DS20L -- LoRaWAN Smart Distance Detector User Manual

Last modified by kai (/xwiki/bin/view/XWiki/kai) on 2024/03/11 16:10

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1. Introduction

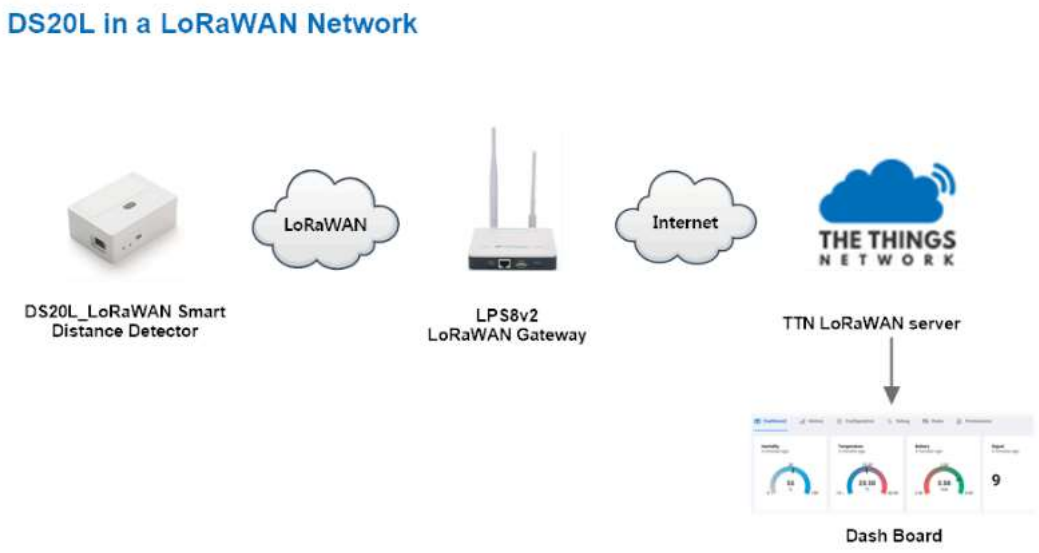
1.1 What is LoRaWAN Smart Distance Detector

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 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 imm 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 **continu 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.



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: ±2cm @ (3cm~100cm); ±5% @ (100~200cm)
- ToF FoV: ±9°, Total 18°
- Light source: VCSEL

1.4 Power Consumption

Battery Power Mode:

- Idle: 0.003 mA @ 3.3v

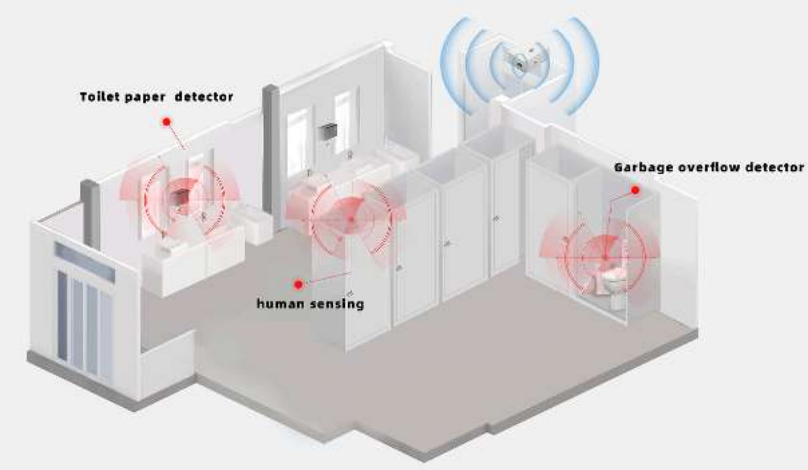
- Max : 360 mA

Continuously mode:

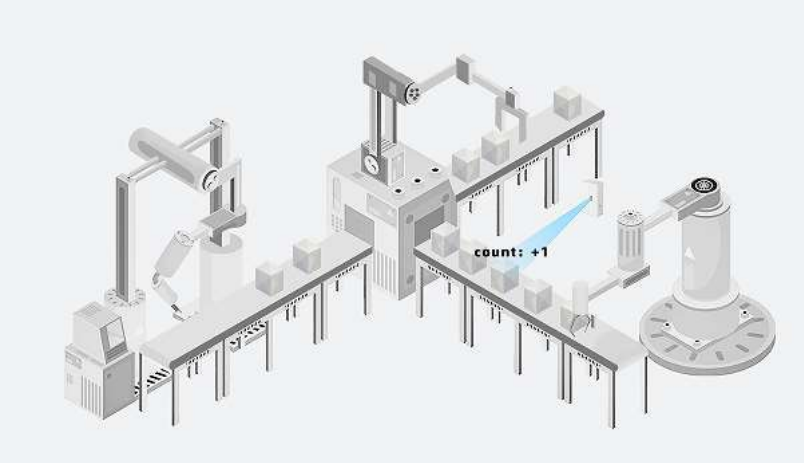
- Idle: 21 mA @ 3.3v
- Max : 360 mA

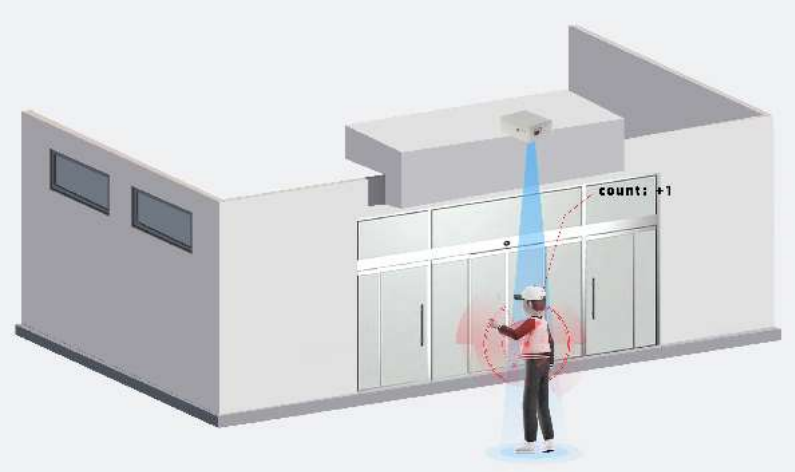
1.5 Use Case

Regular Distance Detect



Counting / Alarm





2. Configure DS20L to connect to LoRaWAN network

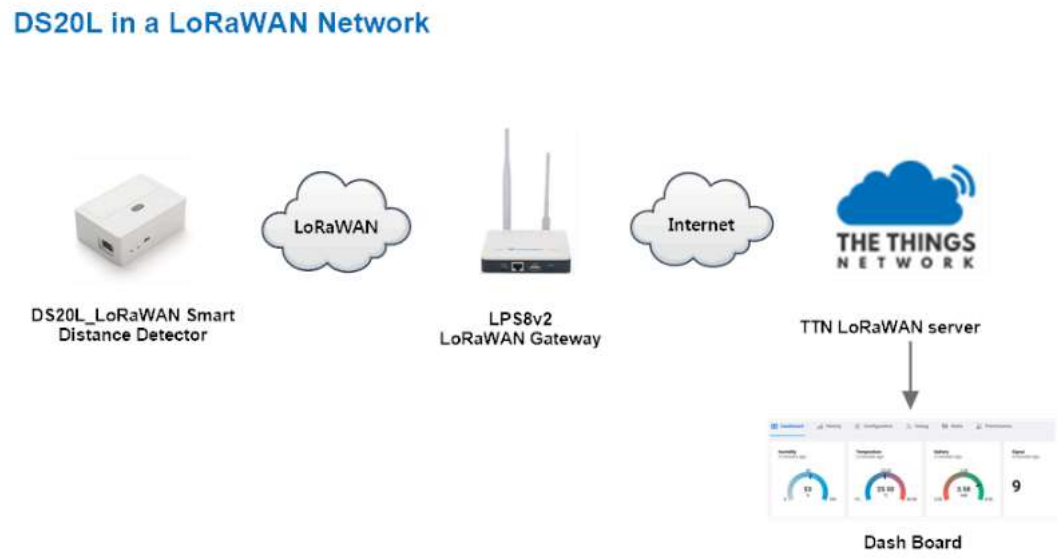
2.1 How it works

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 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 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 (https://console.cloud.thethings.network/) . Below is the network structure; we use the LPS8v2 (https://www.dragino.com/products/lora-lorawan-gateway/item/228-lps8v2.html) as a LoRaWAN gateway in this example.

