
DS20L - LoRaWAN Lidar Distance Sensor

last modified by Mengting Qiu
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1. Introduction

1.1 What is LoRaWAN Smart Distance Detector

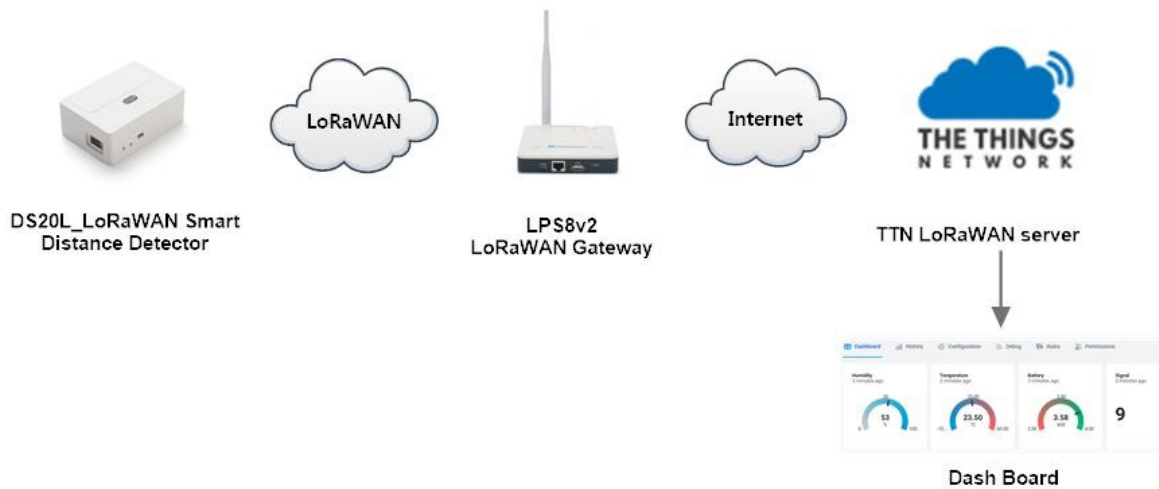
The Dragino **DS20L is a smart distance detector** base on long-range wireless LoRaWAN technology. It uses **LiDAR sensor** to detect the distance between DS20L and object, then DS20L will send the distance data to the IoT Platform via LoRaWAN. DS20L can measure range between 3cm ~ 200cm.

DS20L allows users to send data and reach extremely long ranges via LoRaWAN. It provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption. It targets professional wireless sensor network applications such smart cities, building automation, and so on.

DS20L has a **built-in 2400mAh non-chargeable battery** for long-term use up to several years*. Users can also power DS20L with an external power source for **continuous measuring and distance alarm / counting purposes**.

DS20L is fully compatible with **LoRaWAN v1.0.3 Class A protocol**, it can work with a standard LoRaWAN gateway.

DS20L in a LoRaWAN Network



1.2 Features

- LoRaWAN Class A protocol
- LiDAR distance detector, range 3 ~ 200cm
- Periodically detect or continuously detect mode
- AT Commands to change parameters
- Remotely configure parameters via LoRaWAN Downlink
- Alarm & Counting mode
- Firmware upgradable via program port or LoRa protocol
- Built-in 2400mAh battery or power by external power source

1.3 Specification

LiDAR Sensor:

- Operation Temperature: -40 ~ 80 °C
- Operation Humidity: 0~99.9%RH (no Dew)
- Storage Temperature: -10 ~ 45°C
- Measure Range: 3cm~200cm @ 90% reflectivity
- Accuracy: $\pm 2\text{cm}$ @ (3cm~100cm); $\pm 5\%$ @ (100~200cm)
- ToF FoV: $\pm 9^\circ$, Total 18°
- Light source: VCSEL

1.4 Power Consumption

Battery Power Mode:

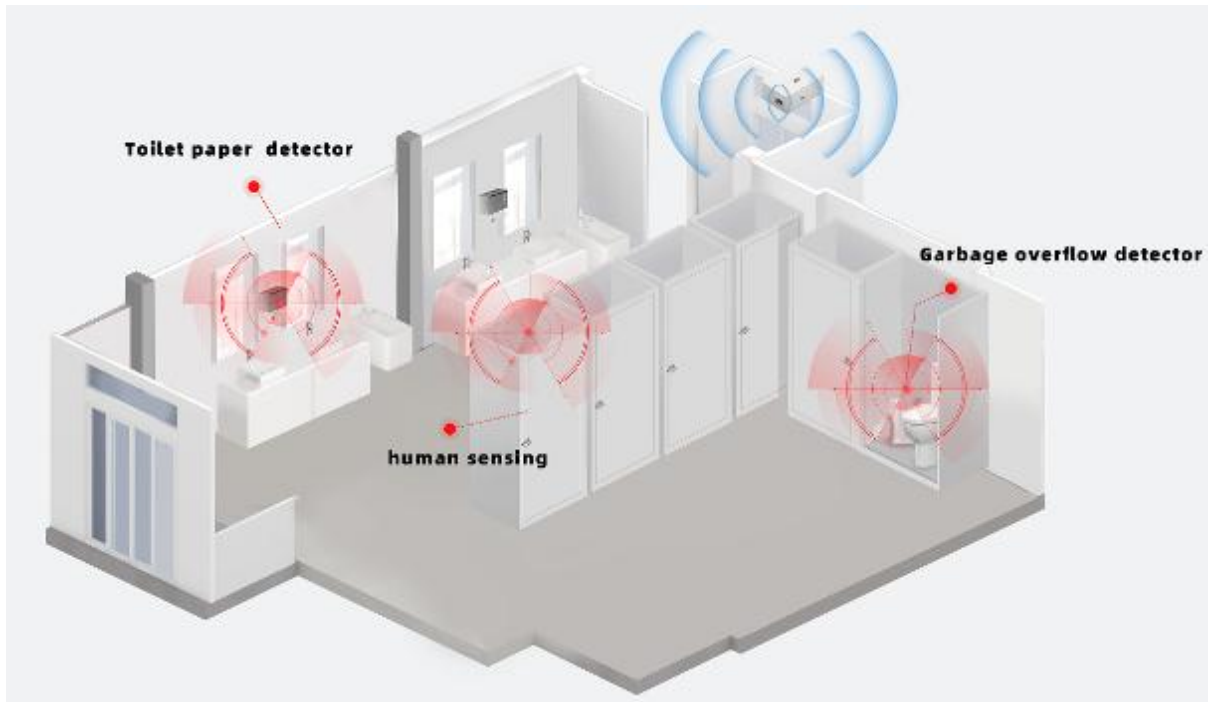
- Idle: 0.003 mA @ 3.3v
- Max : 360 mA

Continuously mode:

