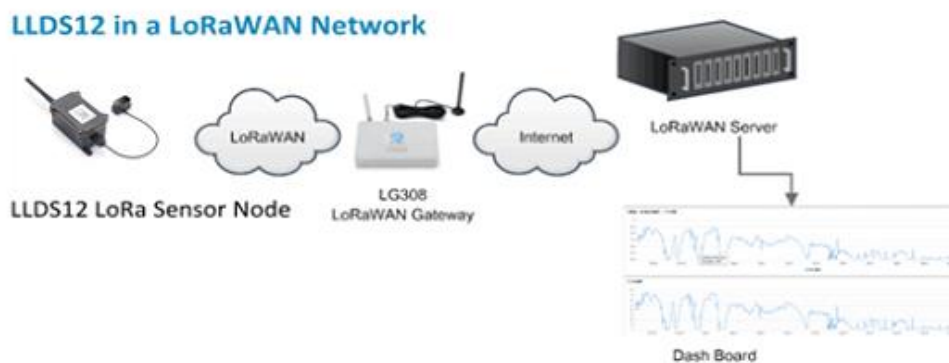
The LLDS12 can be applied to scenarios such as horizontal distance measurement, parking management system, object proximity and presence detection, intelligent trash can management system, robot obstacle avoidance, automatic control, sewer, etc.

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.



### 1.2 Features

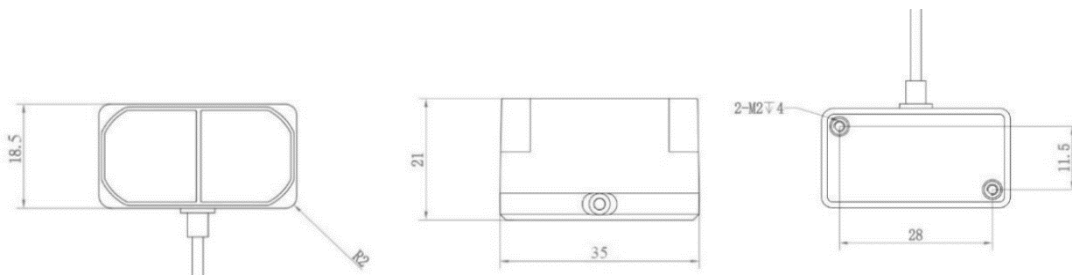
- ✧ LoRaWAN 1.0.3 Class A
- ✧ Ultra-low power consumption
- ✧ Laser technology for distance detection
- ✧ Operating Range - 0.1m~12m①
- ✧ Accuracy -  $\pm 5\text{cm}@ (0.1-6\text{m})$ ,  $\pm 1\%@(6\text{m}-12\text{m})$
- ✧ Monitor Battery Level

- ✧ 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

### 1.3 Probe Specification

- ✧ Storage temperature :  $-20^{\circ}\text{C}\sim 75^{\circ}\text{C}$
- ✧ Operating temperature -  $-20^{\circ}\text{C}\sim 60^{\circ}\text{C}$
- ✧ Operating Range - 0.1m~12m①
- ✧ Accuracy -  $\pm 5\text{cm}@ (0.1-6\text{m})$ ,  $\pm 1\%@(6\text{m}-12\text{m})$
- ✧ Distance resolution - 5mm
- ✧ Ambient light immunity - 70klux
- ✧ Enclosure rating - IP65
- ✧ Light source - LED
- ✧ Central wavelength - 850nm
- ✧ FOV -  $3.6^{\circ}$
- ✧ Material of enclosure - ABS+PC
- ✧ Wire length - 25cm

