LLDS40-LoRaWAN LiDAR ToF Distance Sensor User Manual

Last modified by Xiaoling (/xwiki/bin/view/XWiki/Xiaoling) on 2023/05/25 14:04

(http://wiki.dragino.com/xwiki/bin/download/Main/User%
LoRaWAN%20LiDAR%20ToF%20Distance%20Sensor%
1.jpeg?width=574&height=574&rev=1.1)

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1. Introduction

1.1 What is LoRaWAN LiDAR ToF Distance Sensor

The Dragino LLDS40 is a **LoRaWAN LiDAR ToF (Time of Flight) Distance Sensor** for Internet of Things solution. It is capable of measuring the distance to objects as c laser induction technology for distance measurement.

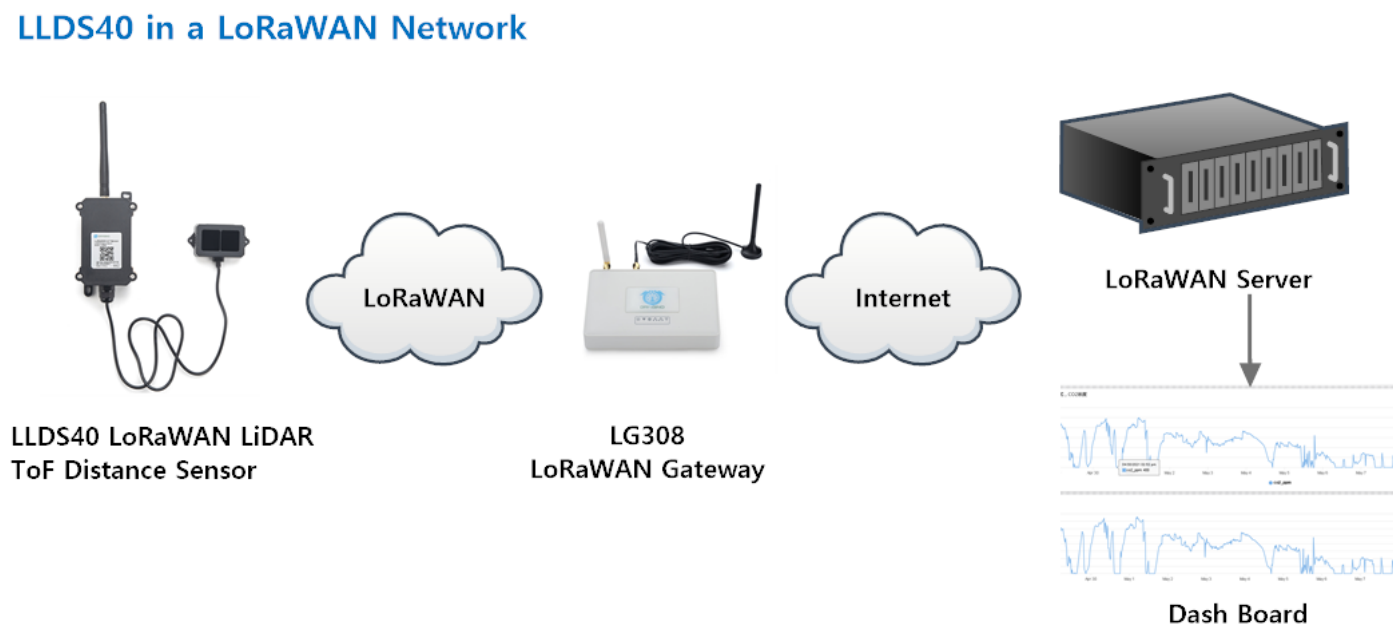
The LLDS40 can be applied to scenarios such as horizontal distance measurement, parking management system, object proximity and presence detection, intelligent tra obstacle avoidance, automatic control, sewer, etc.

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 LLDS40 allows device to send data and reach extremely long ranges at low data-rates. It provides ultra-long range spread spectru immunity whilst minimizing current consumption.

LLDS40 is powered by **8500mAh Li-SOCl2 battery**, it is designed for long term use up to 5 years.

Each LLDS40 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

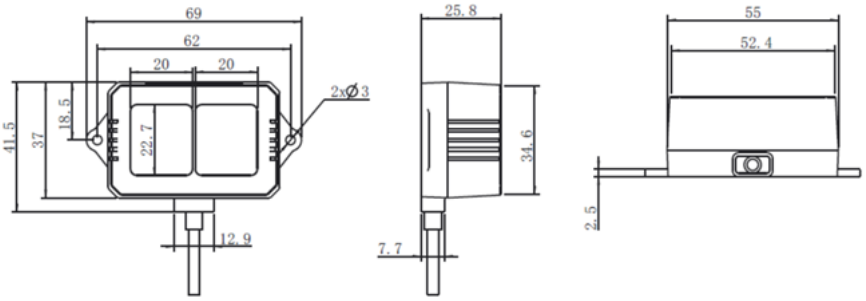
- LoRaWAN 1.0.3 Class A
- Ultra-low power consumption
- Laser technology for distance detection
- Measure Distance: 0.1m ~ 40m @ 90% Reflectivity
- Monitor Battery Level
- Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865
- AT Commands to change parameters

- Uplink on periodically
- Downlink to change configure
- 8500mAh Battery for long-term use

1.3 Probe Specification

- Storage temperature：-30℃~80℃
- Operating temperature: -20℃~60℃
- Measure Distance:
  - 0.1m ~ 40m @ 90% Reflectivity
  - 0.1m ~ 13.5m @ 10% Reflectivity
- Distance resolution: 1cm
- Ambient light immunity: 100klux
- Enclosure rating : IP65
- Light source : VCSEL
- Central wavelength : 850nm
- FOV : 3°
- Material of enclosure : ABS+PC
- Wire length : 75cm

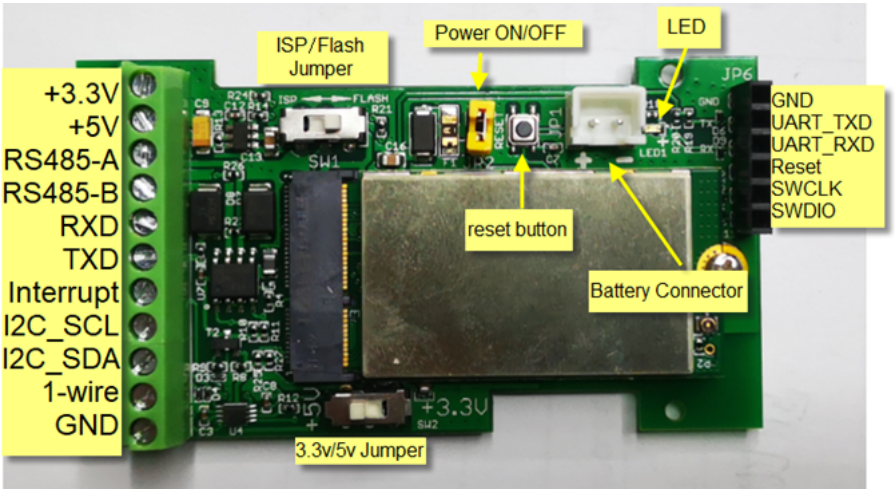
1.4 Probe Dimension



1.5 Applications

- Horizontal distance measurement
- Oil Tank
- 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 LLDS40 to connect to LoRaWAN network