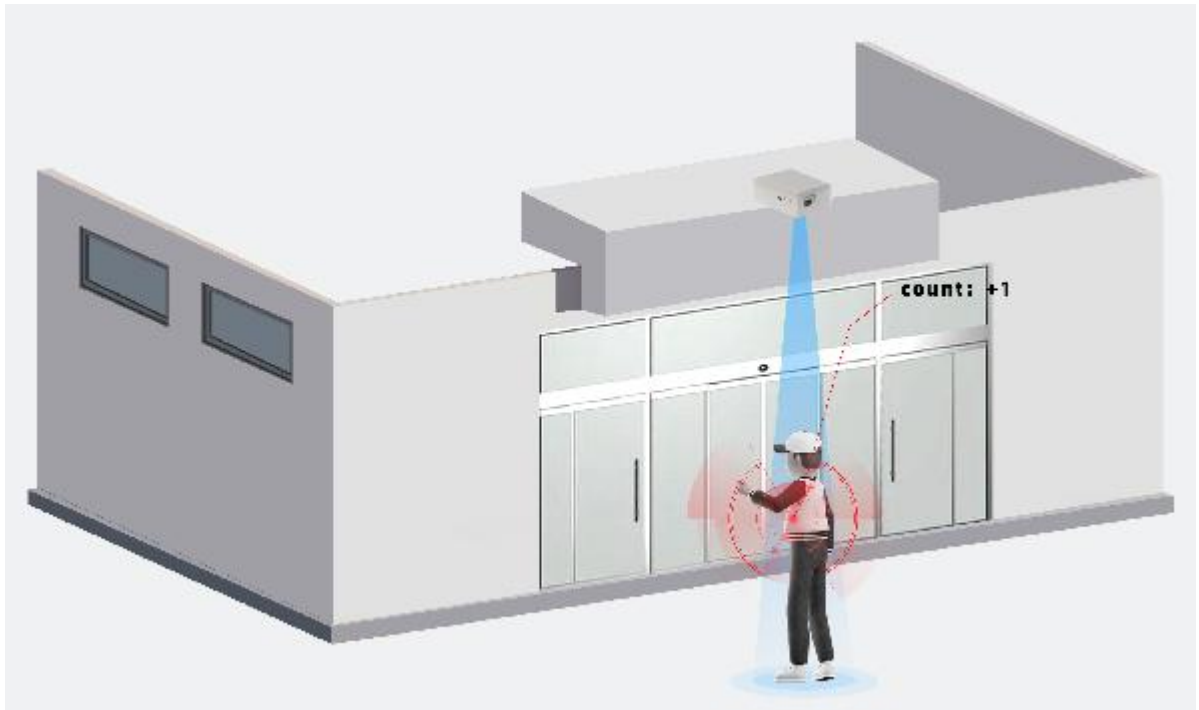
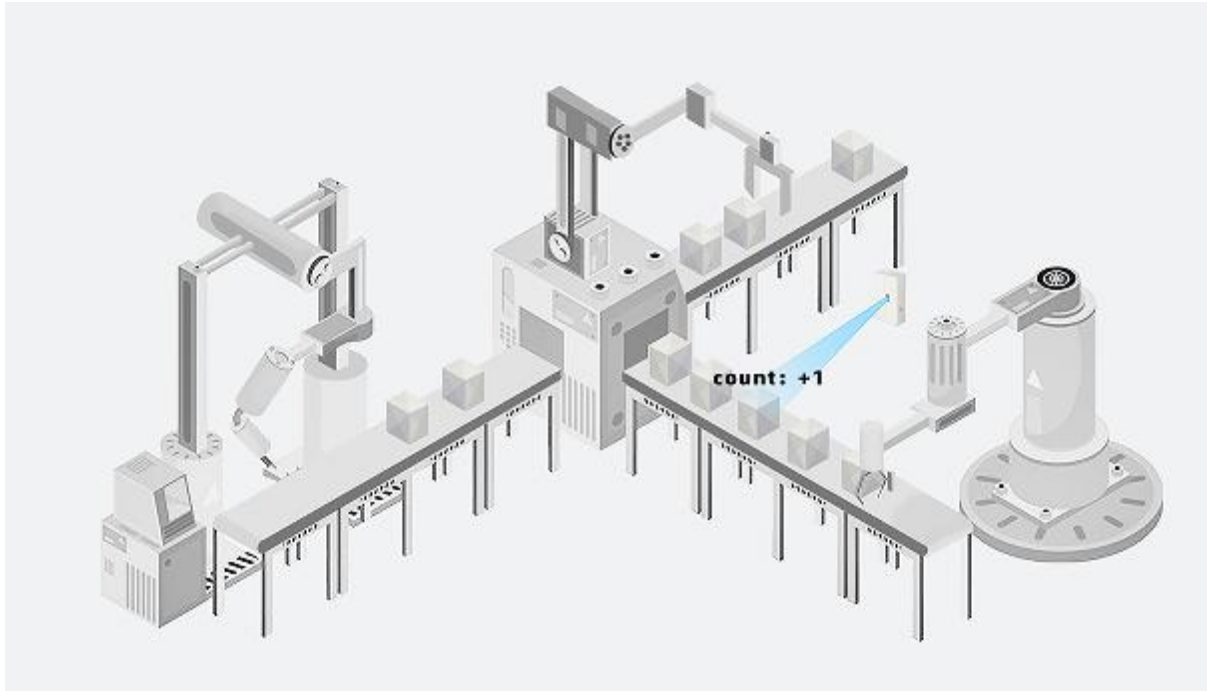
- Idle: 21 mA @ 3.3v
- Max : 360 mA

1.5 Use Case

Regular Distance Detect



Counting / Alarm



1.6 LiDAR probe position

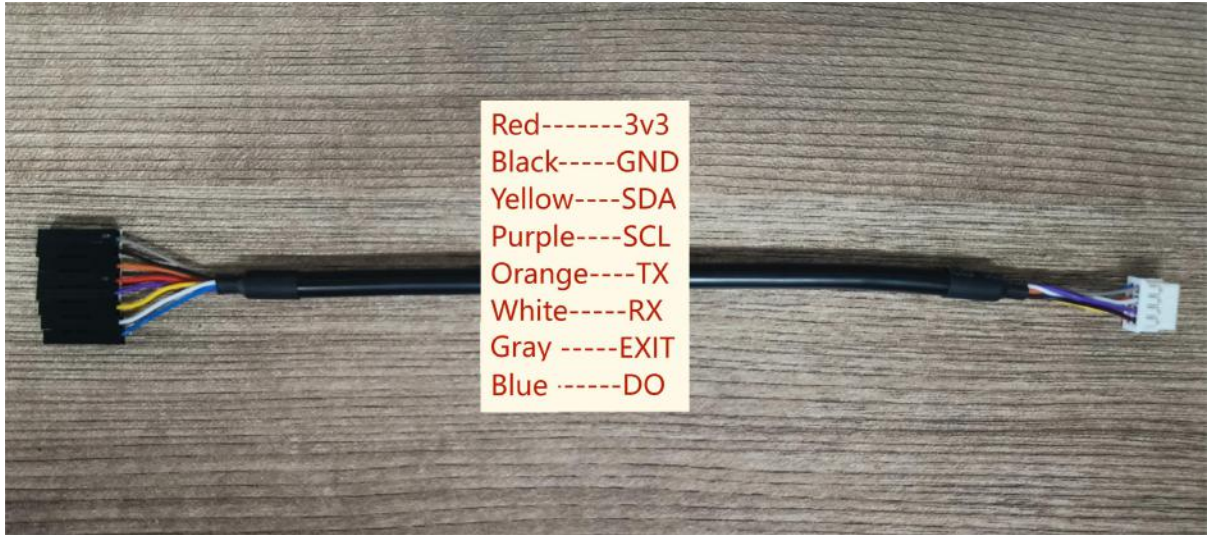


The black oval hole in the picture is the LiDAR probe.

1.7 Interface Definition



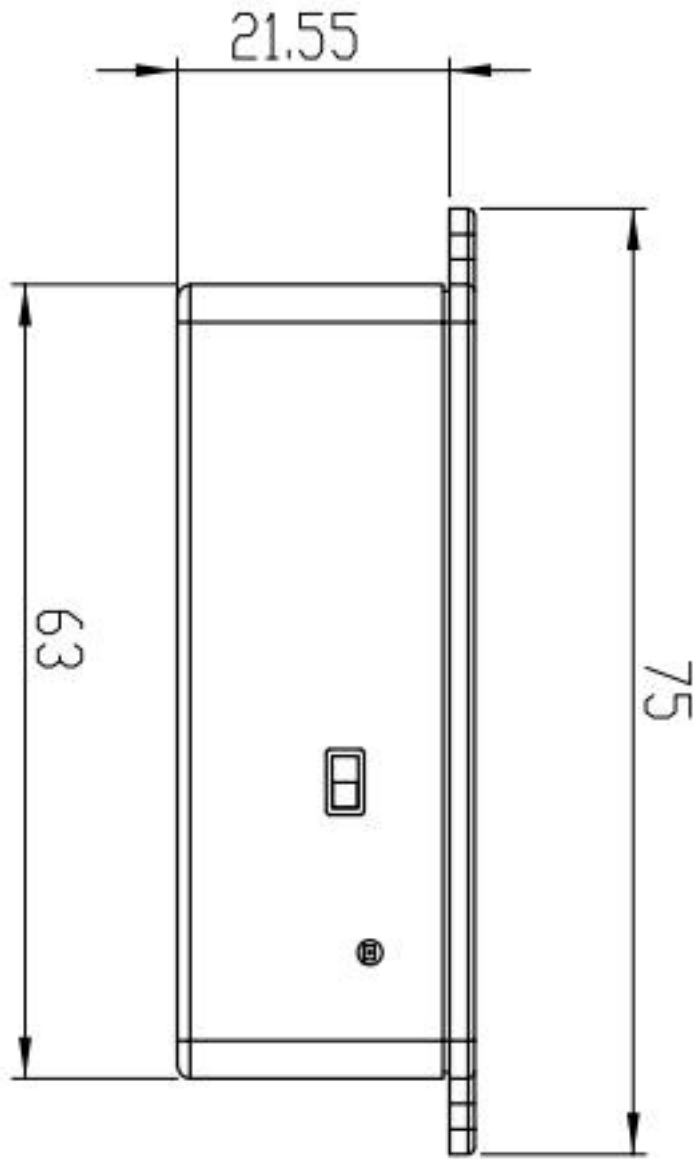
1.8 Program Cable Pin Mapping

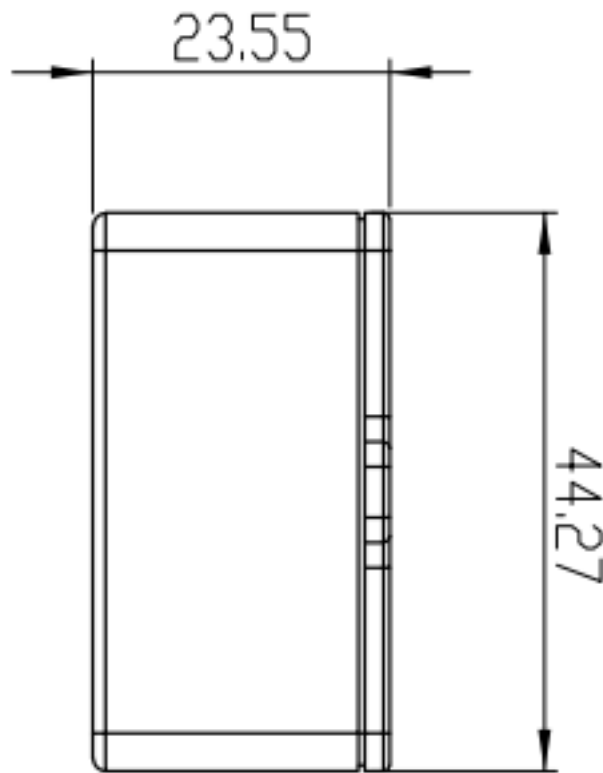


Usage For the Program Cable:

- 1) Configure DS20L via AT Command
- 2) Update Firmware
- 3) Input for external interrupt
- 4) Input for external power

1.9 Mechanical





2. Configure DS20L to connect to LoRaWAN network

2.1 How it works

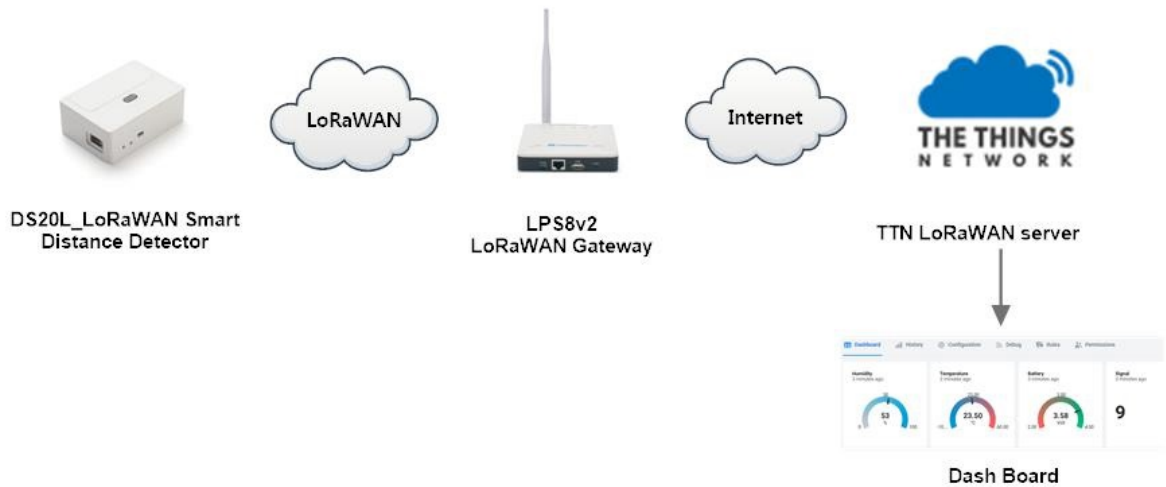
The DS20L is configured as **LoRaWAN OTAA Class A** mode by default. It has OTAA keys to join LoRaWAN network. To connect a local LoRaWAN network, you need to input the OTAA keys in the LoRaWAN IoT server and press the button to activate the DS20L. It will automatically join the network via OTAA and start to send the sensor value. The default uplink interval is 20 minutes.

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 [LPS8v2](#) as a LoRaWAN gateway in this example.

The LPS8v2 is already set to connected to [TTN network](#), so what we need to now is configure the TTN server.

DS20L in a LoRaWAN Network



Step 1: Create a device in TTN with the OTAA keys from DS20L.

Each DS20L 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 V3 screenshot:

[Register the device](#)

Register end device

Does your end device have a LoRaWAN® Device Identification QR Code? Scan it to speed up onboarding.

 Scan end device QR code

 [Device registration help](#)

End device type

Input method 

☐ Select the end device in the LoRaWAN Device Repository

1 ☒ Enter end device specifics manually

Frequency plan  *

2 Europe 863-870 MHz (SF12 for RX2)

Select the frequency corresponding to the node firmware

LoRaWAN version  *

3 LoRaWAN Specification 1.0.3

Regional Parameters version  *

RP001 Regional Parameters 1.0.3 revision A

[Show advanced activation, LoRaWAN class and cluster settings](#)

Provisioning information

JoinEUI  *

00 00 00 00 00 00 00 00

Confirm

input AppEUI(jionEUI),click "Confirm"

To continue, please enter the JoinEUI of the end device so we can determine onboarding options

Add DevEUI and AppKey

Provisioning information

JoinEUI ⓘ *

00 00 00 00 00 00 00 00

Reset

This end device can be registered on the network

DevEUI ⓘ *

00 00 00 00 00 00 00 00

Generate

5/50 used

AppKey ⓘ *

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Generate

End device ID ⓘ *

eui-0000000000000000

This value is automatically prefilled using the DevEUI

After registration

☒ View registered end device

☐ Register another end device of this type

Register end device

click

Step 2: Activate on DS20L



Press the button for 5 seconds to activate the DS20L.

The switch is switched to **E** and the external power supply is used.

The switch is switched to **I** and DS20L will be power by the built-in battery.

Green led will fast blink 5 times, device will enter **OTA mode** for 3 seconds. And then start to JOIN LoRaWAN network. **Green led** will solidly turn on for 5 seconds after joined in 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

2.3.1 Device Status, FPORT=5

Users can use the downlink command(**0x26 01**) to ask DS20L to send device configure detail, include device configure status. DS20L will uplink a payload via FPort=5 to server.

The Payload format is as below.

Size(bytes)	1	2	1	1	2
Value	Sensor Model	Firmware Version	Frequency Band	Sub-band	BAT

Sensor Model: For DS20L, this value is 0x21

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

Frequency Band:

0x01: EU868

0x02: US915

0x03: IN865

0x04: AU915

0x05: KZ865

0x06: RU864

0x07: AS923

0x08: AS923-1

0x09: AS923-2

0x0a: AS923-3

0x0b: CN470

0x0c: EU433

0x0d: KR920

0x0e: MA869

Sub-Band:

AU915 and US915:value 0x00 ~ 0x08

CN470: value 0x0B ~ 0x0C

Other Bands: Always 0x00

Battery Info:

Check the battery voltage.

Ex1: 0x0B45 = 2885mV

Ex2: 0x0B49 = 2889mV

2.3.2 Uplink Payload, FPORT=2

AT+MOD=1 (Case: Regular Report Distance)

Regularly detect distance and report. When the distance exceeds the limit, the alarm flag is set to 1, and the report can be triggered by external interrupts.

Uplink Payload totals 10 bytes.

Size(bytes)	2	1	2	1	4
Value	BAT	MOD+ Alarm+ Interrupt	Distance	Sensor State	Interrupt Count

MOD+ Alarm+ Interrupt:

Size(bit)	[bit7:bit6]	bit5	bit4
Value	MOD	Digital Interrupt	Distance Alarm 0: No Alarm; 1: Alarm

Battery Info:

Check the battery voltage for DS20L

Ex1: 0x0E10 = 3600mV

MOD & Alarm & Interrupt:

MOD:

Example: (0x60>>6) & 0x3f =1

0x01: Regularly detect distance and report.

0x02: Uninterrupted measurement with counting(external power supply).

0x03: Uninterrupted measurement with distance alarm(external power supply).

Alarm:

When the detection distance exceeds the limit, the alarm flag is set to 1.

Interrupt:

Whether it is an external interrupt.

Distance info:

Example:

If payload is: 0708H: distance = 0708H = 1800 mm

Sensor State:

Ex1: 0x00: Normal collection distance

Ex2: 0x0x: Distance collection is wrong

Ex3: 0xFF: No sensor connection was detected

Interrupt Count:

If payload is:000007D0H: count = 07D0H =2000

AT+MOD=2 (Continuously Measure with Counting)

The power consumption of uninterrupted measurement is high, and the device needs to use external power supply.(The switch is switched to E and the external power supply is used.)



Example: Measure with Counting

- Set the person or object count mode: AT+MOD=2,0,50,200

Continuous measurement and counting, detect and count passing people or objects in distance limit mode.

Uplink Payload totals 13 bytes.

Size(bytes)	2	1	4	4	2
Value	BAT	MOD+Collection mode	Counting	Pulse Time	Collection Threshold

MOD+Collection mode + Count flag:

Size(bit)	[bit7:bit6]	bit5
Value	MOD	Collection mode

BAT & MOD & Collection mode & Interrupt Flag & Counting & Pulse_time & Collection_threshold:

BAT:

The current total battery voltage of the node.

Example: 0x0c 36(hex) = 3126(DEC)/1000 = 3.126V

MOD:

Example: (0x80>>6) & 0x3f =2

0x01: Regularly detect distance and report.

0x02: Uninterrupted measurement with counting(external power supply).

0x03: Uninterrupted measurement with distance alarm(external power supply).

Collection mode:

Interrupt pin input level signal flag.

Example: (bytes[2] >> 7) & 0x01 = 1

0x00: Low level acquisition.

0x01: High level acquisition.