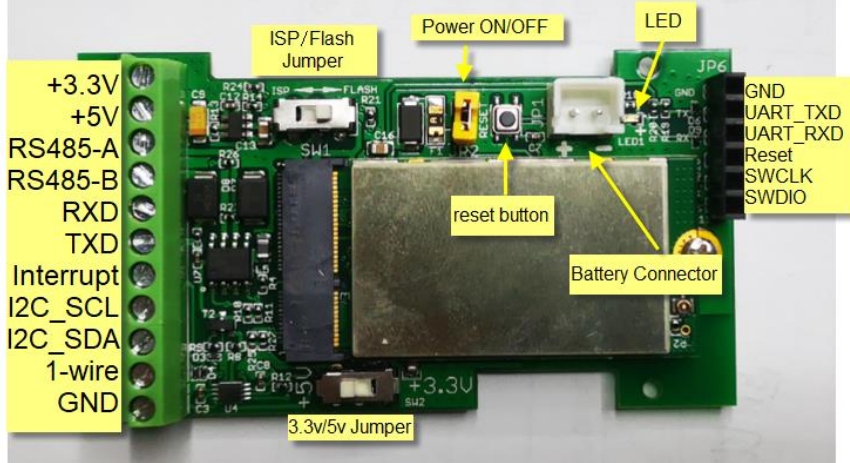
### 1.4 Probe Dimension



### 1.5 Applications

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

### 1.6 Pin mapping and power on



## 2. Configure LLDS12 to connect to LoRaWAN network

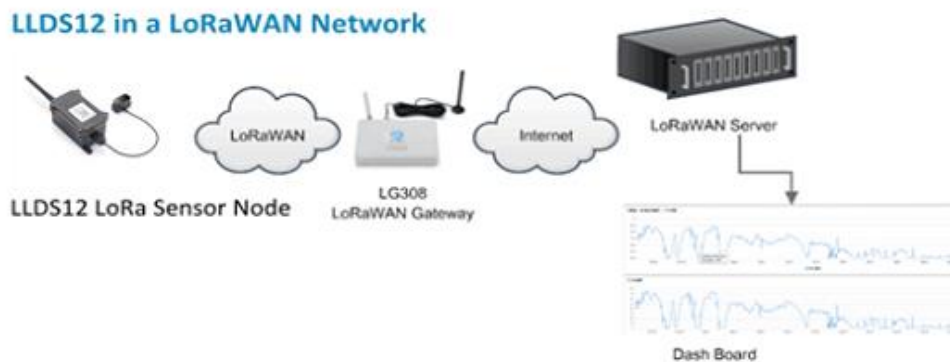
### 2.1 How it works

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.

### 2.2 Quick 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

Register end device

From The LoRaWAN Device Repository [Manually](#)

**Preparation**

Activation mode\*

- Over the air activation (OTAA)
- Activation by personalization (ABP)
- Multicast
- Do not configure activation

LoRaWAN version ⓘ\*

MAC V1.0.3 ← 1

Network Server address

eu1.cloud.thethings.network

Application Server address

eu1.cloud.thethings.network

External Join Server ⓘ

Enabled

Join Server address

eu1.cloud.thethings.network

Start ← 2

### Add APP EUI and DEV EUI

## Register end device

From The LoRaWAN Device Repository **Manually**

- 1 **Basic settings**  
End device ID's, Name and Description
- 2 **Network layer settings**  
Frequency plan, regional parameters, end device class and session keys.
- 3 **Join settings**  
Root keys, NetID and kek labels.

End device ID ⓘ \*

AppEUI ⓘ

DevEUI ⓘ \*

End device name

End device description

Optional end device description; can also be used to save notes about the end device

[Network layer settings >](#)

## Add APP EUI in the application

### Register end device

From The LoRaWAN Device Repository **Manually**

- ✓ **Basic settings**  
End device ID's, Name and Description
- 2 **Network layer settings**  
Frequency plan, regional parameters, end device class and session keys.
- 3 **Join settings**  
Root keys, NetID and kek labels.