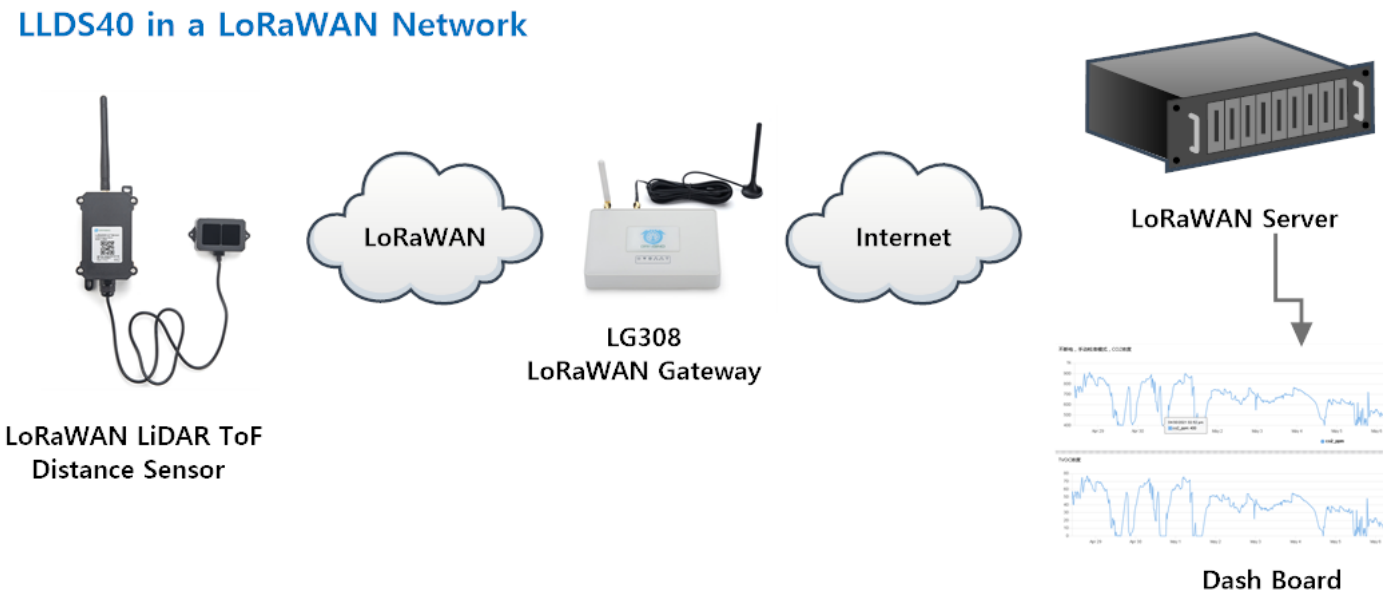
2.1 How it works

The LLDS40 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 server and power on the LLDS40. 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 LLDS

2.2 Quick guide to connect to LoRaWAN server (OTAA)

Following is an example for how to join the TTN v3 LoRaWAN Network (https://console.cloud.thethings.network/) . Below is the network structure; we use the LG308 (http://www.dragino.com/products/lora/item/140-lg308.html) as a LoRaWAN gateway in this example.



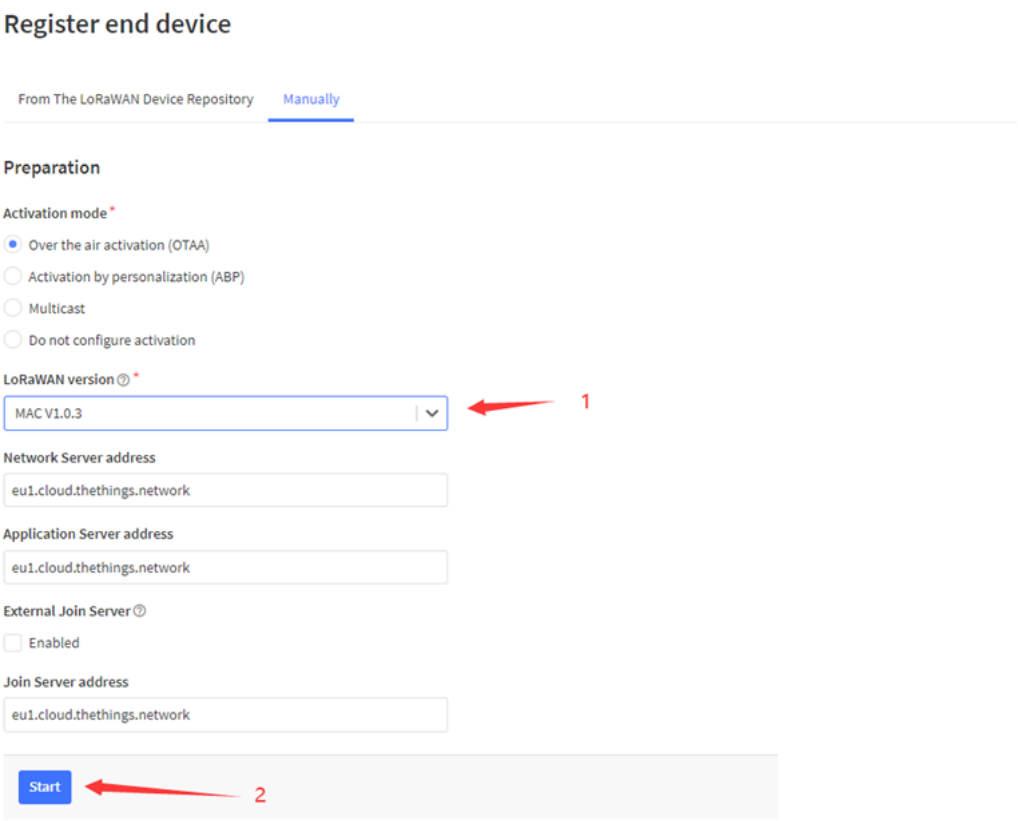
The LG308 is already set to connect to TTN network (https://console.cloud.thethings.network/) , so what we need to now is configure the TTN server.

Step 1: Create a device in TTN with the OTAA keys from LLDS40.