Counting:

The total count from startup to this moment.

Example:0x 00 00 10 10(HEX) = 4112(DEC)

Collection_threshold:

Within the set pulse detection time, collection starts when the object or person enters the set detection range.

Example: 0x00 32(hex) = 50(DEC)(unit: mm)

Note: The minimum threshold is 10 and the maximum is 2000.(Unit:mm)

Pulse_time:

Within the set pulse detection time, the object or person enters the detection range and starts collecting.

Example: 0x00 00 00 C8(hex) = 200(DEC)(unit: ms)

Note: This threshold is unlimited.

AT+MOD=3 (Continuously Measure with Distance detection + Alarm)(Since firmware v1.0.2)

The power consumption of uninterrupted measurement is high, and the device needs to use external power supply.
(The switch is switched to E and the external power supply is used.)



Example: Measure with Distance

- **Set the distance or object count mode: AT+MOD=3,0,50,200**

Continuous measurement and distance detection, Detect the distance of a person or object in distance limit mode and alarm out of limit.

Uplink Payload totals 6 bytes.

Size(bytes)	2	1	2	1
Value	BAT	MOD+Interrupt flag+alarm flag	distance_mm	distance state

MOD+Alarm flag+Interrupt flag:

Size(bit)	[bit7:bit6]	bit5	bit4
Value	MOD	Alarm flag	Interrupt flag

BAT & MOD & Interrupt flag & alarm flag & distance & distance state:

BAT:

The current total battery voltage of the node.

Example: $0x0c\ 36(\text{hex}) = 3126(\text{DEC})/1000 = 3.126\text{V}$

MOD:

Example: $(0xC0 \gg 6) \& 0x3f = 3$

0x01: Regularly detect distance and report.

0x02: Uninterrupted measurement counting(external power supply).

0x03: Uninterrupted measurement with distance alarm(external power supply).

Interrupt flag:

Example: $(0xC0 \gg 4) \& 0x01 = 0$

0x00: The pin is in a low state.

0x01: The pin is in a high state.

Alarm flag:

Example: $(0xC0 \gg 5) \& 0x01 = 0$

0x00: Not in alarm state.

0x01: In alarm state.

Distance info:

Example:

If payload is: 0708H: distance = 0708H = 1800 mm

Distance state:

Ex1: 0x00: Normal collection distance

Ex2 0x0x: Distance collection is wrong

2.4 Decode payload in The Things Network

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

User Manual for LoRaWAN /NB -IoT End Nodes - DS20L

-- LoRaWAN Smart Distance Detector User Manual

Overview Live data Messaging Location **Payload formatters** General settings

Uplink Downlink

Setup

Formatter type*
Custom Javascript formatter

Formatter code*

```
1 //The function is :  
2 function Decoder(bytes, port) {  
3 // Decode an uplink message from a buffer  
4 // (array) of bytes to an object of fields.  
5 var i;  
6 var batV=0; //Battery, units:V  
7 var mod = 0;  
8 var Firmware = 0; // Firmware version; 5 bits  
9 var sub_band;  
10 var freq_band;  
11 var sensor;  
12 var firm_ver;  
13 var distance;  
14 var distance_state;  
15 var interrupt_count;  
16 var interrupt;  
17 var alarm;  
18 var dout;  
19 var toilet_paper;  
20 var limit_flag;  
21 var upper_limit;  
22 var lower_limit;  
23 var limit_alarm_count;  
24  
25 if(port===0x02)
```

Add decoding here
(replace the platform original decode)

Paste application formatter

Save changes

Test

Byte payload
Decoded text
Complete

Learn more

The payload decoder function for TTN is here:

DS20L TTN Payload Decoder: <https://github.com/dragino/dragino-end-node-decoder>

2.5 Show Data in DataCake IoT Server

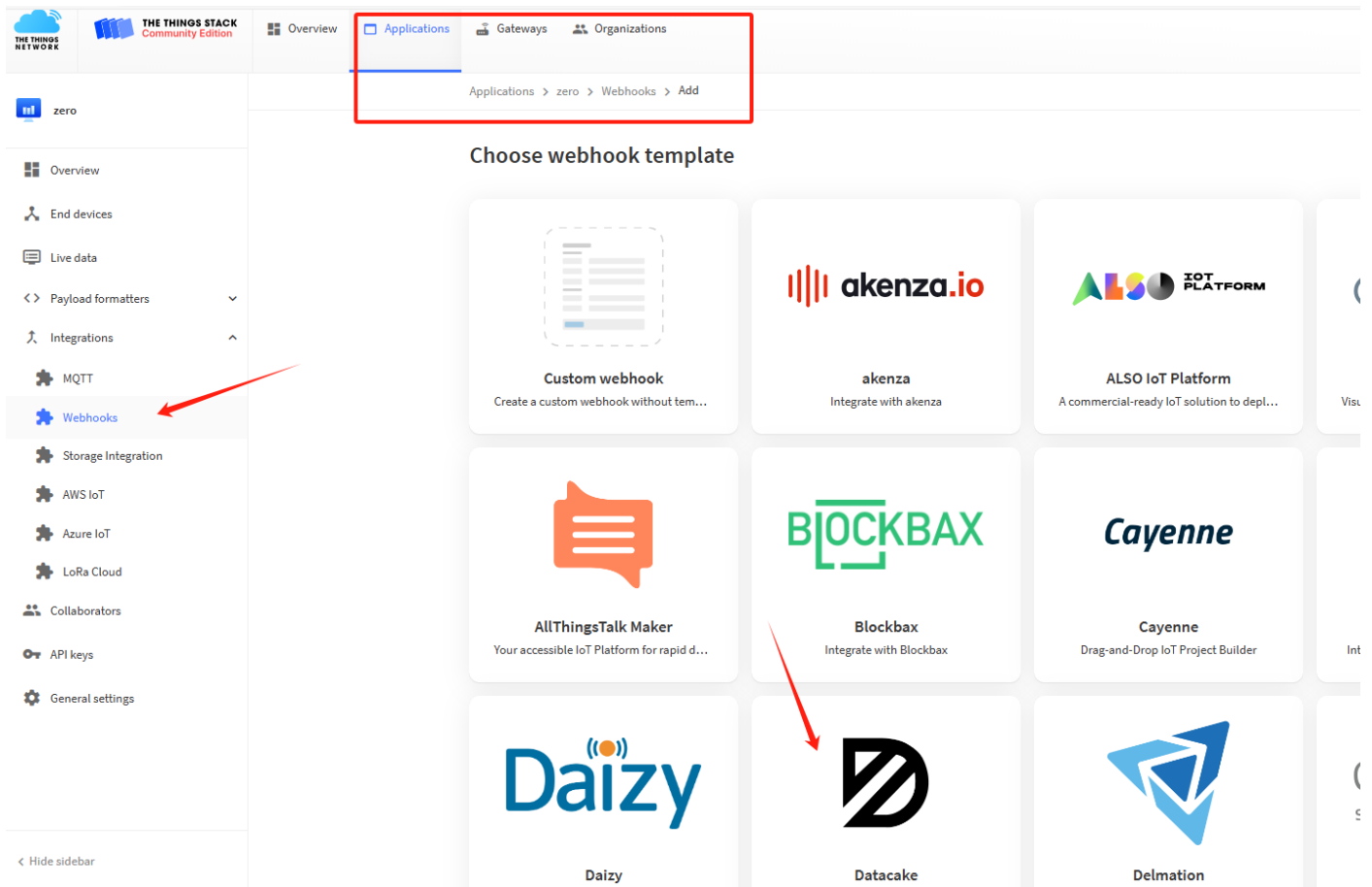
[DATACAKE](#) provides a human friendly interface to show the sensor data, once we have data in TTN, we can use [DATACAKE](#) to connect to TTN and see the data in DATACAKE. Below are the steps:

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:

User Manual for LoRaWAN /NB -IoT End Nodes - DS20L

-- LoRaWAN Smart Distance Detector User Manual



User Manual for LoRaWAN /NB -IoT End Nodes - DS20L
-- LoRaWAN Smart Distance Detector User Manual

Applications > zero > Webhooks > Add > Datacake



Setup webhook for Datacake

Send data to Datacake via TTI adapter

[About Datacake](#)  

[Register or Login](#)

click,can find detailed official instruction

Webhook ID *

Token *

Datacake API Token

Fill in the personal datacake account token

Create Datacake webhook [click](#)

For more detailed instructions, refer to the following instructions: [Welcome - Datacake Docs](#)

The screenshot shows the Datacake Docs website. On the left is a sidebar with a 'Welcome' section and a list of categories: DEVICE, DASHBOARDS, and PORTAL. The main content area has a 'Welcome' header, a 'Get Started with Datacake' section with a bullet point about guides, a 'LoRaWAN Integrations' section with a note about LNS, and a 'The Things Network' section. The 'The Things Network' section contains a bullet point about bringing LoRaWAN devices from The Things Stack v3 to Datacake. Below this, a document icon is next to the text 'The Things Stack (TTN / TTI) Manual Setup'. A red arrow points from the word 'click' to this document icon. The entire 'The Things Network' section is enclosed in a red rectangular box.