Frequency plan ⓘ \*

LoRaWAN version ⓘ \*

Regional Parameters version ⓘ \*

LoRaWAN class capabilities ⓘ  
 Supports class B  
 Supports class C

Advanced settings ▾

[< Basic settings](#)

[Join settings >](#)

## Add APP KEY





## Register end device


From The LoRaWAN Device Repository [Manually](#)

- 1 **Basic settings**  
End device ID's, Name and Description
- 2 **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](#)

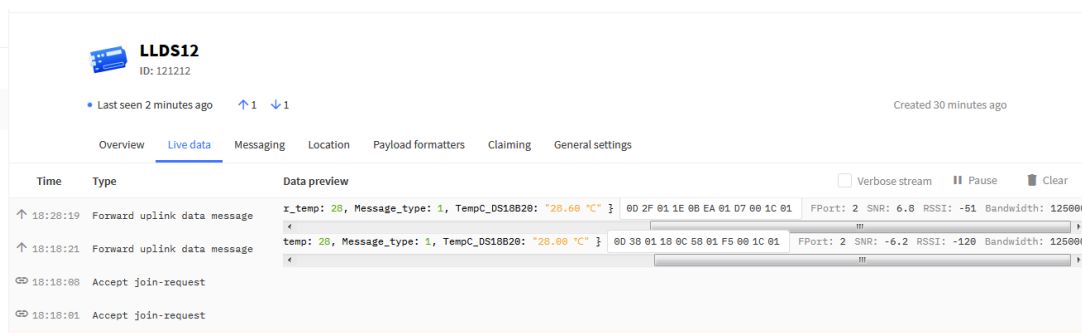
[Add end device](#)

### 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.



**LLDS12**  
ID: 121212

Last seen 2 minutes ago    ↑ 1 ↓ 1    Created 30 minutes ago

Overview    Live data    Messaging    Location    Payload formatters    Claiming    General settings

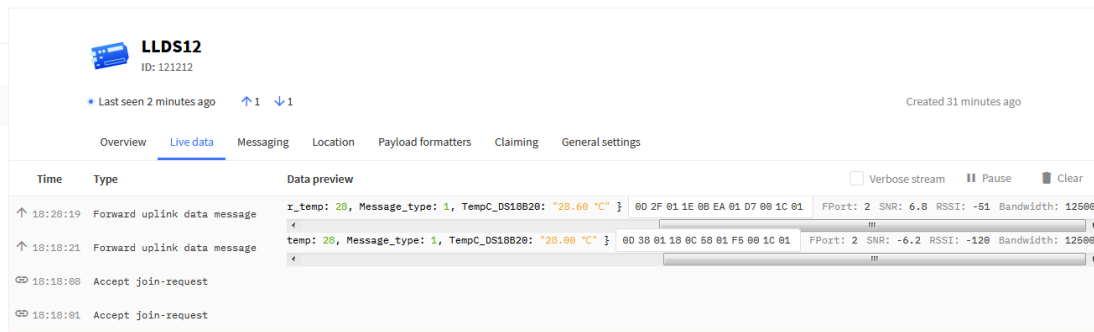
| Time       | Type                        | Data preview                                                                                                                                                            |
|------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ↑ 18:28:19 | Forward uplink data message | <code>{ "x_temp": 28, "Message_type": 1, "TempC_DS18B28": "28.69 °C" } ; 00 2F 01 1E 0B EA 01 D7 00 1C 01</code> FPort: 2    SNR: 6.8    RSSI: -51    Bandwidth: 125000 |
| ↑ 18:18:21 | Forward uplink data message | <code>{ "temp": 28, "Message_type": 1, "Temp_DS18B28": "28.00 °C" } ; 60 38 01 18 0C 50 01 F5 00 1C 01</code> FPort: 2    SNR: -6.2    RSSI: -120    Bandwidth: 125000  |
| ⊞ 18:18:08 | Accept join-request         |                                                                                                                                                                         |
| ⊞ 18:18:01 | Accept join-request         |                                                                                                                                                                         |

## 2.3 Uplink 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 When the signal strength is lower than 100 or equal to 65535 (overexposed) , the detection is unreliable, the distance value will be set to 0.

**Example:**

If the data you get from the register is 0x0B 0xEA, the distance between the sensor and the measured object is

$OB(EA)(H) = 3050 (D)/10 = 305\text{cm}$ .

### 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 Distance is considered credible.

**Notice:** In firmware v1.2, the signal strength will have a special value 65534, this means the LiDAR probe has communication error, this is properly wire connection loose inside the device.

#### Example:

If payload is: 01D7(H)=471(D), distance signal strength=471,  $471 > 100, 471 \neq 65535$ , the measured value of Dist is considered credible.