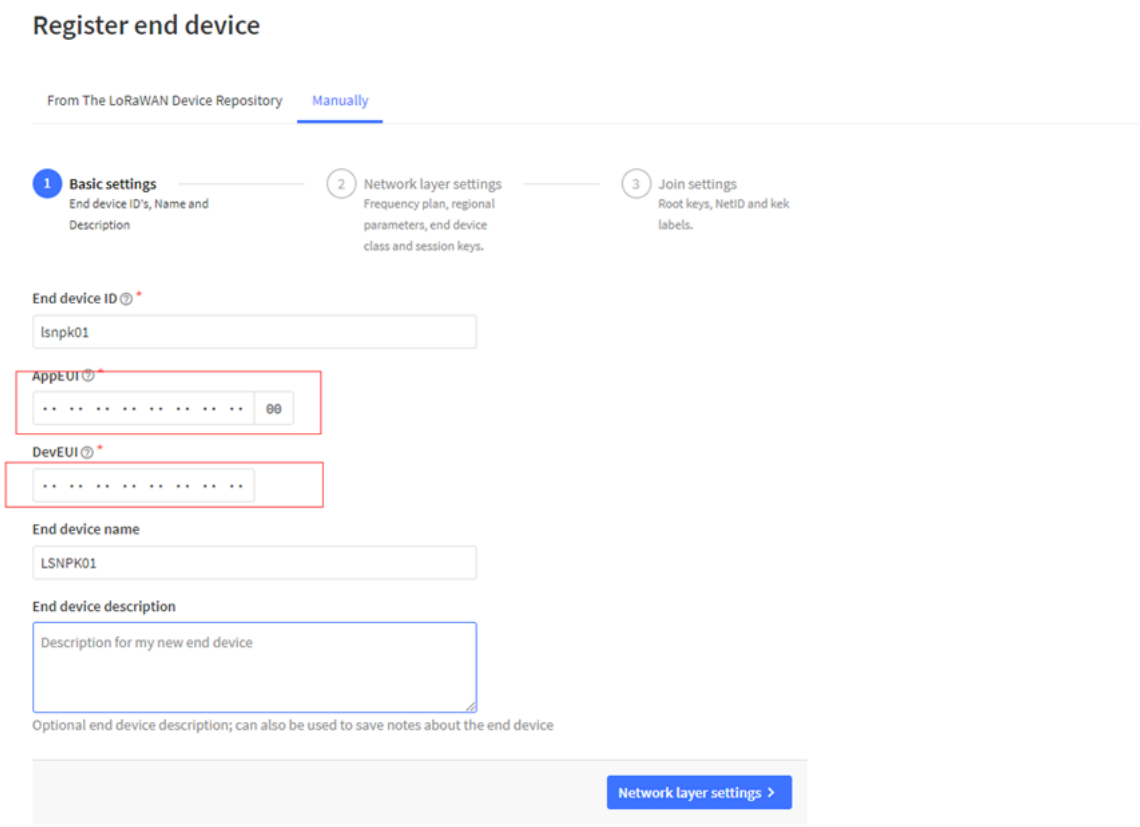
Each LLDS40 is shipped with a sticker with the default device EUI as below:

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

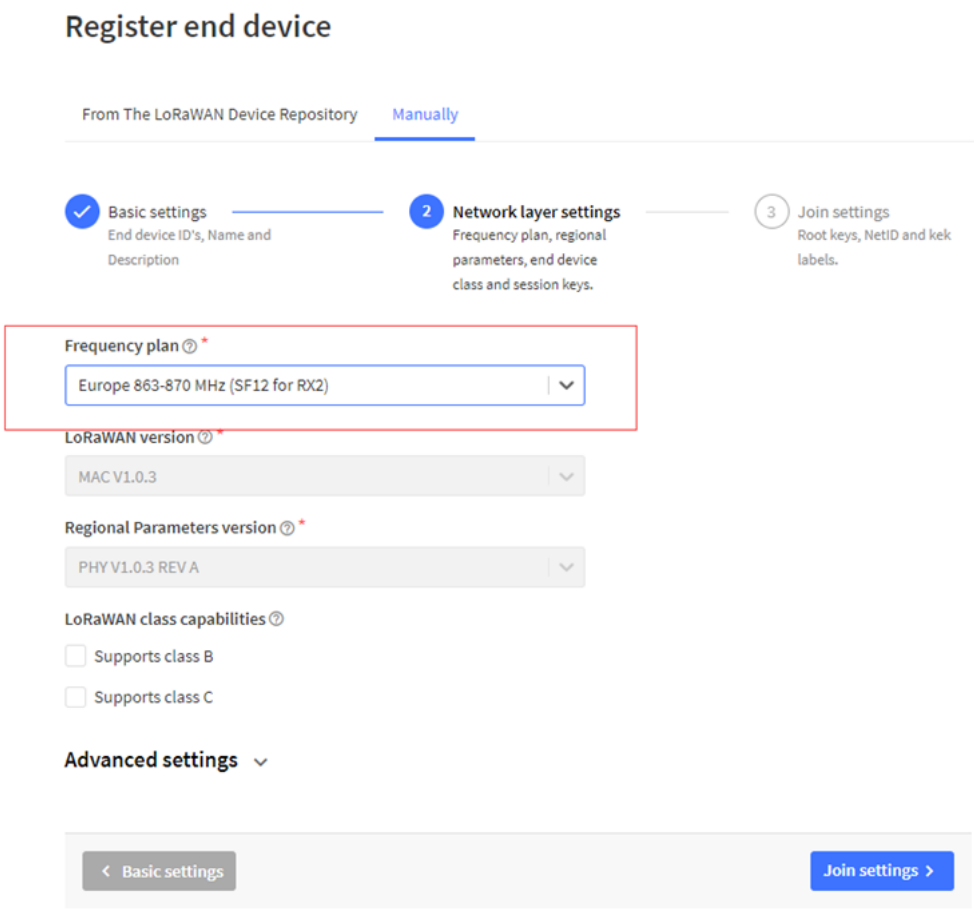
Register the device



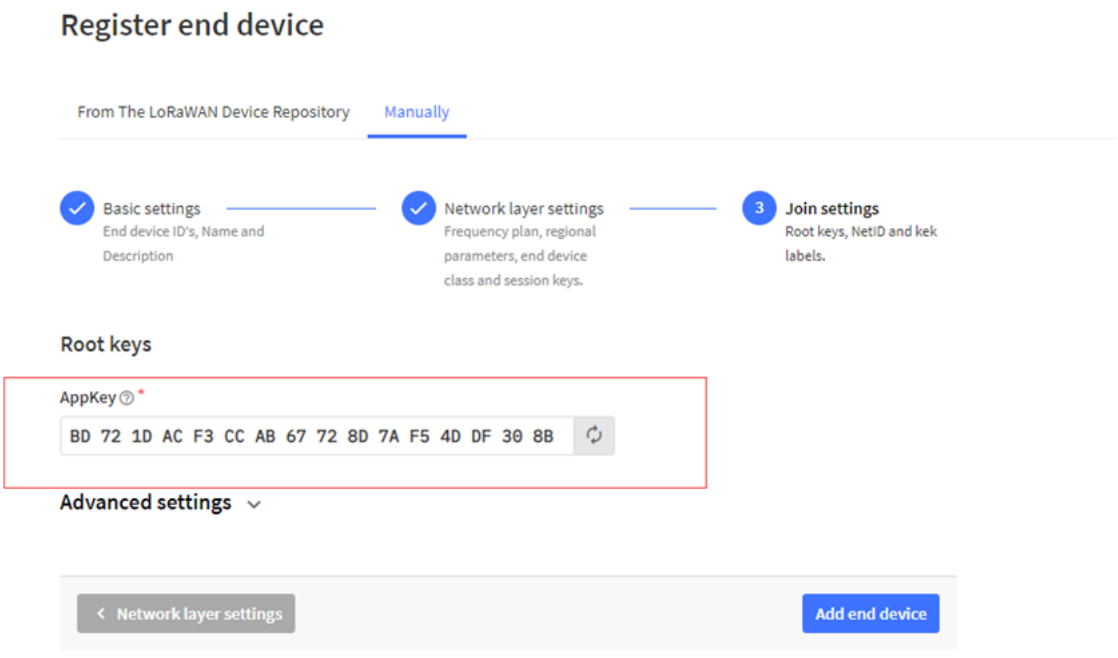
Add APP EUI and DEV EUI



Add APP EUI in the application



Add APP KEY



Step 2: Power on LLDS40

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

Step 3: The LLDS40 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.