Welcome

Welcome to our official Datacake Documentation

Get Started with Datacake

- The following guides will help you to get started with Datacake

Needing some help? You can check out our [support options](#) or join our [Discord community](#) for personalised assistance.

LoRaWAN Integrations

Datacake features all major LNS. Additional can be connected via webhook integration.

The Things Network

- Bring your LoRaWAN Devices from The Things Stack v3 (both Community or Professional Editions) to Datacake.

The Things Stack (TTN / TTI) Manual Setup [click](#)

Step 3: Create an account or log in Datacake.

Step 4: Search the DS20L and add DevEUI.

Add LoRaWAN Device

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

Device Template

Datacake supports LoRaWAN devices from different manufacturers out of the box without complex configuration and setup.

DS2

All Manufacturers

Dragino LDDS20 Liquid level sensor

Dragino

Liquid level sensor

Dragino LMDS200 Distance Sensor

Dragino

Dragino Microwave Distance Sensor

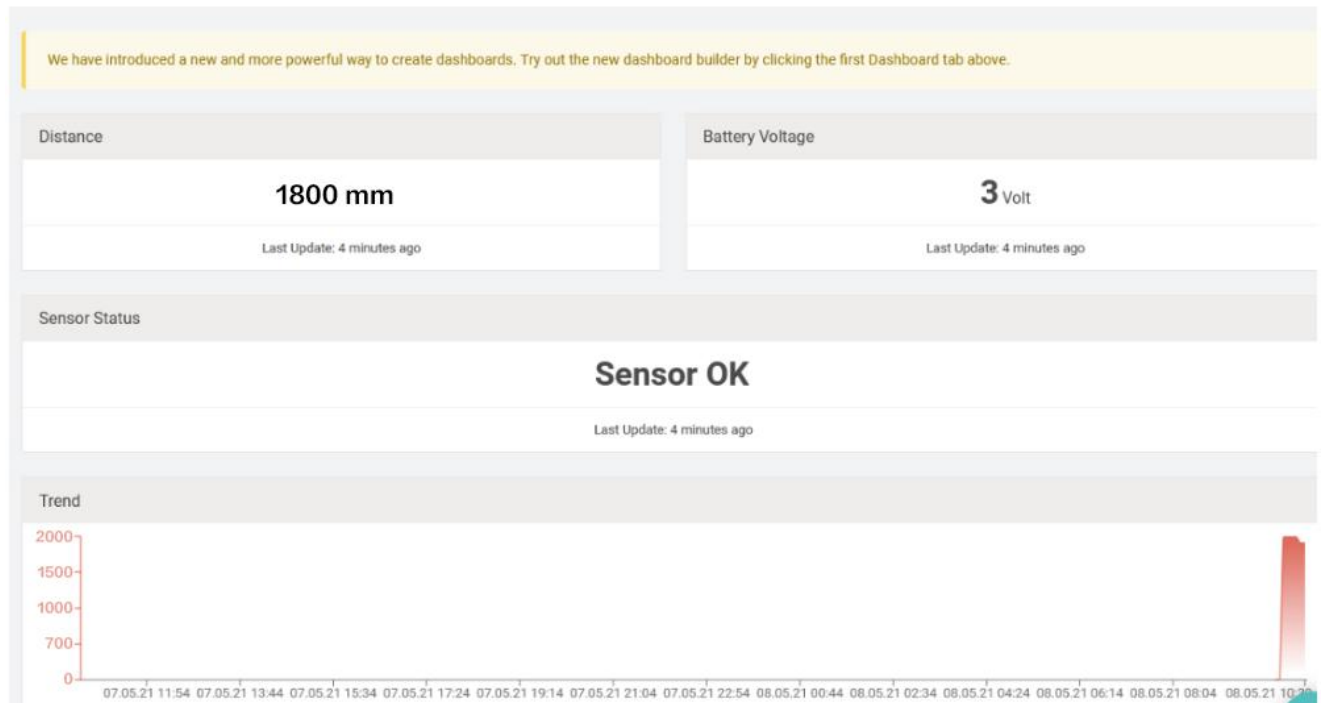
DRAGINO

DRAGINO

Back

Next

After added, the sensor data arrive TTN V3, it will also arrive and show in Datacake.



2.6 Frequency Plans

The DS20L uses OTAA mode and below frequency plans by default. Each frequency band use different firmware, user update the firmware to the corresponding band for their country.

<http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20Frequency%20Band/>

3. Configure DS20L

3.1 Configure Methods

DS20L supports below configure method:

- AT Command via UART Connection : See [UART Connection](#).
- LoRaWAN Downlink. Instruction for different platforms: See [IoT LoRaWAN Server](#) section.

3.2 General Commands

These commands are to configure:

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

They are same for all Dragino Devices which support DLWS-005 LoRaWAN Stack. These commands can be found on the wiki:

[End Device AT Commands and Downlink Command](#)

3.3 Commands special design for DS20L

These commands only valid for DS20L, as below:

3.3.1 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

3.3.2 Set Interrupt Mode

Feature, Set Interrupt mode for pin of GPIO_EXTI.

When AT+INTMOD=0 is set, GPIO_EXTI is used as a digital input port.

AT Command: AT+INTMOD

Command Example	Function	Response
AT+INTMOD=?	Show current interrupt mode	0 OK The mode is 0 =Disable Interrupt
AT+INTMOD=3 (default)	Set Transmit Interval 0. (Disable Interrupt), 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

Note:

1. This interrupt only takes effect in mode 1.

2. If set INTMOD=1, the interrupt mode will not work properly because the rising edge and falling edge cannot exist at the same time, which will affect the low power consumption of the motherboard and increase battery consumption.

3.3.3 Set work mode

Feature: Switch working mode(**Note: After the modified mode is issued, the node will automatically reset and restart**)

AT Command: AT+MOD (1: Regular Measurement , 2: Continuous Measuring & Counting, 3: Continuous Measuring & Distance Alarm)

Command Example	Function	Response
AT+MOD=?	Get the current working mode.	OK
AT+MOD=1	Set the working mode to Regular measurements.	OK Attention: Take effect after ATZ
AT+MOD=2,0,50,200	Set the working mode to Continuous measurement with counting.	OK Attention: Take effect after ATZ
AT+MOD=3,0,1800,200	Set the working mode to Continuous measurement with distance alarm.	OK Attention: Take effect after ATZ

Explanation of MOD=2

Command Example	Parameters	Explanation
AT+MOD=2,aa,bb,cc	2: Set MOD=2	Continuous Measuring & Counting
	AA: Counting Condition	0: Count while detect value Smaller than Distance Settings(Parameters BB) 1: Count while detect value Bigger than Distance Settings(Parameters BB)
	BB: Distance setting	10mm~2000mm
	CC: Min Counting Time	The object is detected within the set distance for CC time, count +1 (unit :ms) (Unit: ms)
Example: AT+MOD=2,1,50,200		
DS20L adopts uninterrupted measurement + counting mode.		
Within a distance of 50 to 2000mm(bigger than 50mm), when DS20L detects an object for 200ms, count +1.		

Downlink Command:

Format: Command Code (0x0A) followed by 6 bytes.

- **Example:** 0A 01 // Same as AT+MOD=1
- **Example:** 0A 02 00 00 32 00 00 00 C8 // Same as AT+MOD=2,0,50,200

Explanation of MOD=3

Command Example	Parameters	Explanation
AT+MOD=3,aa,bb,cc	3: Set MOD=3	Continuous measurement with distance alarm
	AA: Distance Alarm Condition	0: Distance alarm while detect value Smaller than Distance Settings(Parameters BB)

Example: AT+MOD=3,0,50,200

DS20L adopts uninterrupted measurement + distance alarm mode.
When the distance is detected to be less than 50mm for 200ms, node alarm.

1: Distance alarm while detect value **Bigger** than Distance Settings(Parameters **BB**)
10mm~2000mm
When continuous **CC** time detects the distance exceeds the set range, alarm (Unit: ms)

BB: Distance Setting
CC: Min Alarm Time

Downlink Command:

Format: Command Code (0x0A) followed by 6 bytes.

- **Example:** 0A 01 // Same as AT+MOD=1
- **Example:** 0A 03 00 00 32 00 00 00 C8 // Same as AT+MOD=2,0,50,200

3.3.4 Set threshold and threshold mode(Valid only if AT+MOD=1)

Feature, Set threshold and threshold mode

When **AT+DOL=0,0,0,0,400** is set, No threshold is used, the sampling time is 400ms.

AT Command: AT+DOL

Command Example	Function	Response
AT+ DOL = ?	Get the current threshold mode and sampling time	0,0,0,0,400 OK
AT+ DOL =1,1800,100,0,400	Set the distance limit range of 100~1800mm, detect once every 400ms, over-limit alarm.	OK

Command Example	Function	Parameter
AT+DOL=1,1800,3,0,400	The first bit sets the limit mode	0: Do not use upper and lower limits 1: Use upper and lower limits 2: Less than the upper limit 3: Greater than the lower limit
	The second bit sets the upper limit value	3~2000MM
	The third bit sets the lower limit value	3~2000MM
	The fourth bit sets the over-limit alarm or person or object count.	0: Over-limit alarm, DO output is high 1: Person or object counting statistics
	The fifth bit sets the sampling time	100~10000ms

Downlink Command: 0x07

Format: Command Code (0x07) followed by 9 bytes.