Customers can judge whether they need to adjust the environment based on the signal strength.

When Distance Signal Strength is 65535, it means over-exposed , possible reasons are:

- a) There are 2 LiDAR face to face each other
- b) Measure Object has a very high reflectivity, such as mirror, reflective strip/band, stainless steel

### 2.3.4 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.

### 2.3.5 LiDAR temp

Characterize the internal temperature value of the sensor.

#### Example:

If payload is: 1C(H) <<24>>24=28(D), LiDAR temp=28°C.

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

### 2.3.6 Message Type

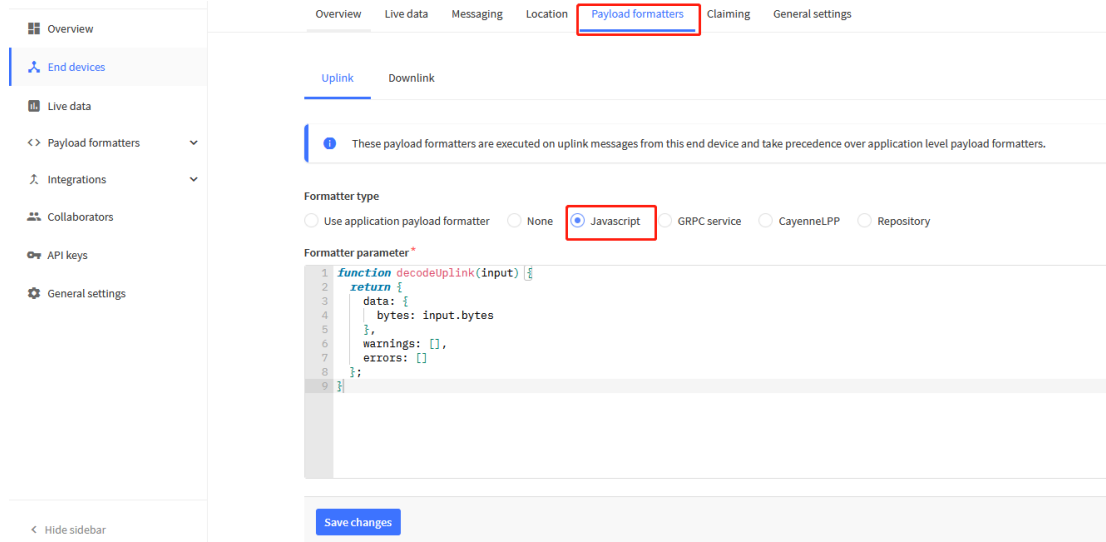
For a normal uplink payload, the message type is always 0x01.

Valid Message Type:

| Message Type Code | Description           | Payload                                |
|-------------------|-----------------------|----------------------------------------|
| 0x01              | Normal Uplink         | <a href="#">Normal Uplink Payload</a>  |
| 0x02              | Reply configures info | <a href="#">Configure Info Payload</a> |
|                   |                       |                                        |

### 2.3.7 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/](https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LLDS12/Decoder/)

### 2.4 Uplink 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:

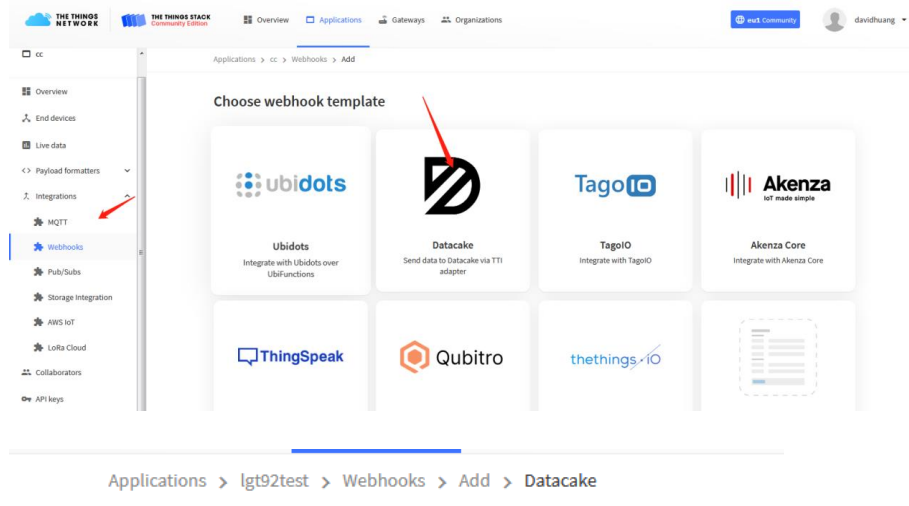
[http://wiki.dragino.com/index.php?title=End\\_Device\\_AT\\_Commands\\_and\\_Downlink\\_Commands#Change\\_Uplink\\_Interval](http://wiki.dragino.com/index.php?title=End_Device_AT_Commands_and_Downlink_Commands#Change_Uplink_Interval)