The LPS8v2 is already set to connected to TTN network (https://console.cloud.thethings.network/) , so what we need to now is configure the TTN server.

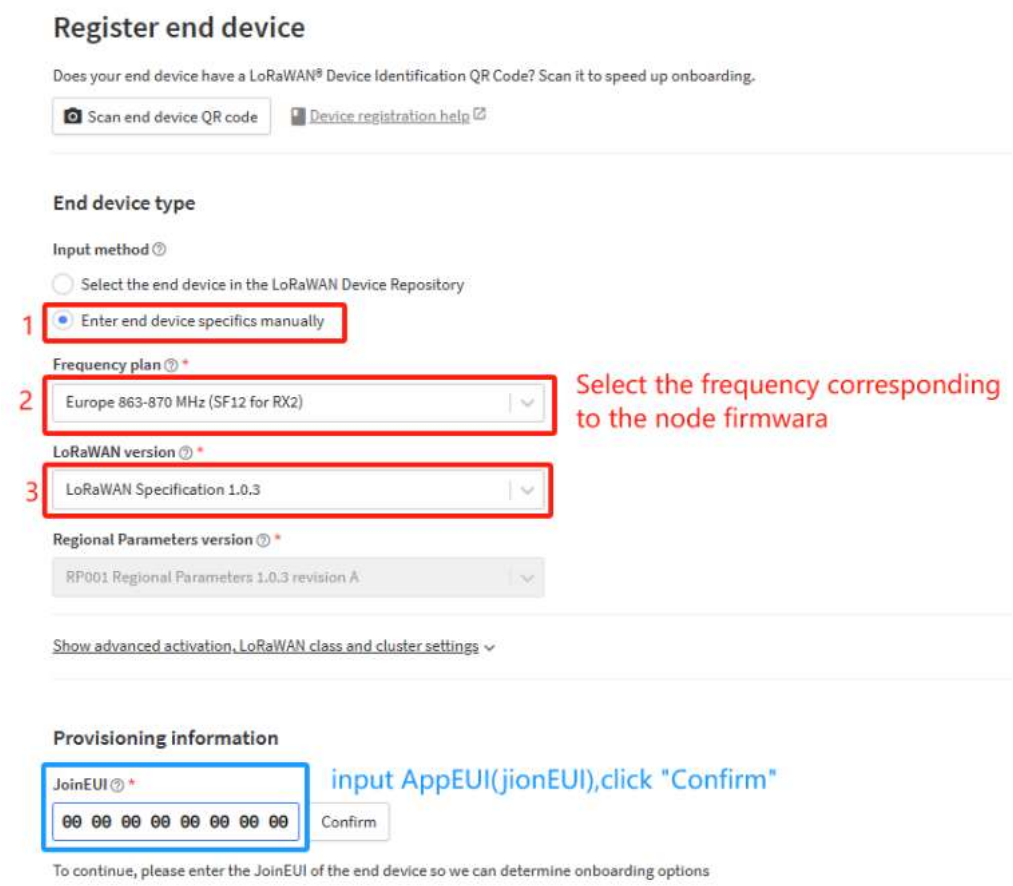


Step 1: Create a device in TTN with the OTAA keys from DS20L.

