



LoRaWAN Liquid Level Sensor User Manual

Document Version: 1.1.1

Image Version: v1.0

Version	Description	Date
1.0	Release	2020-Aug-08
1.1	Add different hardware UART Connection photo	2020-Nov-5
1.1.1	Typo for Payload format	2021-Mar-1

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1. Introduction

1.1 What is LoRaWAN Ultrasonic liquid level sensor

The Dragino LDDS20 is a **LoRaWAN Ultrasonic liquid level sensor** for Internet of Things solution. It uses **none-contact method** to measure the height of liquid in a container without opening the container, and send the value via LoRaWAN network to IoT Server

The LDDS20 sensor is installed directly below the container to detect the height of the liquid level. User doesn't need to open a hole on the container to be tested. The **none-contact measurement makes the measurement safety, easier and possible for some strict situation.**

LDDS20 uses ultrasonic sensing technology for distance measurement. LDDS20 is of high accuracy to measure various liquid such as: **toxic substances, strong acids, strong alkalis** and **various pure liquids** in high-temperature and high-pressure airtight containers.

The LoRa wireless technology used in LDDS20 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.

LDDS20 is powered by **8500mA Li-SOCI2 battery**; It is designed for long term use up to 10 years*.

Each LDDS20 pre-loads with a set of unique keys for LoRaWAN registrations, register these keys to local LoRaWAN server and it will auto connect if there is network coverage, after power on.

*Actually lifetime depends on network coverage and uplink interval and other factors

LDDS20 in a LoRaWAN Network



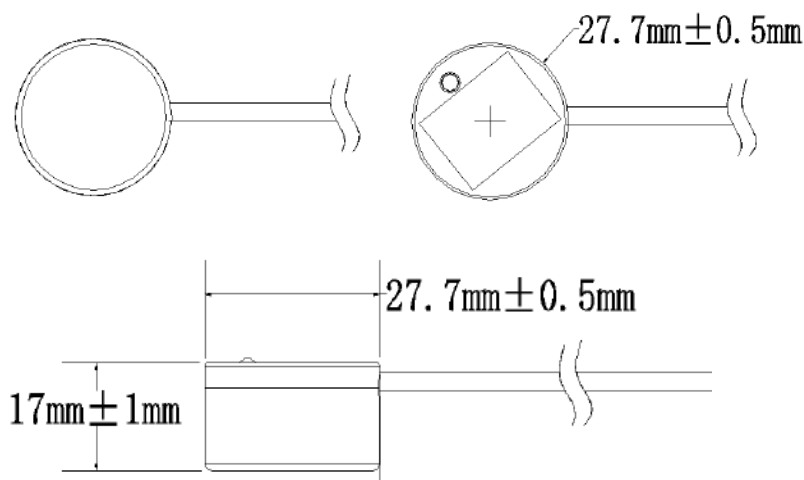
1.2 Features

- ✧ LoRaWAN 1.0.3 Class A
- ✧ Ultra low power consumption
- ✧ Liquid Level Measurement by Ultrasonic technology
- ✧ Measure through container, No need to contact Liquid.
- ✧ Valid level range 20mm - 2000mm
- ✧ Accuracy: $\pm(5\text{mm}+S*0.5\%)$ (S: Measure Value)
- ✧ Cable Length : 25cm
- ✧ Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865
- ✧ AT Commands to change parameters
- ✧ Uplink on periodically
- ✧ Downlink to change configure
- ✧ IP66 Waterproof Enclosure
- ✧ 8500mAh Battery for long term use

1.3 Suitable Container & Liquid

- ✧ Solid Wall container such as: steel, iron, glass, ceramics, non-foaming plastics etc.
- ✧ Container shape is regular, and surface is smooth.
- ✧ Container Thickness:
 - ✓ Pure metal material. 2~8mm, best is 3~5mm
 - ✓ Pure non metal material: <10 mm
- ✧ Pure liquid without irregular deposition.

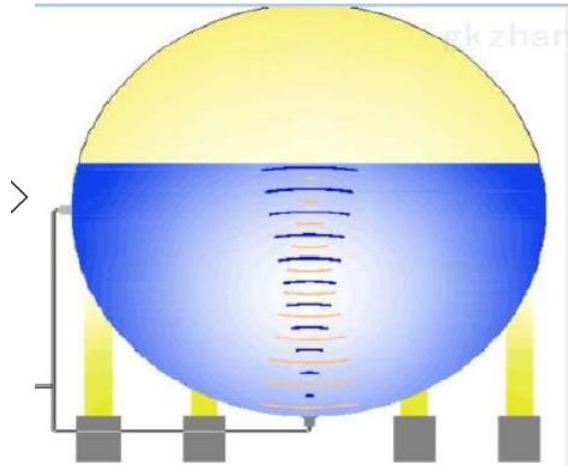
1.4 Mechanical



1.5 Install LDDS20

Step 1: Choose the installation point.