## 2.5 Show Data in DataCake IoT Server

[DATAKAKE](#) provides a human friendly interface to show the sensor data, once we have data in TTN, we can use [DATAKAKE](#) to connect to TTN and see the data in DATAKAKE. 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 DATAKAKE you will need to add integration. To add the DATAKAKE integration, perform the following steps:



### Add custom webhook

#### Template information



#### Datacake

Send data to Datacake via TTI adapter

[About Datacake](#) | [Documentation](#)

#### Template settings

Webhook ID \*

Token \*

Datacake API Token

Create datacake webhook

Step 3: Create an account or log in Datacake.

Step 4: Create LLDS12 product.

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

[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.

|                                  |  |                                                          |                                         |                                          |
|----------------------------------|--|----------------------------------------------------------|-----------------------------------------|------------------------------------------|
| <input checked="" type="radio"/> |  | <b>The Things Stack V3</b><br>TTN V3 / Things Industries | <input type="button" value="Uplinks"/>  | <input type="button" value="Downlinks"/> |
| <input type="radio"/>            |  | <b>The Things Network V2</b><br>The old Things Network   | <input type="button" value="Uplinks"/>  | <input type="button" value="Downlinks"/> |
| <input type="radio"/>            |  | <b>Helium</b>                                            | <input type="button" value="Uplinks"/>  | <input type="button" value="Downlinks"/> |
| <input type="radio"/>            |  | <b>LORIoT</b>                                            | <input type="button" value="Uplinks"/>  | <input type="button" value="Downlinks"/> |
| <input type="radio"/>            |  | <b>Kerlink Wanesy</b>                                    | <input type="button" value="Uplinks"/>  |                                          |
| Showing 1 to 5 of 8 results      |  |                                                          | <input type="button" value="Previous"/> | <input type="button" value="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

**Add Devices**  
Enter one or more LoRaWAN Device EUIs and the names they will have on Datacake.

| DEVEUI                       | NAME   |
|------------------------------|--------|
| 21 21 24 25 35 34 14 8 bytes | LLDS12 |

+ Add another device

Back    Next

Step 5: add payload decode

Location: -    Serial Number: A8404166A18219CF    Last update: Mon May 31 2021 19:27:51 GMT+0800    Product Slug: dragino-ldds75-6

Dashboard **new**    Legacy Dashboard    History    Downlinks    **Configuration**    Debug    Rules    Permissions