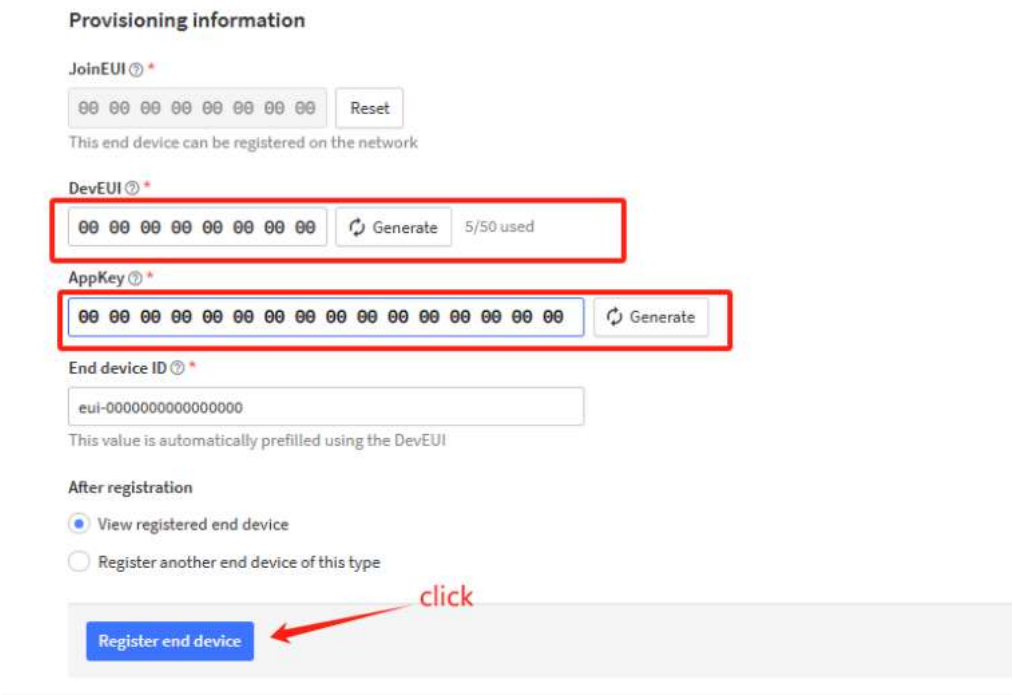
Each DS20L is shipped with a sticker with the default device EUI as below:

You can enter this key in the LoRaWAN Server portal. Below is TTN V3 screenshot:

Register the device



Add DevEUI and AppKey



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 jo 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

The Payload format is as below.

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

Example parse in TTNv3

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

Example parse in TTNv3

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 (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

Interript Count:

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

AT+MOD=2 (Continuously Measure with Counting and Alarm)

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 su 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 11 bytes.

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

MOD+Collection mode + Count flag:

Size(bit)	**[bit7:bit6]**	**bit5**	bit4
Value	MOD	Collection mode	Interrupt flag

Example parse in TTNv3

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

Interrupt level signal flag:

Interrupt pin input level signal.

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

0x00: Low level acquisition.

0x01: High level acquisition.

MOD:

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

0x01: Regularly detect distance and report.
0x02: Uninterrupted measurement (external power supply).

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:

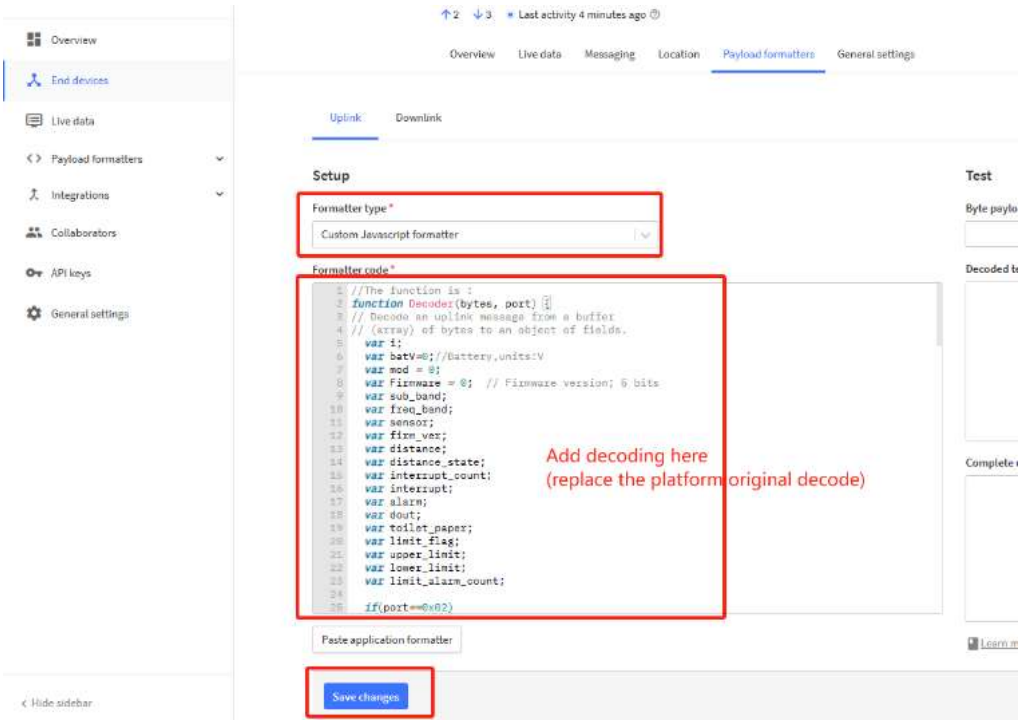
Within the set pulse detection time, the object or person enters the detection range and starts collecting.