LDDS20 **MUST** be installed on the container bottom middle position.



Step 2: Polish the installation point.

For Metal Surface with paint, it is important to polish the surface, first use crude sand paper to polish the paint level, then use exquisite sand paper to polish the metal level to make it shine & smooth. .

No polish needed if the container is shine metal surface without paint or non-metal container.



Metal Surface with paint needs polish

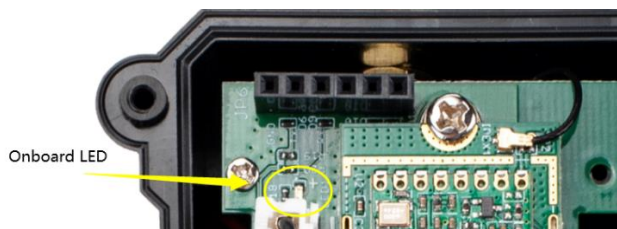


Shine Metal Surface without paint no need polish

Step3: Test the installation point.

Power on LDDS75, check if the blue LED is on, If the blue LED is on, means the sensor works. Then put ultrasonic coupling paste on the sensor and put it tightly on the installation point.

It is necessary to put the coupling paste between the sensor and the container, otherwise LDDS20 won't detect the liquid level.



After paste the LDDS20 well, power on LDDS20. In the first 30 seconds of booting, device will check the sensors status and BLUE LED will show the status as below. After 30 seconds, BLUE LED will be off to save battery life.

LED Status:

- Onboard LED: When power on device, the onboard LED will fast blink 4 times which means detect the sensor well.
- BLUE LED **always ON**: Sensor is power on but doesn't detect liquid. There is problem in installation point.
- BLUE LED **slowly blinking**: Sensor detects Liquid Level, The installation point is good. LDDS20 will enter into low power mode at 30 seconds after system reset or power on, Blue LED will be off after that.

Note 2:

Ultrasonic coupling paste is subjected in most shipping way. So the default package doesn't include it and user needs to purchase locally.

Step4: Install use Epoxy ab glue.

Prepare Epoxy AB glue.

Put Epoxy AB glue in the sensor and press it hard on the container installation point.

Reset LDDS20 and see if the BLUE LED is slowly blinking.

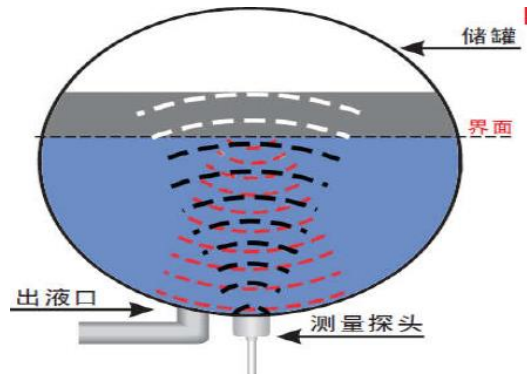


Note1:

Epoxy AB glue needs 3~ 5 minutes to stable attached. we can use other glue material to keep it in the position.

Note 2:

Epoxy AB glue is subjected in most shipping way. So the default package doesn't include it and user needs to purchase locally.



1.6 Applications

- ✧ Smart liquid control solution.
- ✧ Smart liquefied gas solution.

1.7 Precautions

- ✧ At room temperature, containers of different materials, such as steel, glass, iron, ceramics, non-foamed plastics and other dense materials, have different detection blind areas and detection limit heights.
- ✧ For containers of the same material at room temperature, the detection blind zone and detection limit height are also different for the thickness of the container.

- ✧ When the detected liquid level exceeds the effective detection value of the sensor, and the liquid level of the liquid to be measured shakes or tilts, the detected liquid height is unstable.

2. Configure LDDS20 to connect to LoRaWAN network

2.1 How it works

The LDDS20 is configured as LoRaWAN OTAA Class A mode by default. It has OTAA keys to join LoRaWAN network. To connect a LoRaWAN network, you need to input the OTAA keys in the LoRaWAN IoT server and power on the LDDS20. If there is coverage of the LoRaWAN network, it will automatically join the network via OTAA and start to send the sensor value

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 LDDS20.

2.2 Quick guide to connect to LoRaWAN server (OTAA)

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

LoRaWAN Network



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 LDDS20.