**General Configuration**

**Name**  
ldd75-test

**Location**

**Tags**  
You can use tags to organize your devices and create filters on the dashboard  
Add tag

**Metadata**  
Metadata is displayed on the device overview and can be used in dashboards

**Payload Decoder** Product-wide setting

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.

```

1 * function Decoder(bytes, port) {
2   // Decode an uplink message from a buffer
3   // (array) of bytes to an object of fields.
4   var value=(bytes[0]<<8 | bytes[1]) & 0x3FFF;
5   var batV=value/1000;//Battery,units:V
6
7   value=bytes[2]<<8 | bytes[3];
8   if(bytes[2] & 0x08)
9     {value |= 0xFFFF0000;}
10  var temp_DS18B20=(value/10).toFixed(2);//DS18B20,temperature
11
12  value=bytes[4]<<8 | bytes[5];
13  var hum=(value/10).toFixed(1);
14
15  value=bytes[6]<<8 | bytes[7];
16  var temp=(value/10).toFixed(1);
17  var i_flag = bytes[8];
18
19  return [
20 *
21 *   {
22 *     field: "BATTERY",
23 *     value: batV
24 *   },
25 *
26 *   {
27 *     field: "LEAF_MOISTURE",
28 *     value: hum
29 *   },
30 *
31 *   {
32 *     field: "LEAF_TEMPERATURE",
33 *     value: temp
34 *   }
35 * ];

```

Payload:  Port:  Try Decoder

Output: console.log Output Recognized measurements

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

|          |                  |                                   |                  |
|----------|------------------|-----------------------------------|------------------|
| Location | Serial Number    | Last update                       | Product Slug     |
| -        | AB404166A18219CF | Mon May 31 2021 19:27:51 GMT+0800 | dragino-ldds75-6 |

Dashboard new Legacy Dashboard History Downlinks Configuration Debug Rules Permissions

We have introduced a new and more powerful way to create dashboards. Try out the new dashboard builder by clicking the first Dashboard tab above.

|                                                                                                                                                                                                                     |                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Distance</p> <div style="text-align: center; font-size: 24px; font-weight: bold;">2,799</div> <p style="font-size: 18px;">mm</p> <p style="font-size: 12px; text-align: center;">Last Update: 19 minutes ago</p> | <p>Battery Voltage</p> <div style="text-align: center; font-size: 24px; font-weight: bold;">3</div> <p style="font-size: 18px;">Volt</p> <p style="font-size: 12px; text-align: center;">Last Update: 19 minutes ago</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Sensor Status

Sensor OK

Last Update: 19 minutes ago

Trend

## 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.

## 2.8 Firmware Change Log

**Firmware download link:**

[http://www.dragino.com/downloads/index.php?dir=LoRa\\_End\\_Node/LLDS12/Firmware/](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](http://wiki.dragino.com/index.php?title=Firmware_Upgrade_Instruction_for_STM32_base_products#Introduction)