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

Note: This threshold is unlimited.

2.4 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:

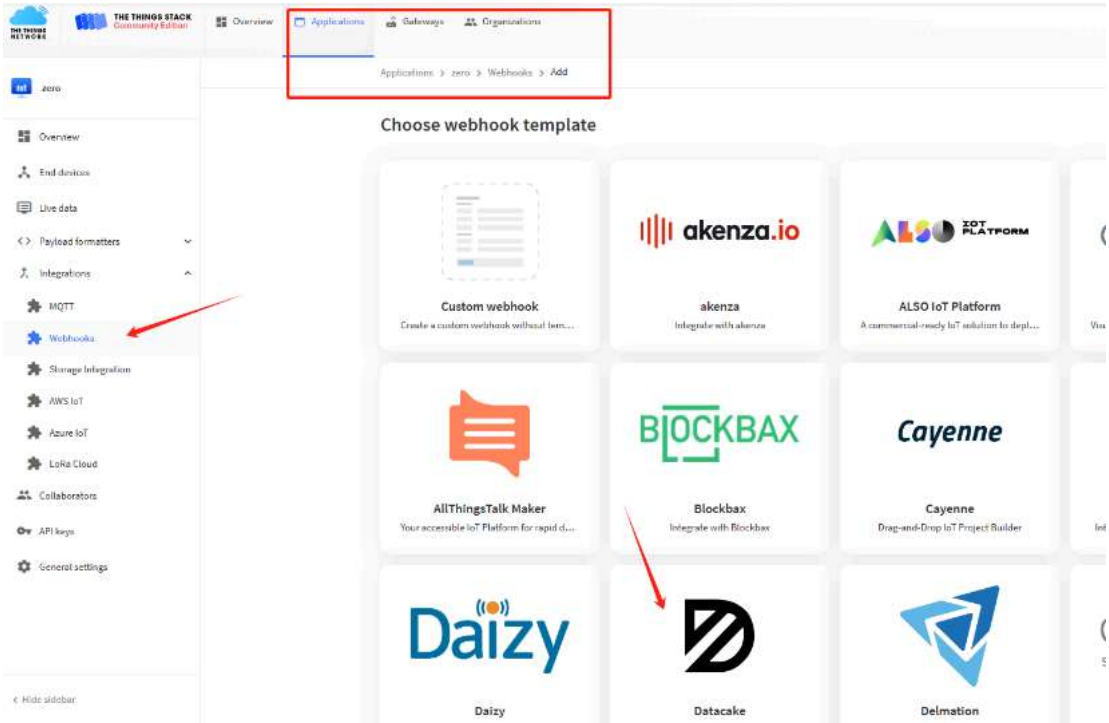
DS20L TTN Payload Decoder: https://github.com/dragino/dragino-end-node-decoder (https://github.com/dragino/dragino-end-node-decoder)