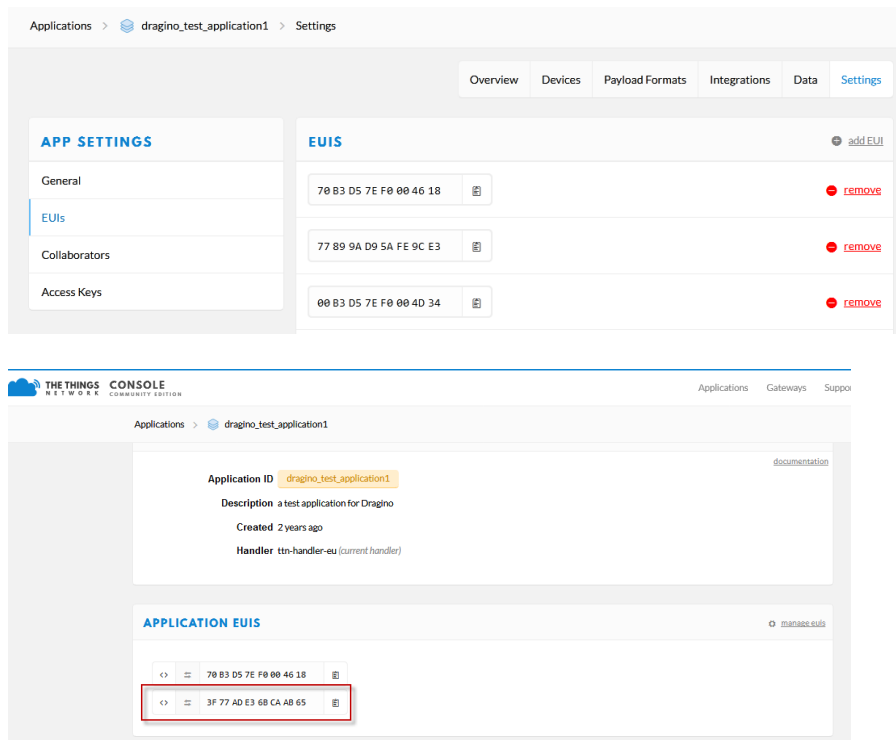
Each LDDS20 is shipped with a sticker with the default device keys, user can find this sticker in the box. it looks like below.



For OTAA registration, we need to set **APP EUI/ APP KEY/ DEV EUI**. Some server might no need to set APP EUI.

Enter these keys in the LoRaWAN Server portal. Below is TTN screen shot:

Add APP EUI in the application



Applications > dragino_test_application1 > Settings

Overview Devices Payload Formats Integrations Data **Settings**

APP SETTINGS

- General
- EUIs**
- Collaborators
- Access Keys

EUIs [add EUI](#)

70 B3 D5 7E F0 00 46 18	remove
77 89 9A D9 5A FE 9C E3	remove
00 B3 D5 7E F0 00 4D 34	remove

THE THINGS NETWORK CONSOLE COMMUNITY EDITION Applications Gateways Support

Applications > dragino_test_application1

Application ID: dragino_test_application1 [documentation](#)

Description: a test application for Dragino

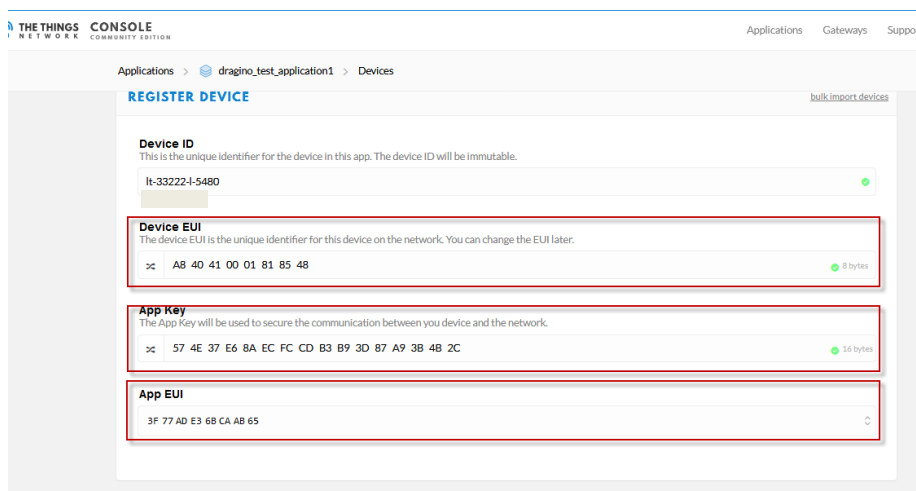
Created: 2 years ago

Handler: ttn-handler-eu (current handler)

APPLICATION EUIs [manage euis](#)

70 B3 D5 7E F0 00 46 18
3F 77 AD E3 6B CA AB 65

Add APP KEY and DEV EUI



THE THINGS NETWORK CONSOLE COMMUNITY EDITION Applications Gateways Support

Applications > dragino_test_application1 > Devices

REGISTER DEVICE [bulk import devices](#)

Device ID
This is the unique identifier for the device in this app. The device ID will be immutable.

It-33222-I-5480

Device EUI
The device EUI is the unique identifier for this device on the network. You can change the EUI later.

A8 40 41 00 01 81 85 48 8 bytes

App Key
The App Key will be used to secure the communication between you device and the network.