2.3 Uplink Payload

LLDS40 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 LLDS40.

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 the 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

Indicates the distance value measured by the LLDS40. The default unit is cm and the range is 0-4000.

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 ranging gear is fixed, the farther the ranging, the lower the signal strength.

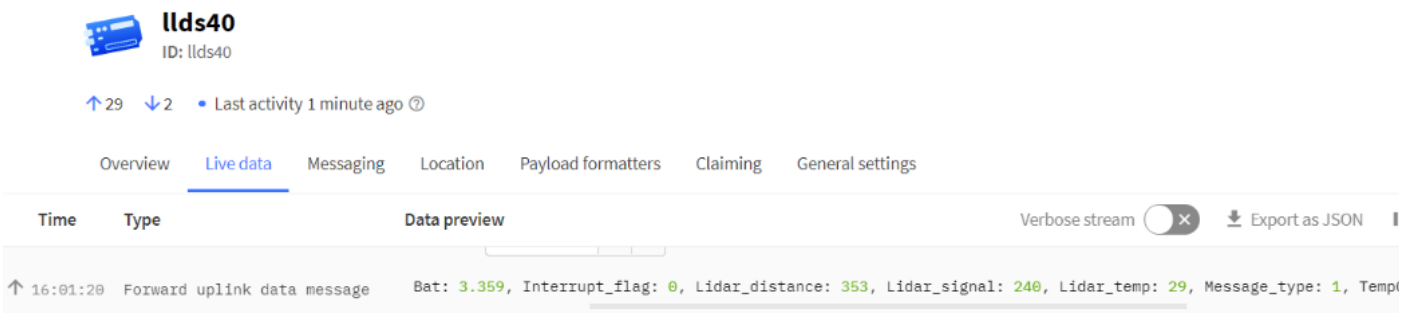
In actual use, when the signal strength value Strength≤60, the measured value of Dist is considered unreliable, and the default output is 4500. When the signal strength is and the actual distance is 45~60m, the output value of Dist is 4500. When the signal strength is greater than 60 and the actual distance is more than 60m, there will be ov abnormal values.

Example:

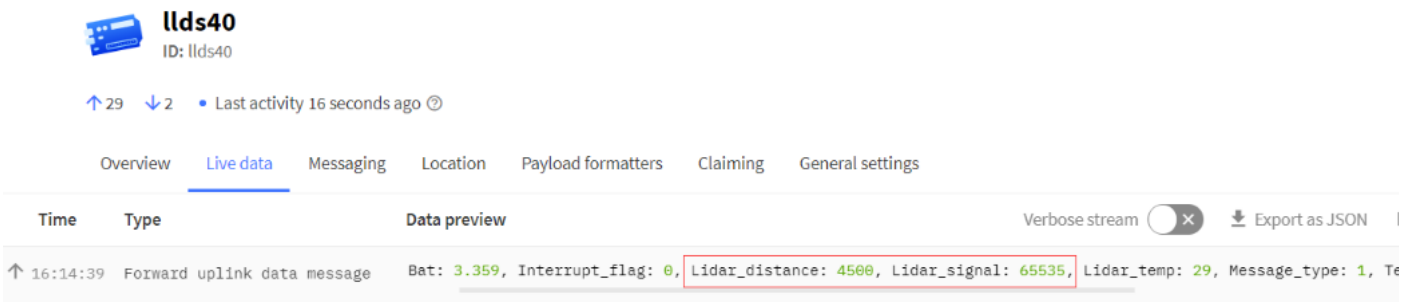
If payload is: 01D7(H)=471(D), distance signal strength=471, 471>100,471≠65535, the measured value of Dist is considered credible.

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

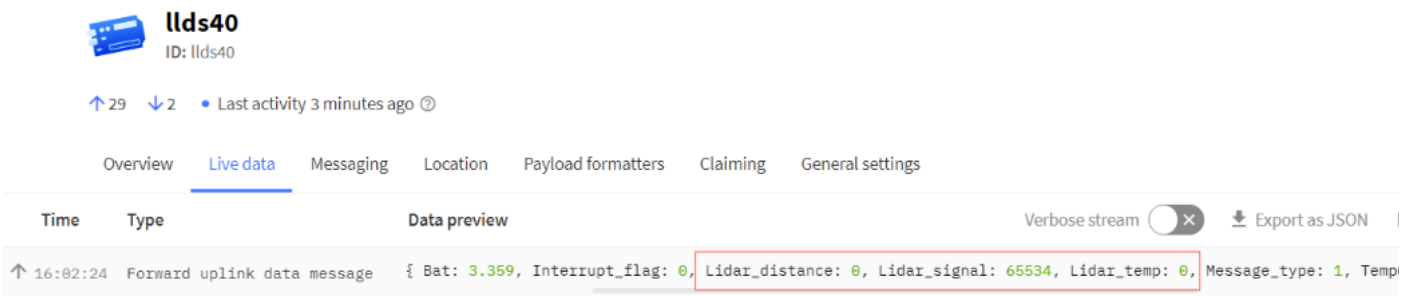
1) When the sensor detects valid data:



2) When the sensor detects invalid data:



3) When the sensor is not connected:



2.3.5 Interrupt Pin

This data field shows if this packet is generated by interrupt 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

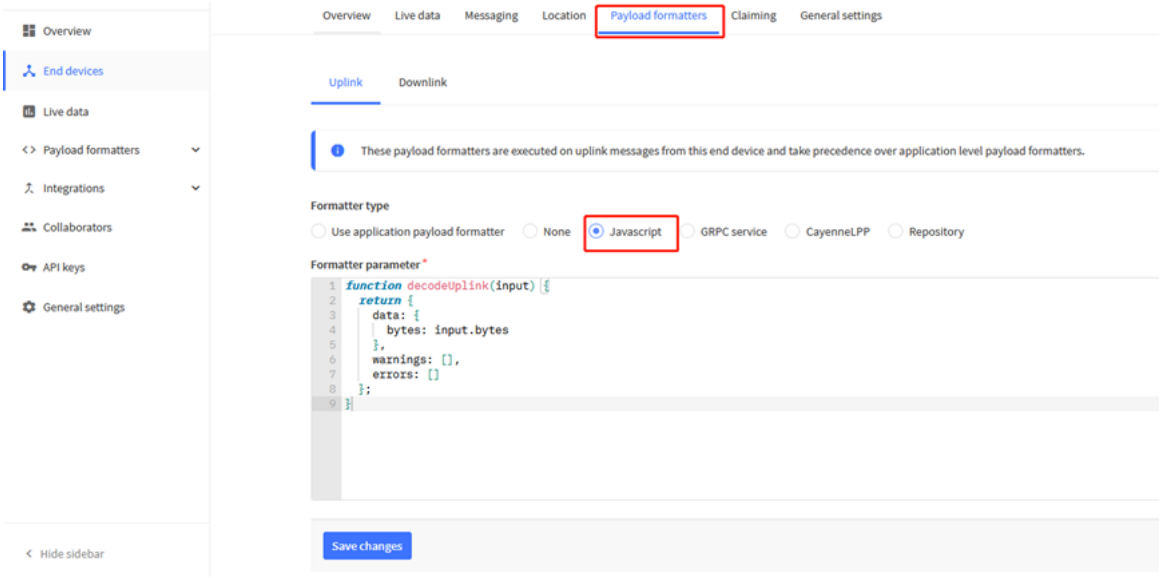
For a normal uplink payload, the message type is always 0x01.