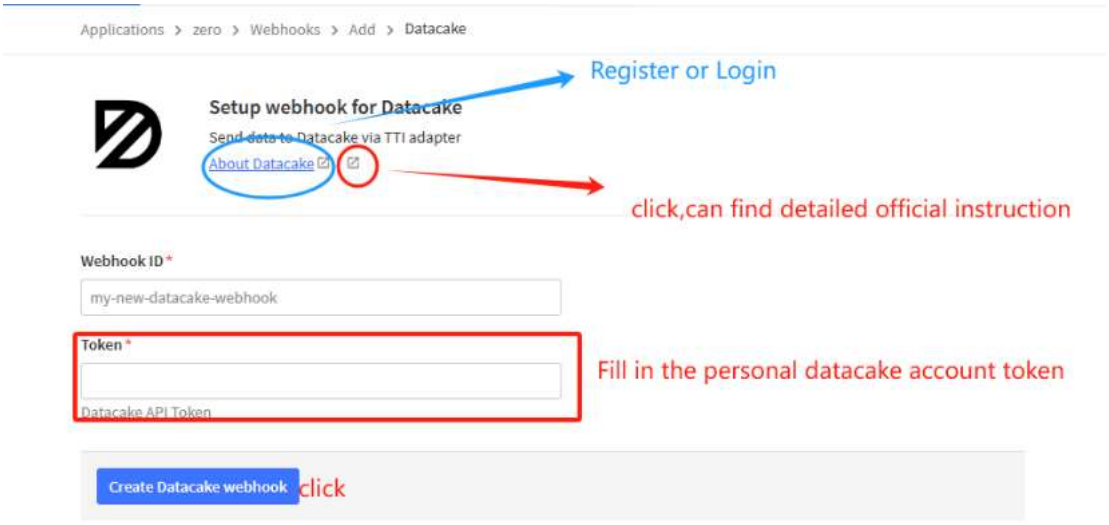
2.5 Show Data in DataCake IoT Server

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/ connect to TTN and see the data in DATACAKE. Below are the steps:

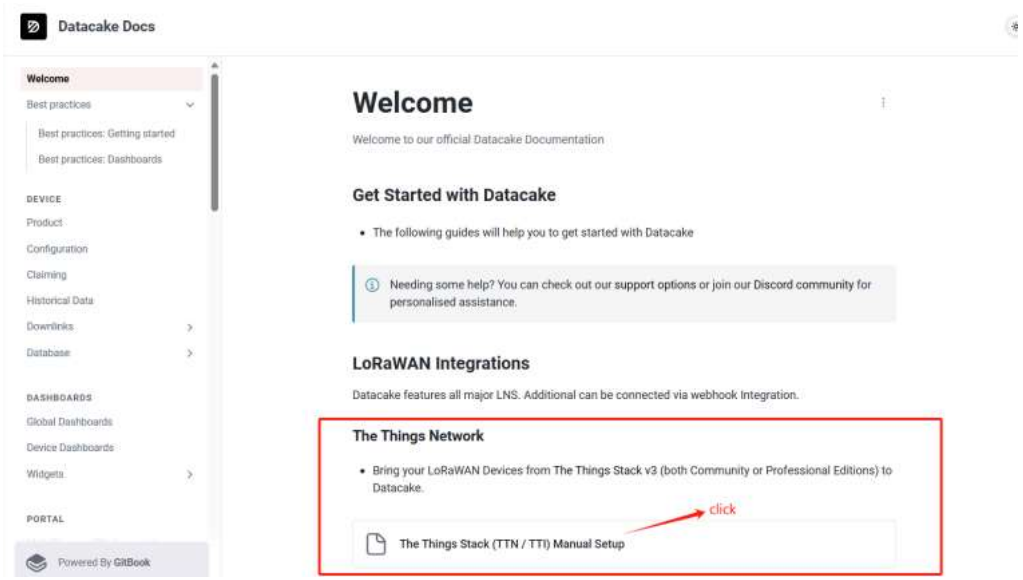
Step 1: Be sure that your device is programmed and properly connected to the network at this time.