57 4E 37 E6 8A EC FC CD B3 B9 3D 87 A9 38 4B 2C 16 bytes

App EUI

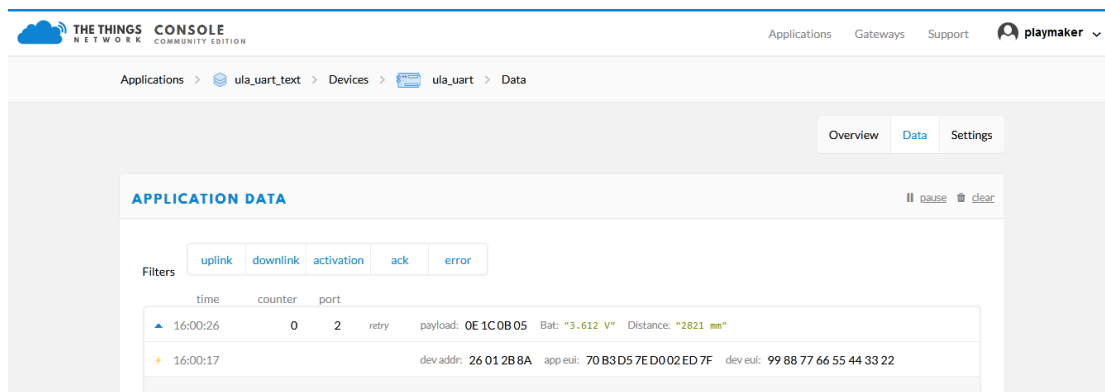
3F 77 AD E3 6B CA AB 65

Step 2: Power on LDDS20

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



Step 3: The LDDS20 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.



The screenshot shows the 'Data' tab of the 'ula_uart_text' device in the The Things Network Console. The 'APPLICATION DATA' section displays a list of messages. The first message is an uplink received at 16:00:26 with a payload of '0E1C0B05', battery level of '3.612 V', and distance of '2821 mm'. The second message is a downlink received at 16:00:17 with device address '26 01 2B 8A', application EUI '70 B3 D5 7E D0 02 ED 7F', and device EUI '99 88 77 66 55 44 33 22'.

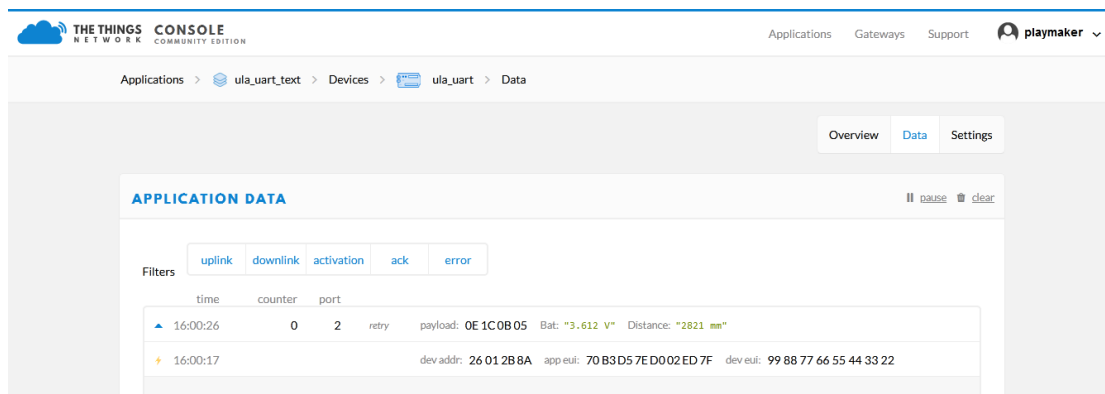
time	counter	port	payload	Bat	Distance
16:00:26	0	2	0E1C0B05	3.612 V	2821 mm
16:00:17			dev addr: 26 01 2B 8A app eui: 70 B3 D5 7E D0 02 ED 7F dev eui: 99 88 77 66 55 44 33 22		

2.3 Uplink Payload

LDDS20 will uplink payload via LoRaWAN with below payload format:

Uplink payload includes in total 5 bytes.

Size (bytes)	2	2	1
Value	BAT	Liquid height (unit: mm)	Interrupt



The screenshot shows the 'Data' tab of the 'ula_uart_text' application in the The Things Network Console. The 'APPLICATION DATA' section displays a table of uplink messages. The first message at 16:00:26 shows a 'retry' status with a payload of '0E 1C 0B 05'. The second message at 16:00:17 shows the device address '26 01 2B 8A', application EUI '70 B3 D5 7E D0 02 ED 7F', and device EUI '99 88 77 66 55 44 33 22'. The console also shows battery voltage '3.612 V' and distance '2821 mm'.

2.3.1 Battery Info

Check the battery voltage for LDDS20.

Ex1: 0x0B45 = 2885mV

Ex2: 0x0B49 = 2889mV

2.3.2 Liquid height

Get the distance. Flat object range 20mm - 2000mm.