If the downlink payload=**07 01 0708 0064 00 0190**, it means set the END Node's limit mode to 0x01,upper limit value to 0x0708=1800(mm), lower limit value to 0x0064=100(mm), to over-limit alarm(0x00), the sampling time to 0x0190=400(ms), while type code is 0x07.

- Example 0: Downlink Payload: 07 00 0000 0000 00 0190 ---> AT+DOL=0,0,0,0,400 // No threshold is used, the sampling time is 400ms
- Example 1: Downlink Payload: 07 01 0708 0064 00 0190 ---> AT+DOL=1,1800,100,0,400 //MOD1 uses distance alarm mode, when the TDC time arrives, the node sampling time is 400ms. When the node detects that the distance is lower than 100mm or higher than 1800mm, it sends an alarm packet. The alarm flag is 1. Otherwise, the node normally uplink and the alarm flag is 0.

Note: AT+DOL command is applied to MOD1.

For example:

- AT+MOD=1

AT+DOL=1,500,244,0,300

4. Case Study

4.1 Detect the level for rubbish bin

4.1.1 Case Description

DS20L's ToF FoV angle: $\pm 9^\circ$, total 18° , very suitable for object height acquisition. This case describes how to set up DS20L to calculate the amount of garbage in the trash can.

As shown in the figure below, DS20L detects the distance regularly. When the garbage in a trash can reaches the set capacity, it will issue a warning and regularly report the status of the trash can at that time.

Note: This mode uses scheduled collection, has very low power consumption and is powered





4.1.2 Software Configuration

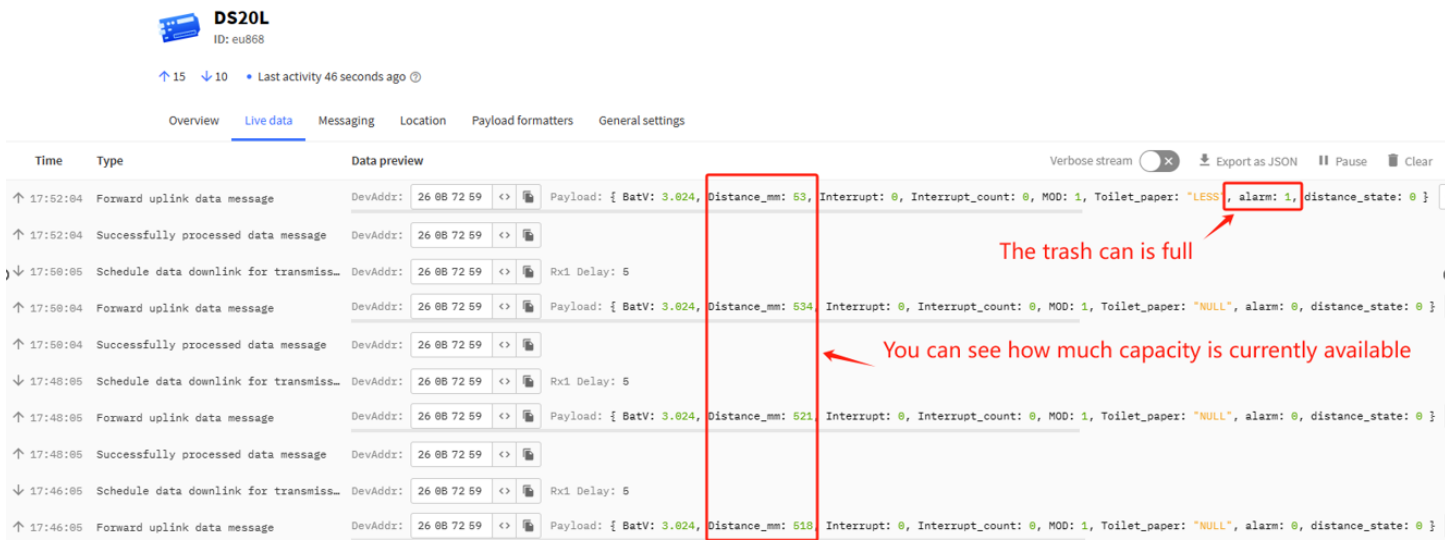
- Open the serial port assistant tool, enter the key, and set **AT+MOD=1** and **AT+DOL=2,200,10,400**
- or send downlink command **0A 01** and **07 02 00 C8 00 0A 01 90**

Every 20 minutes, DS20L will check rubbish level of the trash can. If it exceeds the set threshold, it will alarm.

Detail explain for this command please see [Working Mode](#) .

Notice: To save battery life, user can ignore the alarm setting (AT+DOL).

4.1.3 Test Result



DS20L
ID: eu868

↑ 15 ↓ 10 • Last activity 46 seconds ago ©

Overview **Live data** Messaging Location Payload formatters General settings

Time	Type	Data preview
↑ 17:52:04	Forward uplink data message	DevAddr: 26 08 72 59 <> Payload: { BatV: 3.024, Distance_mm: 53, Interrupt: 0, Interrupt_count: 0, MOD: 1, Toilet_paper: "LESS", alarm: 1, distance_state: 0 }
↑ 17:52:04	Successfully processed data message	DevAddr: 26 08 72 59 <>
↓ 17:58:05	Schedule data downlink for transmiss...	DevAddr: 26 08 72 59 <> Rx1 Delay: 5
↑ 17:58:04	Forward uplink data message	DevAddr: 26 08 72 59 <> Payload: { BatV: 3.024, Distance_mm: 534, Interrupt: 0, Interrupt_count: 0, MOD: 1, Toilet_paper: "NULL", alarm: 0, distance_state: 0 }
↑ 17:58:04	Successfully processed data message	DevAddr: 26 08 72 59 <>
↓ 17:48:05	Schedule data downlink for transmiss...	DevAddr: 26 08 72 59 <> Rx1 Delay: 5
↑ 17:48:05	Forward uplink data message	DevAddr: 26 08 72 59 <> Payload: { BatV: 3.024, Distance_mm: 521, Interrupt: 0, Interrupt_count: 0, MOD: 1, Toilet_paper: "NULL", alarm: 0, distance_state: 0 }
↑ 17:48:05	Successfully processed data message	DevAddr: 26 08 72 59 <>
↓ 17:46:05	Schedule data downlink for transmiss...	DevAddr: 26 08 72 59 <> Rx1 Delay: 5
↑ 17:46:05	Forward uplink data message	DevAddr: 26 08 72 59 <> Payload: { BatV: 3.024, Distance_mm: 518, Interrupt: 0, Interrupt_count: 0, MOD: 1, Toilet_paper: "NULL", alarm: 0, distance_state: 0 }

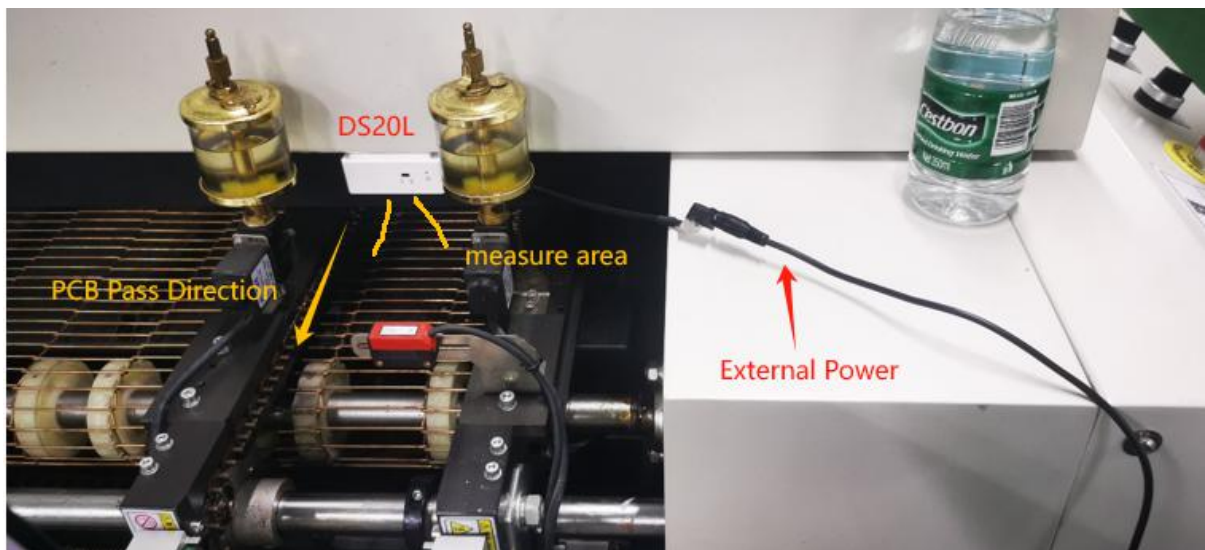
4.2 Uses DS20L to Count object pass in the machine

4.2.1 Case Decription

DS20L has angle of ToF FoV: $\pm 9^\circ$, Total 18° , which is good to use it for object counting. This case descript how to set up DS20L to count how many PCBA pass in the SMT machine.