### 3. LiDAR ToF Measurement

#### 3.1 Principle 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.

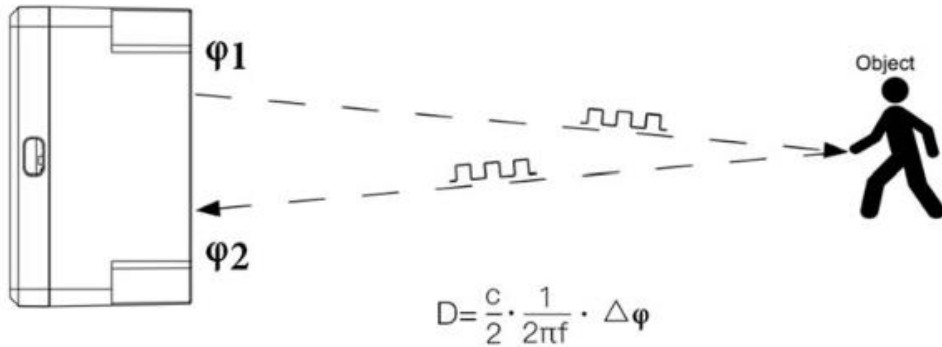


Figure 1 Schematics of TOF Principle

#### 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:

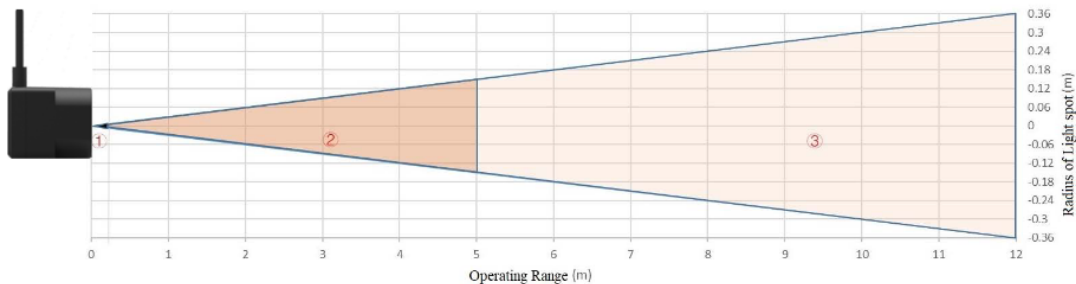


Figure 2 Schematic diagram of size of light spot

- ① Represents the detection blind zone of The LiDAR probe, 0-10cm, within which the output data is unreliable.
- ② Represents the operating range of The LiDAR probe detecting black target with 10% reflectivity, 0.1-5m.
- ③ Represents 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;  $\beta$  is the value of the receiving angle of The LiDAR probe,  $3.6^\circ$ . 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.

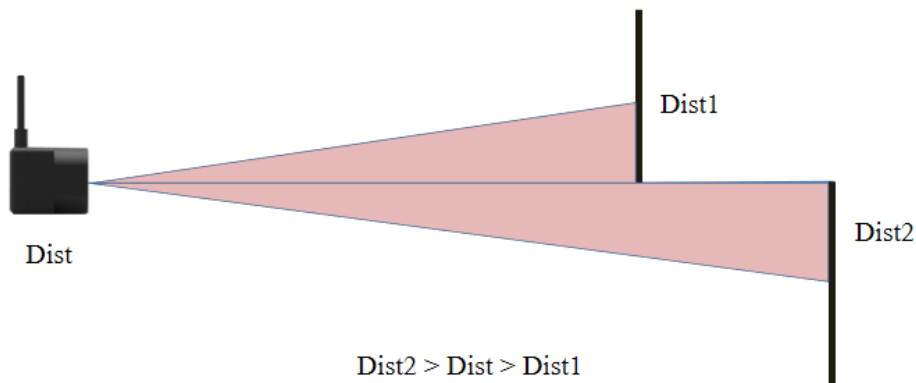


Figure 3 Distance Measurement in the case of Two Objects of Different Distances

### 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](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](http://wiki.dragino.com/index.php?title=End_Device_Downlink_Command)

- **Commands special design for LLDS12**

These commands only valid for LLDS12, as below:

### 4.1 Set 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<br>OK<br>the interval is 30000ms = 30s        |
| AT+TDC=60000    | Set Transmit Interval          | OK<br>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



## 4.2 Set Interrupt Mode

Feature, Set Interrupt mode for GPIO\_EXIT.

### AT Command: AT+INTMOD

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

## 4.3 Get 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 | <a href="#">Message Type</a><br>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

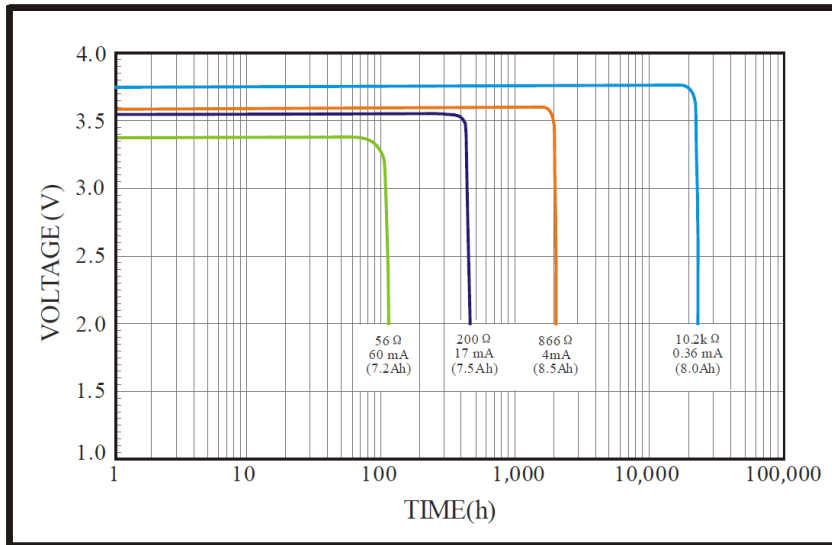
## 5. Battery & how to replace

### 5.1 Battery 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 °C (Typical value)



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

### 5.2 Replace Battery

Any battery with range 2.45 ~ 3.6v can be a replacement. We recommend to use Li-SOCI2 Battery. And make sure the positive and negative pins match.