For example, if the data you get from the register is 0x06 0x05, the distance between the sensor and the measured object is

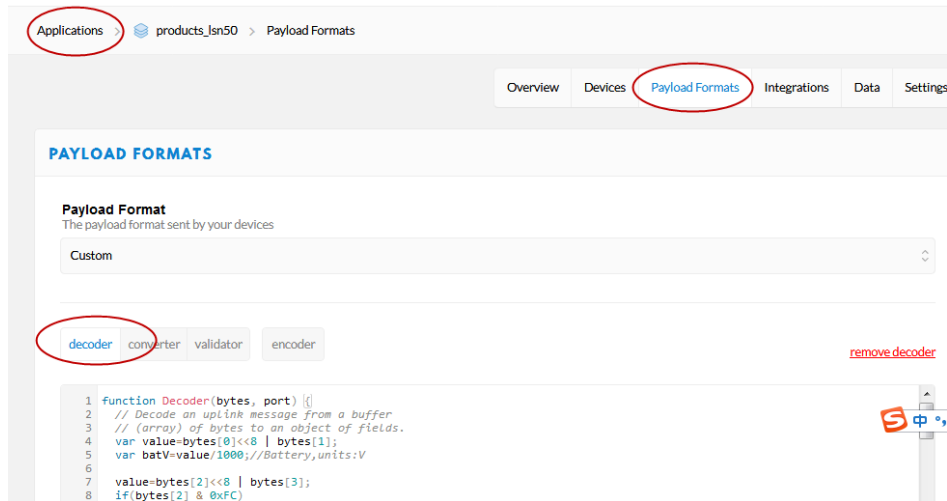
$$0605(H) = 1541 (D) = 1541 \text{ mm.}$$

If the sensor value is 0x0000, it means system doesn't detect ultrasonic sensor.

If the sensor value lower than 0x0014 (20mm), the sensor value will be invalid.

2.3.3 Decode payload in The Things Network

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



PAYLOAD FORMATS

Payload Format
The payload format sent by your devices

Custom

decoder converter validator encoder

```

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];
5   var batV=value/1000;//Battery,units:V
6
7   value=bytes[2]<<8 | bytes[3];
8   if(bytes[2] & 0xFC)
  
```

remove decoder

The payload decoder function for TTN is here:
LDDS20 TTN Payload Decoder:

http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LDDS20/Payload_Decoder/

2.4 Downlink Payload

By default, LDDS20 prints the downlink payload to console port.

Downlink Control Type	FPort	Type Code	Downlink payload size(bytes)
TDC (Transmit Time Interval)	Any	01	4
RESET	Any	04	2
AT+CFM	Any	05	4
INTMOD	Any	06	4