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:

LLDS40 TTN Payload Decoder: https://github.com/dragino/dragino-end-node-decoder/tree/main/LLDS40 (https://github.com/dragino/dragino-end-node-decoder/tree/mai

2.4 Uplink Interval

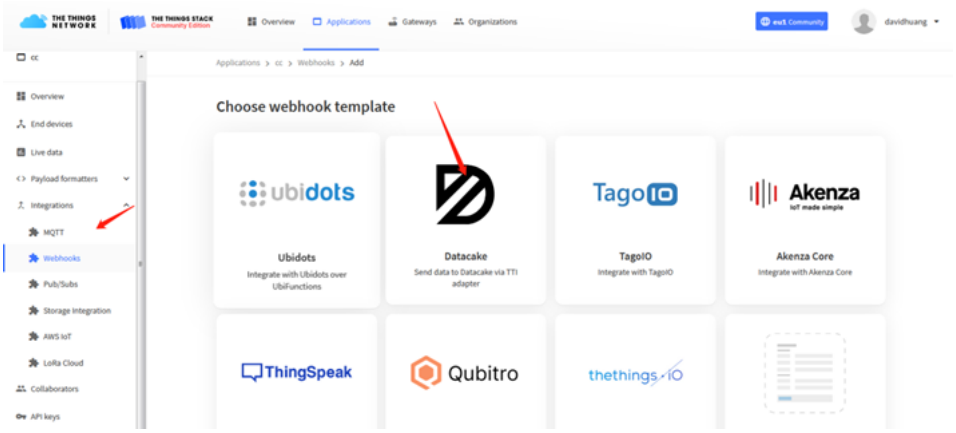
The LLDS40 by default uplink the sensor data every 20 minutes. User can change this interval by AT Command or LoRaWAN Downlink Command. See this link: Change (/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/)

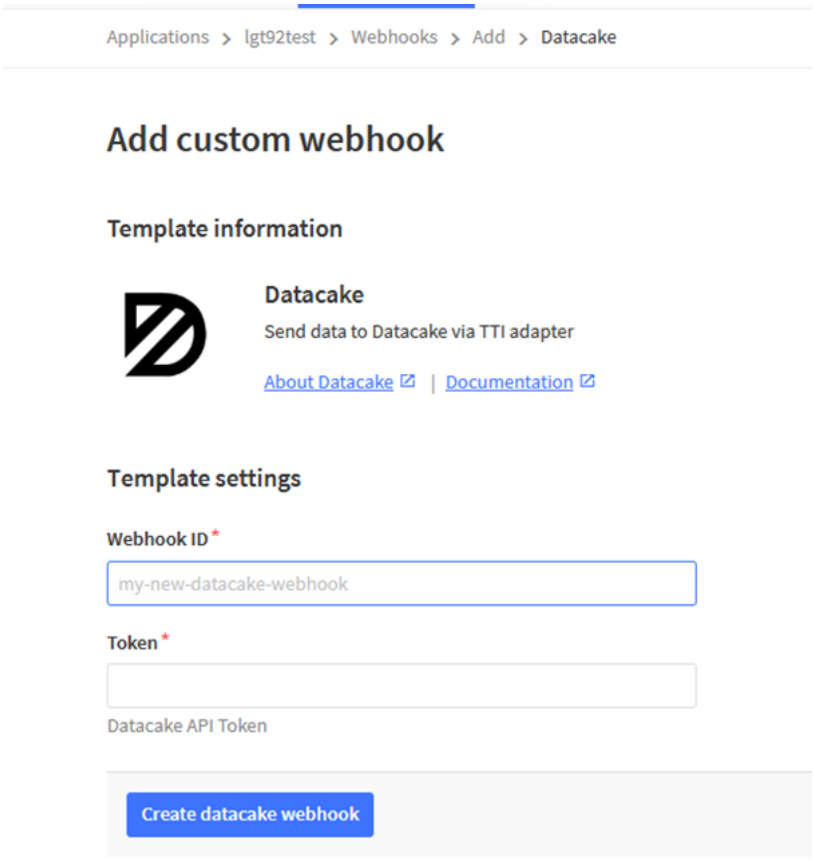
2.5 Show Data in DataCake IoT Server

DATACAKE (https://datacake.co/) provides a human friendly interface to show the sensor data, once we have data in TTN, we can use DATACAKE (https://datacake.co DATACAKE. Below are the steps:

Step 1: Be sure that your device is programmed and properly connected to the network at this time.