### 5.3 Power 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.

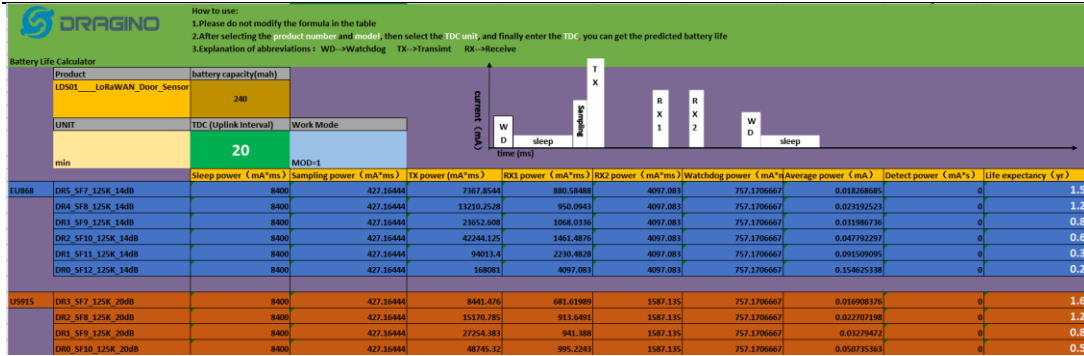
Instruction to use as below:

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/](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.



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.



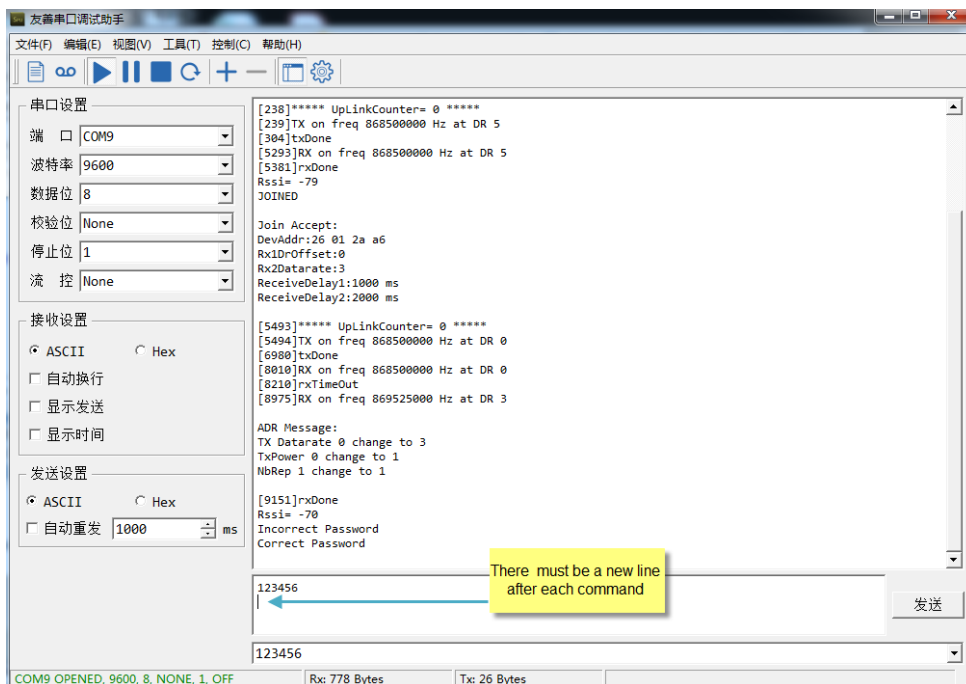
Connection:

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

### 7.1 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.

## 8. Trouble Shooting

### 8.1 AT 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.

### 8.2 Significant 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](mailto:support@dragino.com)