Examples

Set TDC

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

Payload: 01 00 00 1E TDC=30S

Payload: 01 00 00 3C TDC=60S

Reset

If payload = 0x04FF, it will reset the LDDS20

CFM

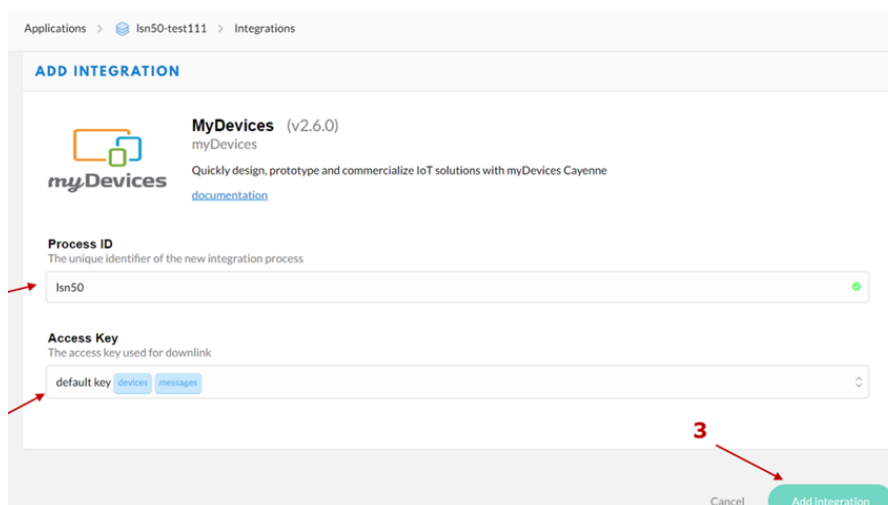
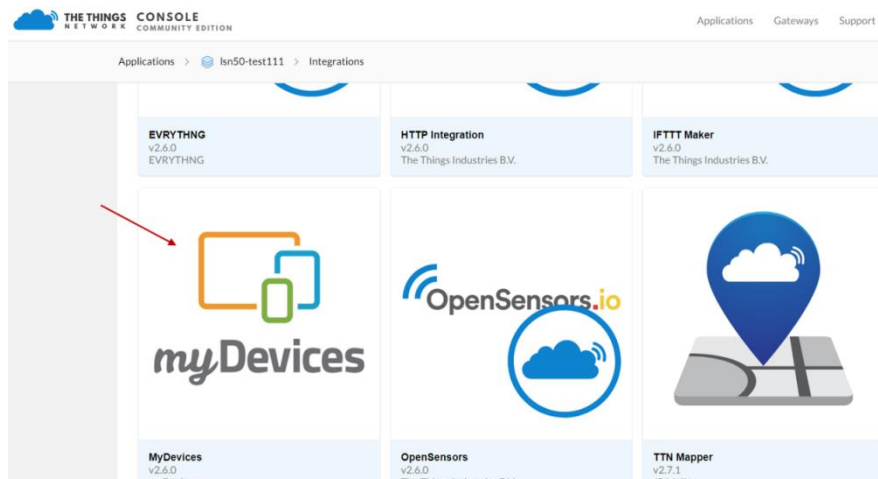
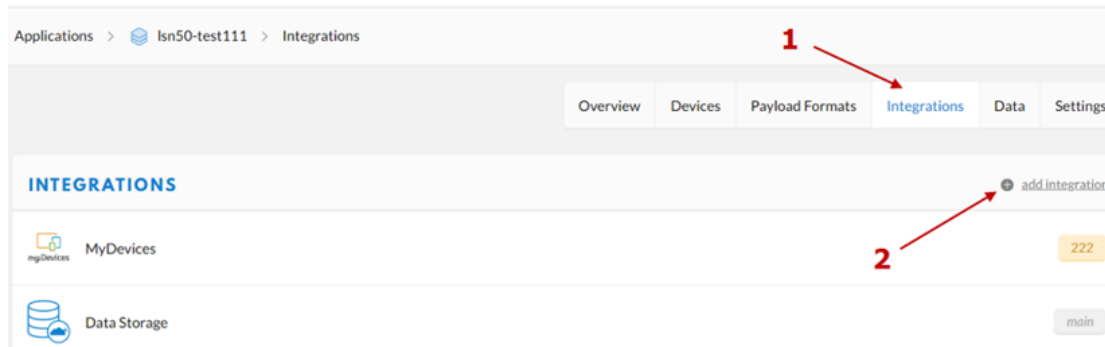
Downlink Payload: 05000001, Set AT+CFM=1 or 05000000 , set AT+CFM=0

2.5 Show Data in Mydevices IoT Server

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

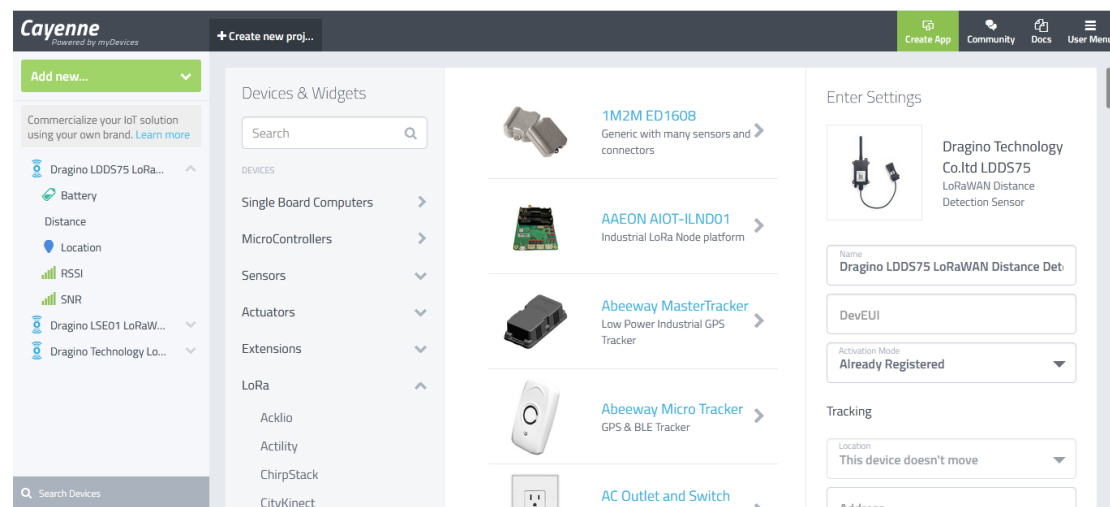
Step 1: Be sure that your device is programmed and properly connected to the network at this time.