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 s



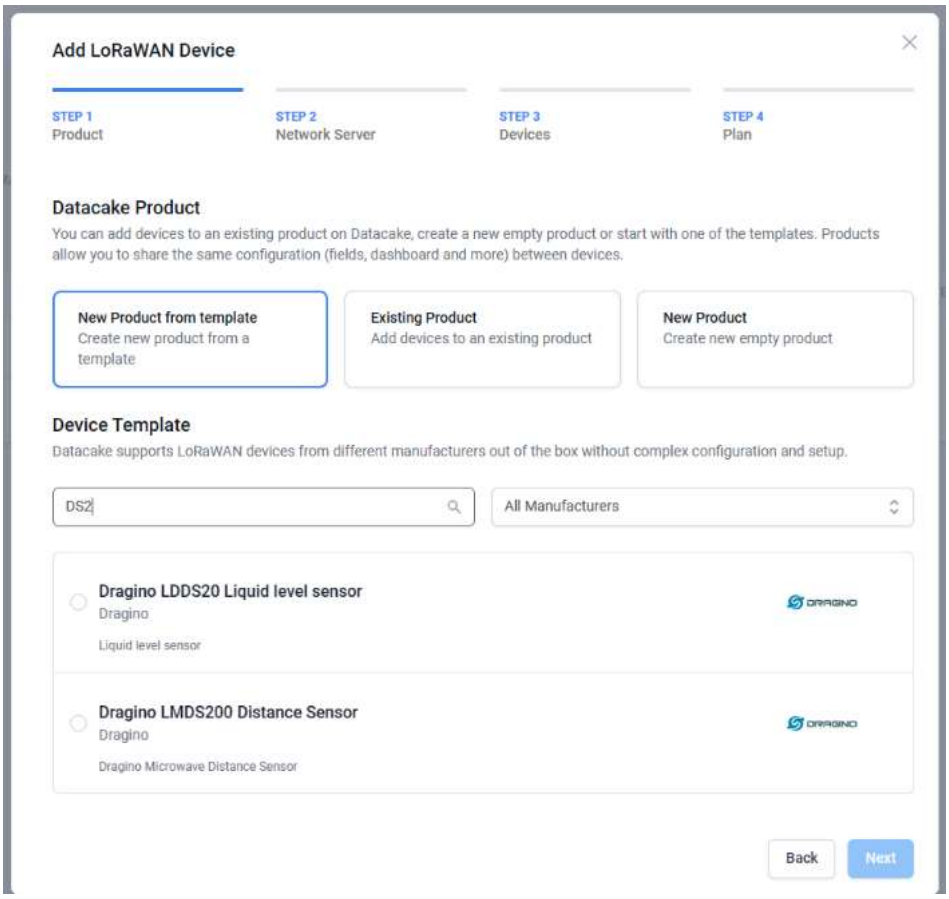


For more detailed instructions, refer to the following instructions: Welcome - Datacake Docs (https://docs.datacake.de/)

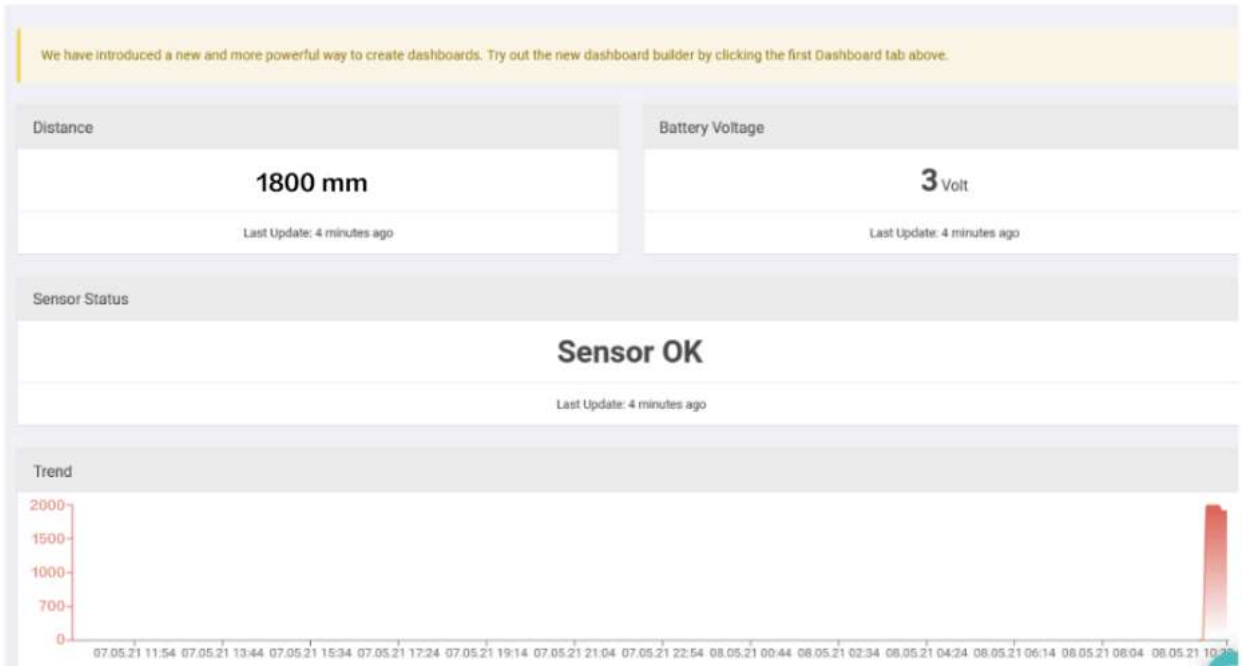


Step 3: Create an account or log in Datacake.