As show below, DS20L keep checking the detect distance, when there is a PCB pass the rail, the distance shown in DS20L will become a small value and DS20L will count PCB +1.

Notice: To continously count object, user need to use external power source to power DS20L, Use battery is not enough



4.2.2 Software Configuration

- Open the serial port assistant tool, enter the key, and set **AT+MOD=2,0,50,200**
- or send downlink command **0A 02 00 00 32 00 00 00 CB**

This command will continue to read distance, if distance read below 5cm and last for more than 200ms. Counting + 1.

Detail explain for this command please see [Working Mode](#) .

4.2.3 Test Result

DS20L
ID: eu868

↑ 1 ↓ n/a • Last activity 17 minutes ago ②

Overview **Live data** Messaging Location Payload formatters General settings

Time Type Data preview Verbose stream Export as JSON Pause Clear

15:41:59 Console: Stream connection clo... The connection was closed

15:38:51 Console: Stream reconnected The stream connection has been re-established

↑ 15:29:29 Forward uplink data message DevAddr: 26 08 17 37 Payload: { BatV: 2.892, MOD: 2, collection_threshold: 70, count: 39, count_method: null, pulse_time: 7344 }

↑ 15:29:29 Successfully processed data me... DevAddr: 26 08 17 37

15:16:29 Console: Stream connection clo... The connection was closed

↓ 15:09:31 Schedule data downlink for tra... DevAddr: 26 08 17 37 Rx1 Delay: 5

↑ 15:09:30 Forward uplink data message DevAddr: 26 08 17 37 Payload: { BatV: 2.976, MOD: 2, collection_threshold: 70, count: 0, count_method: null, pulse_time: 7344 }

↑ 15:09:30 Successfully processed data me... DevAddr: 26 08 17 37

↑ 15:09:24 Forward join-accept message DevAddr: 26 08 17 37

↑ 15:09:23 Successfully processed join-re... DevAddr: 26 08 C9 E8

15:09:22 Accept join-request DevAddr: 26 08 17 37

DS20L detect 39 PCB pass in 20 minutes.

4.3 Distance Alarm

4.3.1 Case description

DS20L's ToF FoV angle: $\pm 9^\circ$, total 18° , very suitable for object distance detection. This case describes how to set up DS20L to determine whether people enter prohibited areas.

As shown in the figure below, DS20L continuously checks the detection distance. When someone breaks into a prohibited area, the detection distance of DS20L becomes a small value and sends an Alarm.

Notice: To continuously count object, user need to use external power source to power DS20L, Use battery is not enough.



4.3.2 Software configuration

Open the serial port assistant tool, enter the key, and set AT+MOD=3,0,1800,200

Or send downlink command 0A 03 00 07 08 00 00 00 CB

This command will continue to read the distance, if the reading distance is below 1800 cm and lasts longer than 200 ms. Then DS20L will send an Alarm.

Detail explain for this command please see [Working Mode](#) .

4.3.3 Test Result

DS20L
ID: eu868

↑ 1 ↓ 1 • Last activity just now ⓘ

Overview Live data Messaging Location Payload formatters General settings

Time	Type	Data preview
15:31:56	Schedule data downlink for transmiss...	DevAddr: 26 08 75 CE <> Rx1 Delay: 5
15:31:56	Forward uplink data message	DevAddr: 26 08 75 CE <> Payload: { BatV: 3.648, Distance_mm: 480, Interrupt: 0, MOD: 3, alarm: 1, distance_state: 0 } 08 E8 E0 01 90 00 <> FPort: 2 Data rat...
15:31:56	Successfully processed data message	DevAddr: 26 08 75 CE <>
15:31:58	Schedule data downlink for transmiss...	DevAddr: 26 08 75 CE <> Rx1 Delay: 5
15:31:37	Forward uplink data message	DevAddr: 26 08 75 CE <> Payload: { BatV: 3.132, Distance_mm: 0, Interrupt: 0, MOD: 3, alarm: 0, distance_state: 0 } 0C 3C C0 00 00 00 <> FPort: 2 Data rat...
15:31:37	Successfully processed data message	DevAddr: 26 08 75 CE <>

5. Battery & Power Consumption

DS20L use built-in 2400mAh non-chargeable battery for long-term use up to several years*. See below link for detail information about the battery info and how to replace.

[Battery Info & Power Consumption Analyze](#) .

6. Firmware update

User can change firmware DS20L to:

- Change Frequency band/ region.
- Update with new features.
- Fix bugs.

Firmware and changelog can be downloaded from : [Firmware download link](#)

Methods to Update Firmware:

- (Recommended way) OTA firmware update via wireless: <http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20OTA%20Update%20for%20Sensors/>
- Update through UART TTL interface: [Instruction](#).

7. FAQ

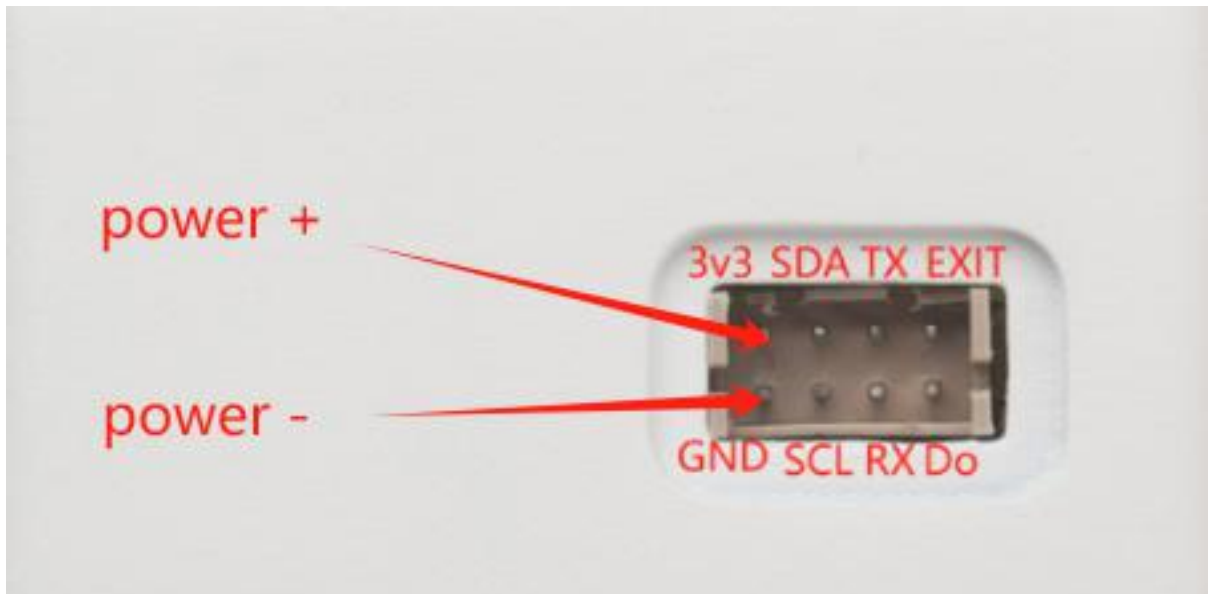
7.1 What is the frequency plan for DS20L?

DS20L use the same frequency as other Dragino products. User can see the detail from this link: [Introduction](#)

7.2 How to connect external power supply to DS20L?

Use the positive pole of the regulated power supply to connect the 3.3v pin of the interface;

Use the negative pole of the regulated power supply to connect the GND pin of the interface.