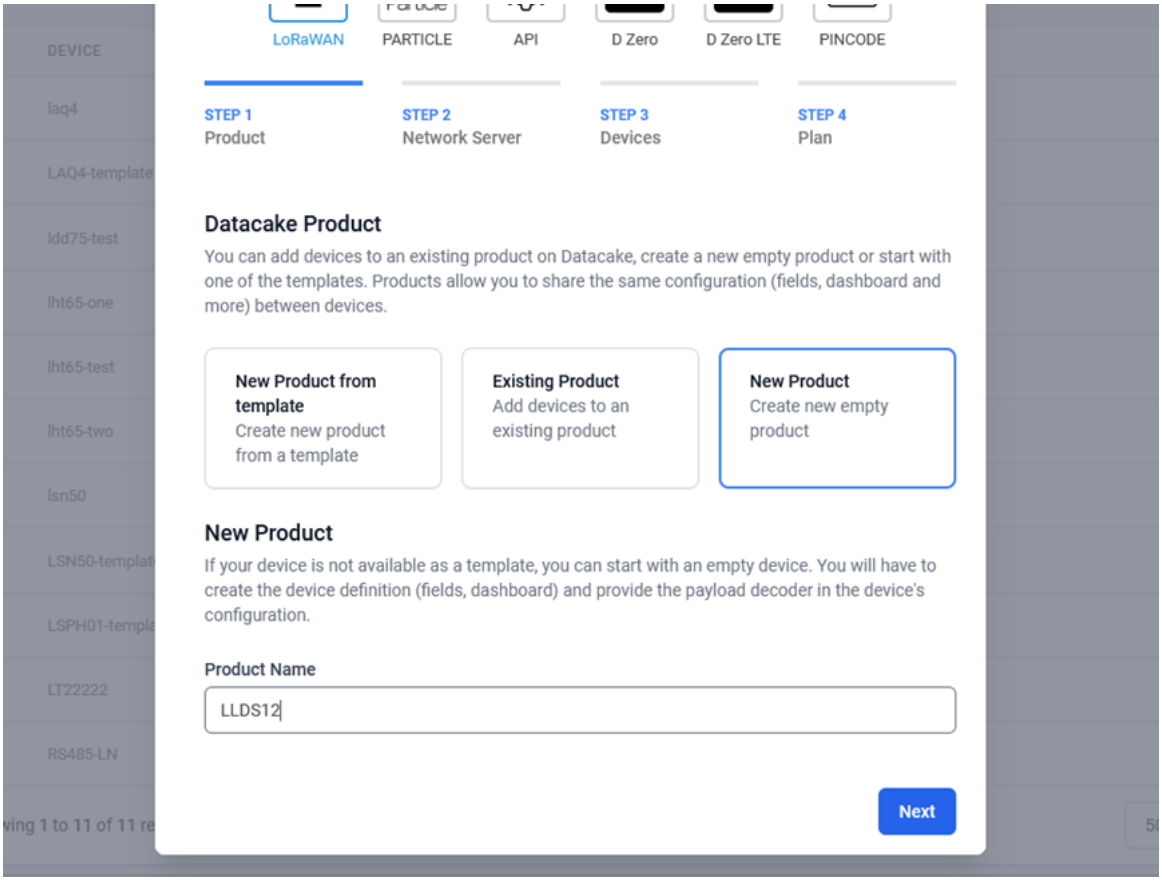
Step 2: To configure the Application to forward data to DATACAKE you will need to add integration. To add the DATACAKE integration, perform the following s





Step 3: Create an account or log in Datacake.

Step 4: Create LLDS40 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
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

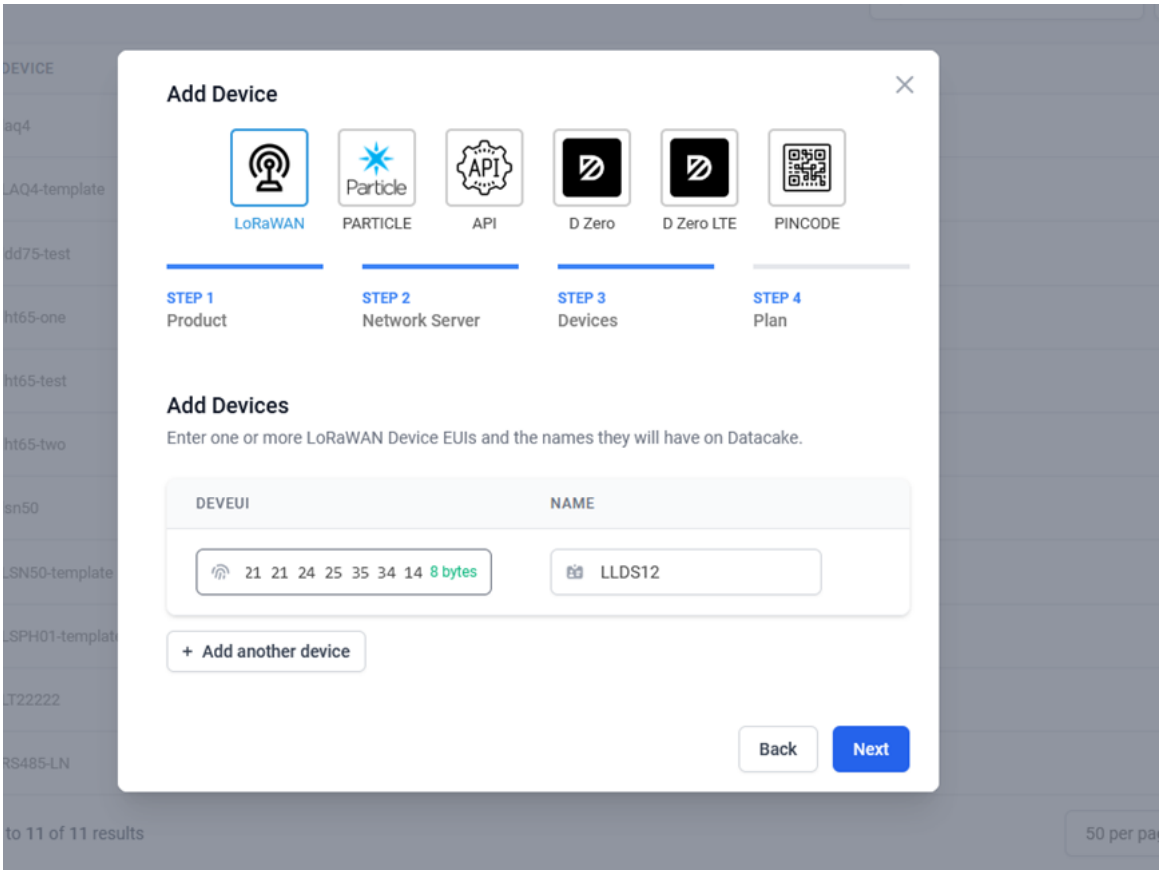
Please choose the LoRaWAN Network Server that your devices are connected to.