Step 4: Search the DS20L and add DevEUI.



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 country.

http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20Frequency%20Band/ (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 (http://wiki.dragino.com/xwiki/bin/view/Main/UART%20Access%20for%20LoRa%20ST%20v4%20base%20model/#H2.5UARTConnectionforDS20Lmotherboard) .
- LoRaWAN Downlink. Instruction for different platforms: See IoT LoRaWAN Server (http://wiki.dragino.com/xwiki/bin/view/Main/) 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 (http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Comma

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), 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

3.3.3 Set work mode

Feature: Switch working mode

AT Command: AT+MOD

Command Example	Function	Response
AT+MOD=?	Get the current working mode.	OK
AT+MOD=1,0,0,0	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

Downlink Command:

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

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

3.3.4 Set threshold and threshold mode

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 only the upper and lower thresholds	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=1(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+MOD=0,0,0,0,400
- Example 1: Downlink Payload: 070107080064000190 **--->** AT+MOD=1,1800,100,0,400

Note: The over-limit alarm is applied to MOD1.

For example:

- **AT+MOD=1**

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

Send data according to the normal TDC time. If the mode limit is exceeded, the alarm flag is set to 1:

4. 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
(http://wiki.dragino.com/xwiki/bin/view/Main/How%20to%20calculate%20the%20battery%20life%20of%20Dragino%20sensors%3F/) .

5. OTA 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 (https://www.dropbox.com/sh/zqv1vt3komgp4tu/AAC33PnXIcWOVI_UXBEAeT_xa?dl**

Methods to Update Firmware:

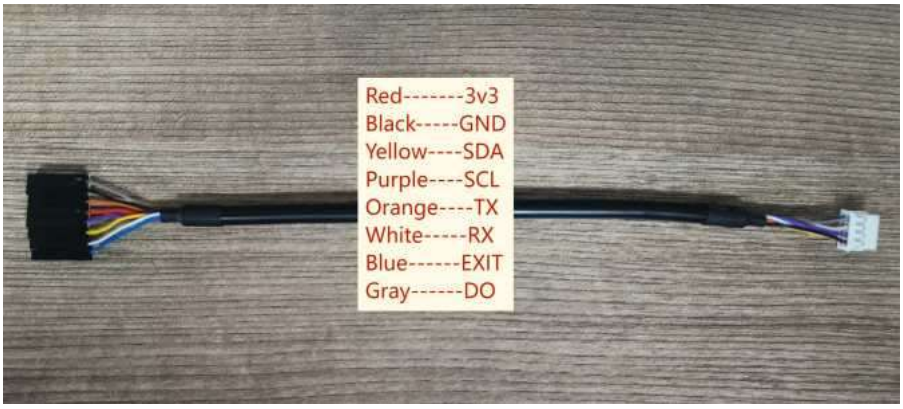
- (Recommanded way) OTA firmware update via wireless: **http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20OTA%20Update%20for%20Sensors/ (http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20OTA%20Update%20for%20Sensors/)**
- Update through UART TTL interface: **Instruction (http://wiki.dragino.com/xwiki/bin/view/Main/UART%20Access%20for%20LoRa%20ST%20v4%20base%20model/#H2.5UARTConnectionforDS20LmotherI**

6. FAQ

6.1 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 (/xwiki/bin/view/Main/End%20Device%20Frequency%20Band/#H1.Introduction)

6.2 DS20L programming line



feature:

for AT commands

Update the firmware of DS20L

Support interrupt mode

6.3 LiDAR probe position

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

6.4 Interface definition

7. Trouble Shooting

7.1 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 se doesn't send **ENTER** while press the send key, user need to add ENTER in their string.

7.2 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 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.

8. 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

9. 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

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 answer 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 (mailto:Support@dragino.cc) .