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

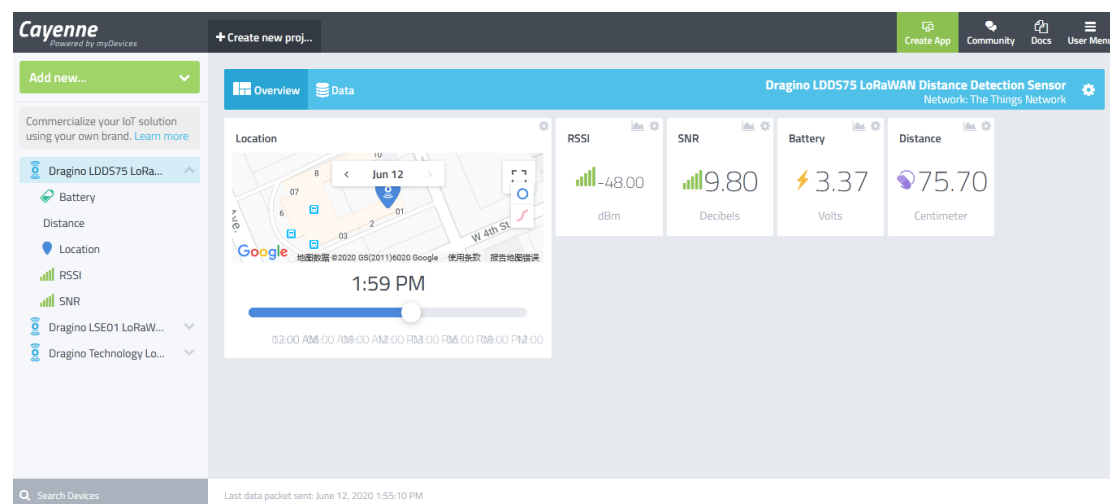


Step 3: Create an account or log in Mydevices.

Step 4: Search the LDDS75 and add DevEUI. (Note: LDDS20 use same payload as LDDS75)



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



2.6 LED Indicator

The LDDS20 has an internal LED which is to show the status of different state.

- Blink once when device power on.
- The device detects the sensor and flashes 5 times.
- Solid ON for 5 seconds once device successful Join the network.
- Blink once when device transmit a packet.

2.7 Firmware Change Log

Firmware download link:

http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LSE01/Firmware/

Firmware Upgrade Method:

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

2.8 Battery Analysis

2.8.1 Battery Type

The LDDS20 battery is a combination of a 8500mAh Li/SOCI2 Battery and a Super Capacitor. The battery is non-rechargeable battery type with a low discharge rate (<2% per year). This type of battery is commonly used in IoT devices such as water meter.

The battery is designed to last for more than 10 years for the LDDS20.

The battery related documents as below:

- [Battery Dimension](#),
- [Lithium-Thionyl Chloride Battery datasheet](#)
- [Lithium-ion Battery-Capacitor datasheet](#),



2.8.2 Power consumption Analyze

The file DRAGINO_LDDS20-Power-Analyzer.pdf from http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LDDS20/ describes a detail measurement to analyze the power consumption in different case. User can use it for design guideline for their project.

2.8.3 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 uplink data, then the battery life may be decreased.

2.8.4 Replace the battery

You can change the battery in the NBSN95. 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 NBSN95 includes a ER26500 plus super capacitor. If user can't find this pack locally, they can find ER26500 or equivalence without the SPC1520 capacitor, which will also work in most case. The SPC can enlarge the battery life for high frequency use (update period below 5 minutes)

3. Using the AT Commands

3.1 Access AT Commands

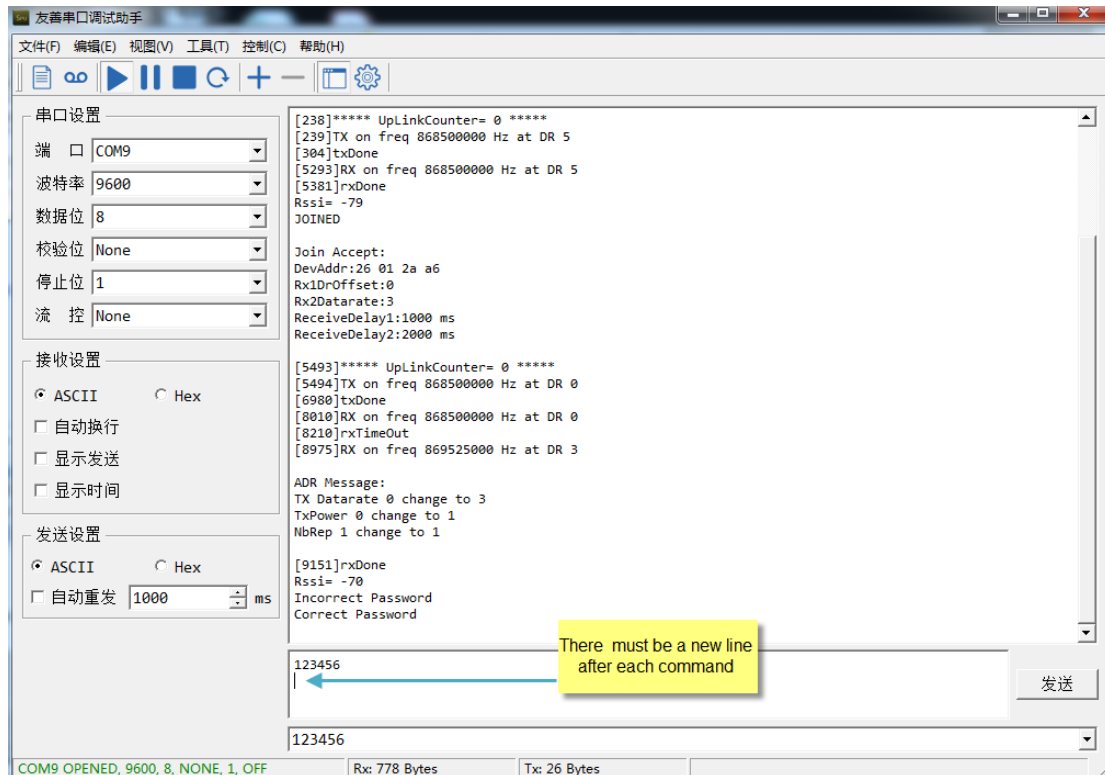
LDDS20 supports AT Command set in the stock firmware. You can use a USB to TTL adapter to connect to LDDS20 for using AT command, as below.