When using external power supply, the gear position is in E position(

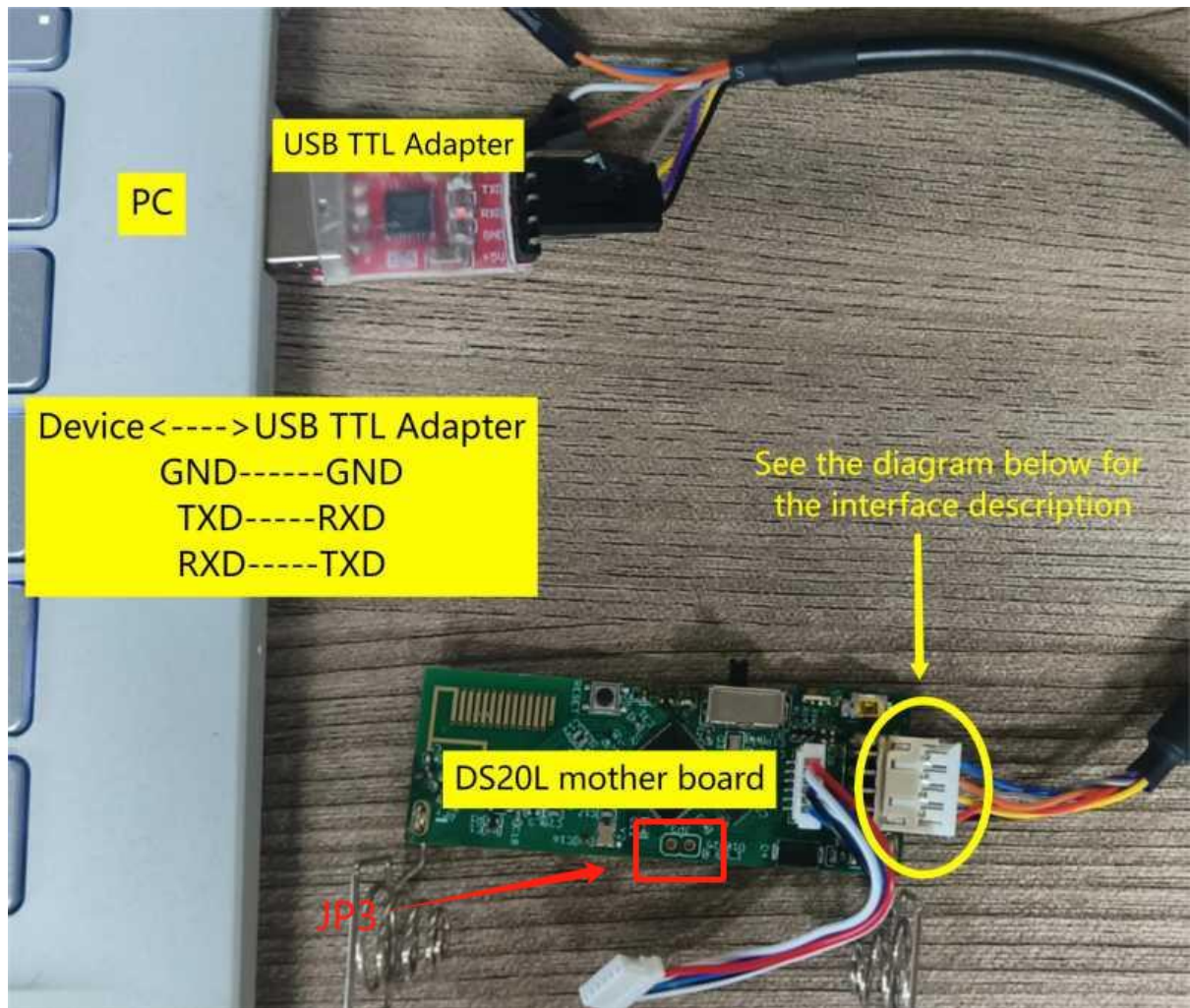


7.3 Why cannot Mode be modified?

If mode cannot be modified, upgrade the firmware version to v1.0.2 or later.

7.4 Why is there no response to burning firmware through TremoProgrammer?

If we use the TremoProgrammer (green arrow icon) to update the firmware, we need to keep the two pins of JP3 connected while burning.



The shipping node has boot program, it is recommended to directly use Dragino Sensor Manager Utility.exe for firmware burning.

Refer to the link: [UART Access for LoRa ST v4 base model - DRAGINO](#)

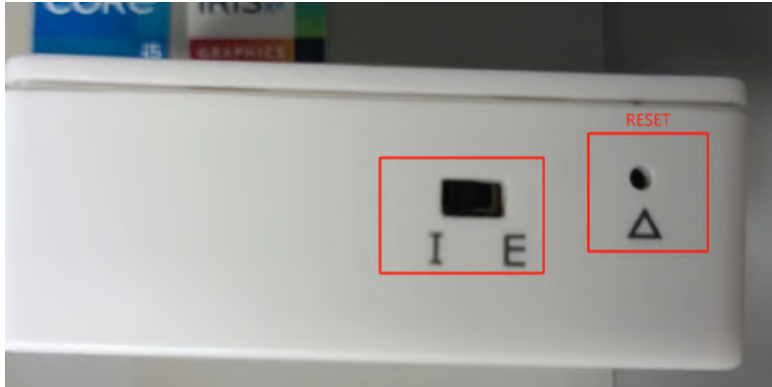
7.5 How to check the problem when the sensor status is 0xFF (255) ?

The sensor state 0xFF(H)=255(D) indicates that the node has not detected the sensor connection and needs to check whether the sensor is properly connected and can work properly.

First, we need to see if the sensors work properly when the node is active.

1. Reactivate the node

- Battery powered, reactivate the node (three options) :
 - a. Reinstall the battery
 - b. Switch the side power mode switch to E (external power) and back to I (battery power)
 - c. Click the RESET button



- External power, reactivate the node(three options):
 - a. Turn off the external power supply and turn it on again
 - b. Switch the side power mode switch to I (battery power) and back to E (external power)
 - c. Click the RESET button

2. Check the sensor probe with our phone's camera

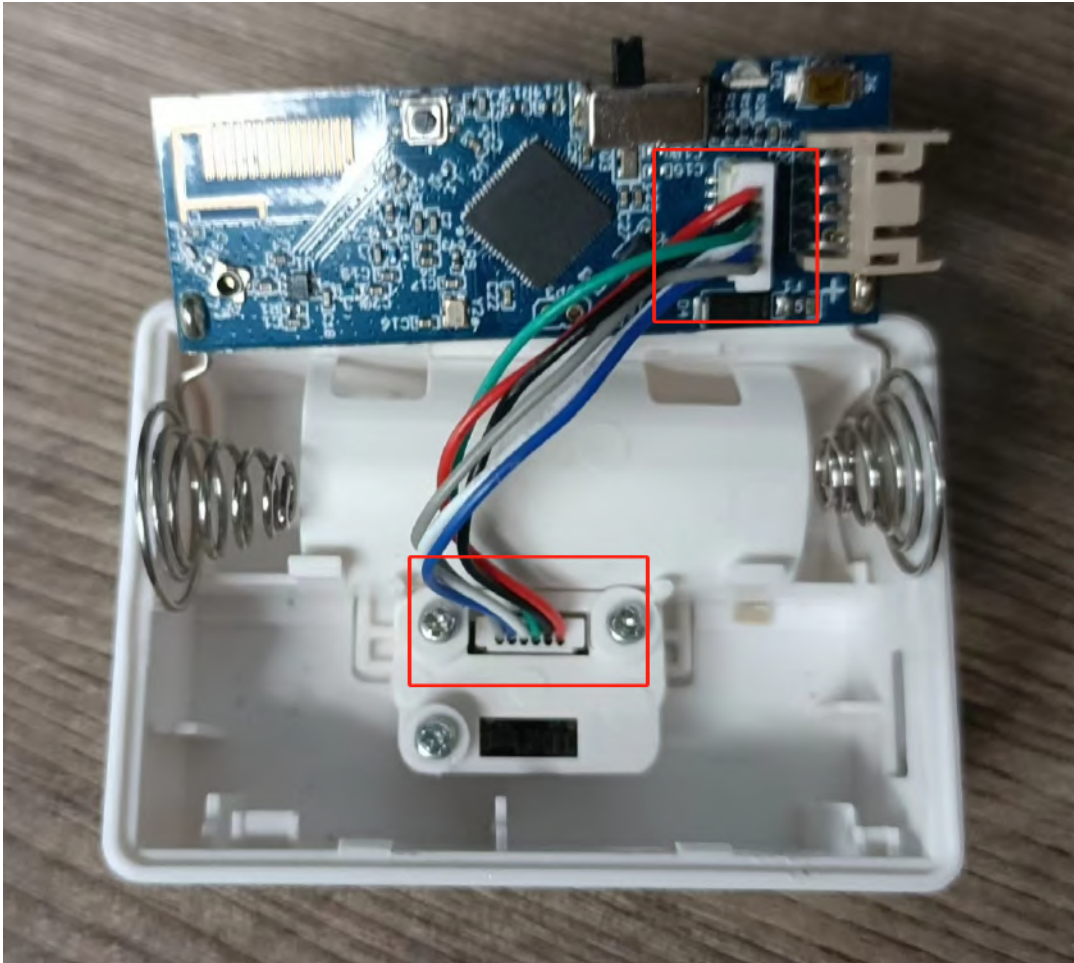
- After reactivating the node, quickly use the phone camera to take a picture of the sensor probe, if we can observe bright spots, it means that the sensor is working. Then it is recommended to re-download the latest firmware to solve the problem that the sensor does not recognize.



- If no bright spots are observed (a short time after the node is activated), then we need to open the node housing and check that the sensor wiring is secure.

3. Checking Sensor cables

Check the sensor cables and secure them.



If after stable wiring, repeat the above operations still can not observe the bright spot, the sensor is broken, please contact your purchase channel to communicate return and exchange matters.

8. Trouble Shooting

8.1 AT Command input doesn't work

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

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: **DS20L-XXX**

XXX: 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:

- DS20L LoRaWAN Smart Distance Detector 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 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.cc.

FCC Caution:

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and , if not installed and used in accordance with the Instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.