◉	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

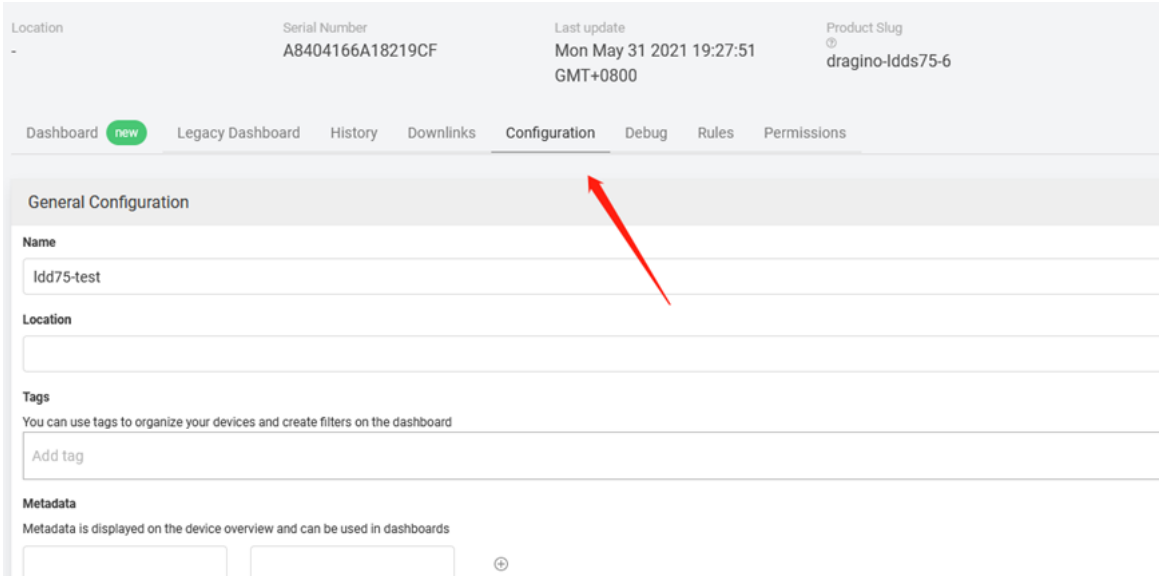
Showing 1 to 5 of 8 results

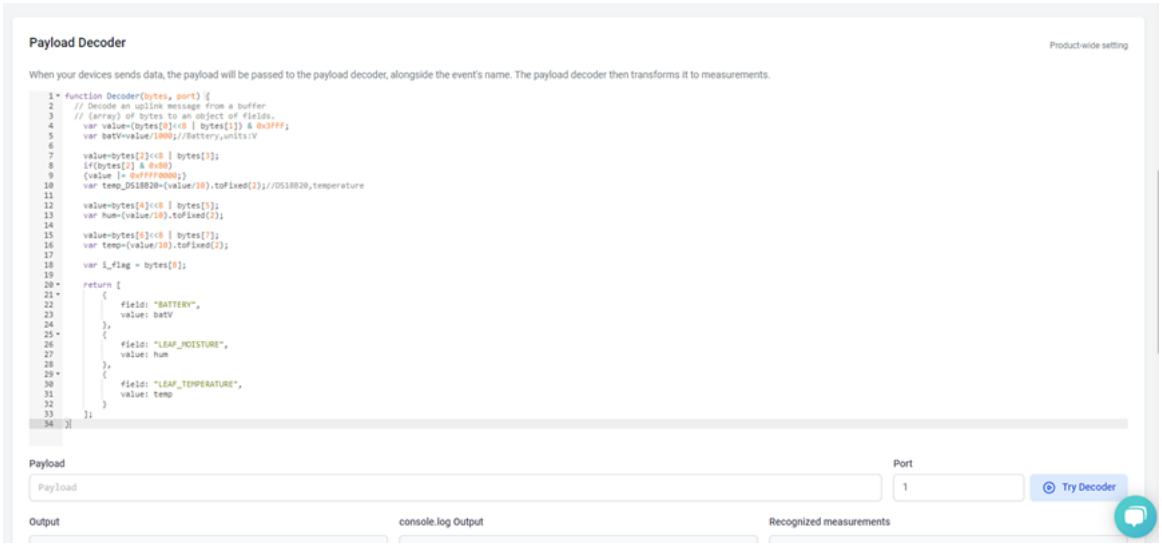
Previous Next

Back Next

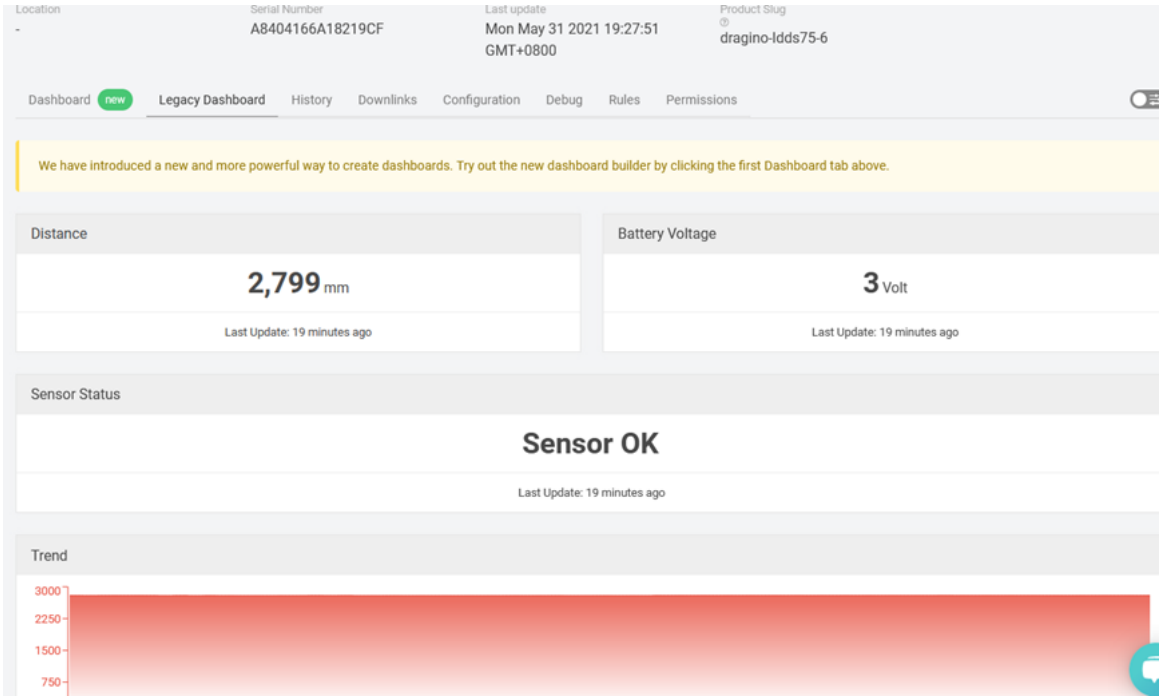


Step 5: add payload decode





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



2.6 Frequency Plans

The LLDS40 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-ba 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-ba 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 LLDS40 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 transmits a packet.

2.8 Firmware Change Log

Firmware download link: https://www.dropbox.com/sh/zjrobt4eb6tju89/AADPX7jC7mLN2dlvV-Miz3nFa?dl=0 (https://www.dropbox.com/sh/zjrobt4eb6tju89/AADPX7jC7

Firmware Upgrade Method: Firmware Upgrade Instruction (/xwiki/bin/view/Main/Firmware%20Upgrade%20Instruction%20for%20STM32%20base%20products/)

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 b
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 belo

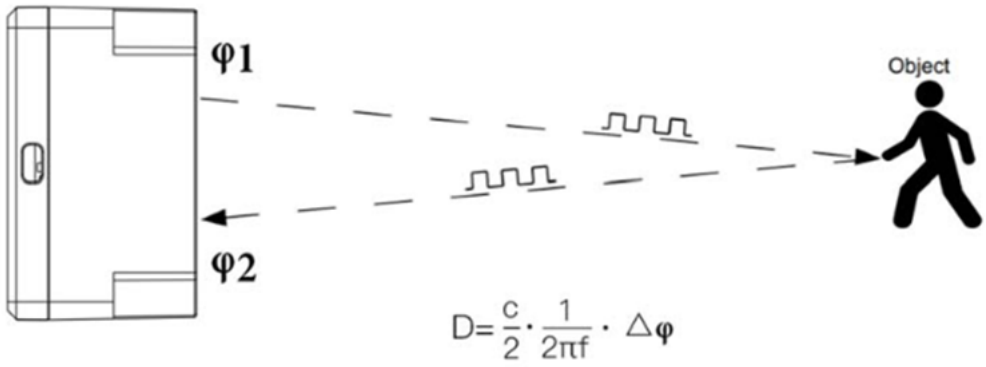


Figure 1 Schematics of TOF Principle

3.2 Distance Measurement Characteristics

The detection angle of the LLDS40 is 3 degrees, and the size of the light spot at different distances is the side length of the detection range. The size of the light spot at d
detection range. The side length of the detection range (the shape is square), as shown.