Or if you have below board, use below connection:



In the PC, you need to set the serial baud rate to **9600** to access the serial console for LDDS20. LDDS20 will output system info once power on as below:



Below are the available commands, a more detailed AT Command manual can be found at

[AT Command Manual:](#)

http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LDDS20/

AT+<CMD>?	: Help on <CMD>
AT+<CMD>	: Run <CMD>
AT+<CMD>=<value>	: Set the value
AT+<CMD>=?	: Get the value

General Commands

AT	: Attention
AT?	: Short Help
ATZ	: MCU Reset
AT+TDC	: Application Data Transmission Interval

Keys, IDs and EUIs management

AT+APPEUI	: Application EUI
AT+APPKEY	: Application Key
AT+APPSKEY	: Application Session Key
AT+DADDR	: Device Address
AT+DEUI	: Device EUI
AT+NWKID	: Network ID (You can enter this command change only after successful network connection)
AT+NWKSKKEY	: Network Session Key Joining and sending date on LoRa network
AT+CFM	: Confirm Mode
AT+CFS	: Confirm Status
AT+JOIN	: Join LoRa? Network
AT+NJM	: LoRa? Network Join Mode
AT+NJS	: LoRa? Network Join Status
AT+RECV	: Print Last Received Data in Raw Format

AT+RECVB	: Print Last Received Data in Binary Format
AT+SEND	: Send Text Data
AT+SENB	: Send Hexadecimal Data

LoRa Network Management

AT+ADR	: Adaptive Rate
AT+CLASS	: LoRa Class(Currently only support class A
AT+DCS	: Duty Cycle Setting
AT+DR	: Data Rate (Can Only be Modified after ADR=0)
AT+FCD	: Frame Counter Downlink
AT+FCU	: Frame Counter Uplink
AT+JN1DL	: Join Accept Delay1
AT+JN2DL	: Join Accept Delay2
AT+PNM	: Public Network Mode
AT+RX1DL	: Receive Delay1
AT+RX2DL	: Receive Delay2
AT+RX2DR	: Rx2 Window Data Rate
AT+RX2FQ	: Rx2 Window Frequency
AT+TXP	: Transmit Power

Information

AT+RSSI	: RSSI of the Last Received Packet
AT+SNR	: SNR of the Last Received Packet
AT+VER	: Image Version and Frequency Band
AT+FDR	: Factory Data Reset
AT+PORT	: Application Port
AT+CHS	: Get or Set Frequency (Unit: Hz) for Single Channel Mode
AT+CHE	: Get or Set eight channels mode, Only for US915, AU915, CN470

4. FAQ

4.1 What is the frequency plan for LDDS20?

LDDS20 use the same frequency as other Dragino products. User can see the detail from this link:

http://wiki.dragino.com/index.php?title=End_Device_Frequency_Band#Introduction

4.2 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.

5. Trouble Shooting

5.1 Why I can't join TTN in US915 / AU915 bands?

It is due to channel mapping. Please see below link:

http://wiki.dragino.com/index.php?title=LoRaWAN_Communication_Debug#Notice_of_US915.2FCN470.2FAU915_Frequency_band

5.2 AT Command input doesn't work

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

6. Order Info

Part Number: **LDDS20-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

7. Packing Info

Package Includes:

- LDDS20 LoRaWAN Liquid Level Sensor x 1

Note:

Ultrasonic coupling paste and Eproxy AB glue are subjected in most shipping way. So the default package doesn't include it and user needs to purchase locally.

Dimension and weight:

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

8. 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