Distance(m)	1	2	3	5	7	10	20	30	40
Detection range side length (cm)	5	10	16	26	37	52	105	156	208

Note that generally, the side length of the detected target object should be greater than the side length of the detection range of the LLDS40; when the detected object is
length; when the detected object is smaller than the detection range side length, the effective range of the radar will be reduced.

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 be 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.

3.4 Reflectivity of different objects:

Item	**Material**	**Relectivity**
1	Black foam rubber	2.4%
2	Black fabric	3%

3	Black rubber	4%
4	Coal (different types of coal)	4~8%
5	Black car paint	5%
6	Black Jam	10%
7	Opaque black plastic	14%
8	Clean rough board	20%
9	Translucent plastic bottle	62%
10	Carton cardboard	68%
11	Clean pine	70%
12	Opaque white plastic	87%
13	White Jam	90%
14	Kodak Standard Whiteboard	100%
15	Unpolished white metal surface	130%
16	Glossy light metal surface	150%
17	stainless steel	200%
18	Reflector plate, reflective tape	>300%

4. Configure LLDS40 via AT Command or LoRaWAN Downlink

Use can configure LLDS40 via AT Command or LoRaWAN Downlink.

- AT Command Connection: See FAQ.
- LoRaWAN Downlink instruction for different platforms: IoT LoRaWAN Server (/xwiki/bin/view/Main/)

There are two kinds of commands to configure LLDS40, 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: End Device AT Commands and Downlink C
(/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/)

- **Commands special design for LLDS40**

These commands only valid for LLDS40, 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 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

4.2 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 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

4.3 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	Message Type Always 0x02

Software Type: Always 0x03 for LLDS40

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: LLDS40

5. Battery & Power Consumption

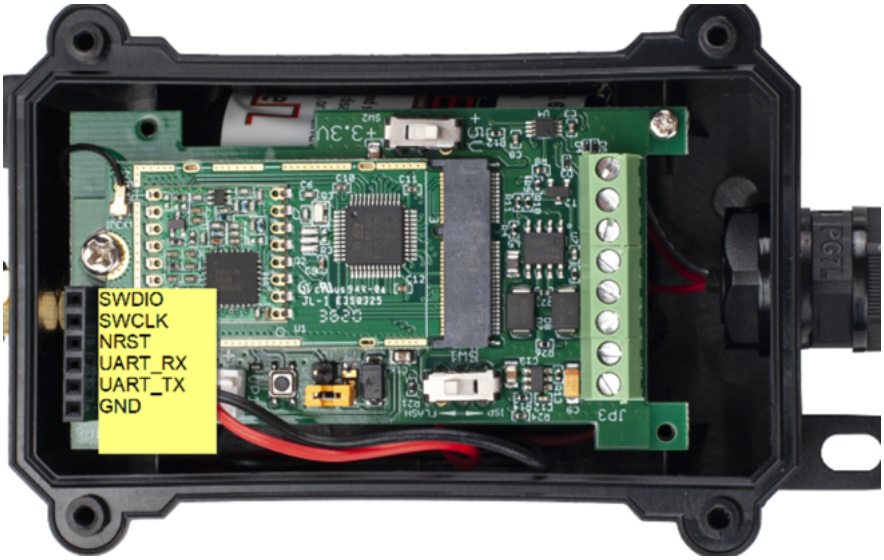
LLDS40 uses ER26500 + SPC1520 battery pack. See below link for detail information about the battery info and how to replace.

Battery Info & Power Consumption Analyze (http://wiki.dragino.com/xwiki/bin/view/Main/How%20to%20calculate%20the%20battery%20life%20of%20Dragino%20sen

6. Use AT Command

6.1 Access AT Commands

LLDS40 supports AT Command set in the stock firmware. You can use a USB to TTL adapter to connect to LLDS40 for using AT command, as below.



Connection:

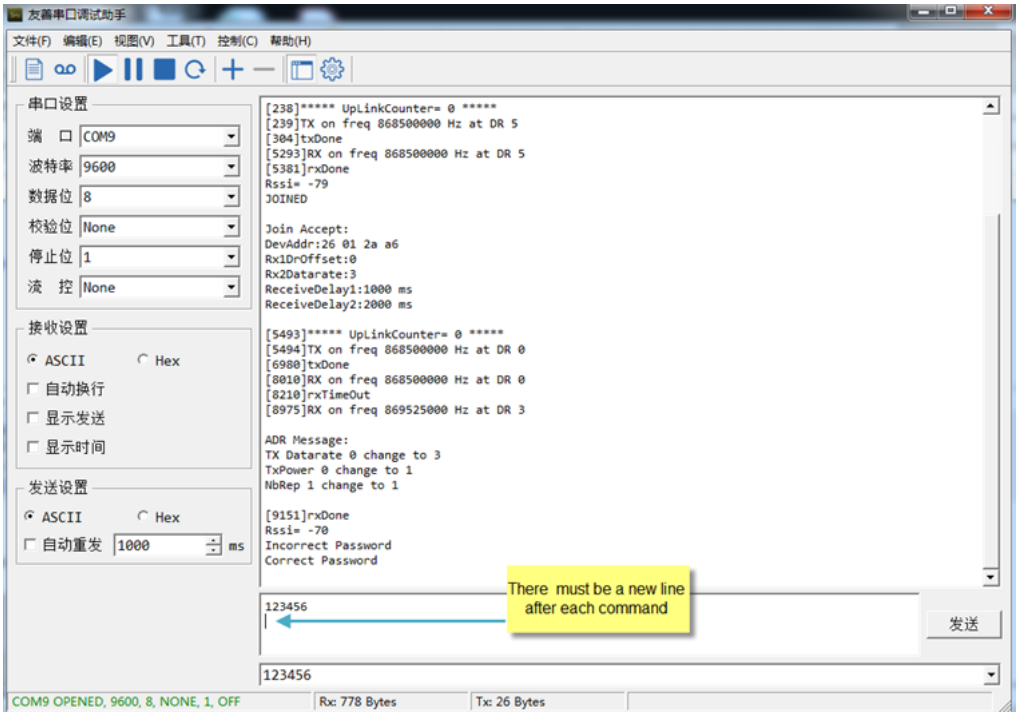
USB TTL GND <----> GND

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 LLDS40.

LLDS40 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 s
the send key, user need to add ENTER in their string.

8.2 Significant error between the output distance value of LiDAR and the 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 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: **LLDS40-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

10. Packing Info

Package Includes:

- LLDS40 LoRaWAN LiDAR Distance Sensor x 1

Dimension and weight:

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

11. 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 answe 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 (http://../../../../../../D:%5C%E5%B8%82%E5%9C%BA%E8%B5%84%E6%96%99%5C%E8%AF%B4%E6%98%8E%E4%B9%A6%5CLoRa%5CLT%E7%B3%BB%