LSN50v2-D20-D22-D23 LoRaWAN Temperature Sensor Manual

Document Version: 2.0.a

Image Version: v1.7.2

Version	Description	Date
1.0	Release	2020-Nov-10
1.1	Add power on info and jumper info.	2021-Feb-5
2.0	Add LSN50v2-D22, D23 models	2021-Aug-22
2.0.a	Modify Temperature sensor decription	2022-Mar-15

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1. Introduction

1.1 What is LSN50V2-D2x LoRaWAN Temperature Sensor

The Dragino LSN50v2-D2x is a **LoRaWAN Temperature Sensor** for Internet of Things solution. It can be used to measure the **temperature of air, liquid or object**, and then upload to IoT server via LoRaWAN wireless protocol.

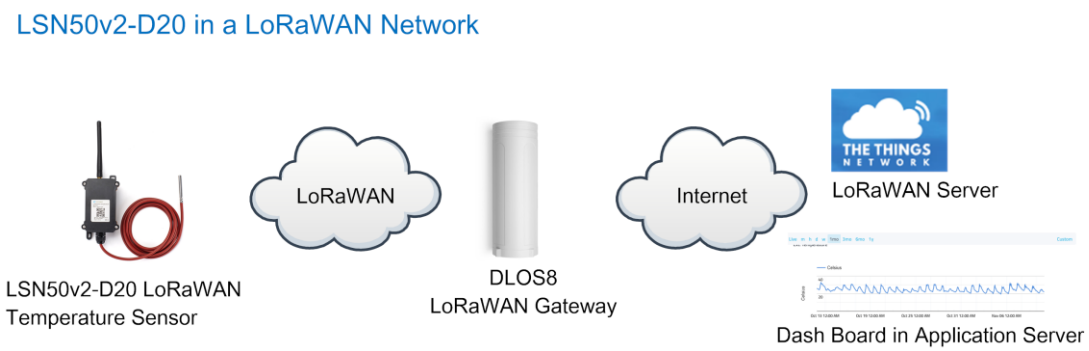
The temperature sensor used in LSN50v2-D2x can **measure -55°C ~ 125°C with accuracy ±0.5°C (max ±2.0 °C)**.

LSN50v2-D2x supports **temperature alarm feature,** user can set temperature alarm for instant notice.

LSN50v2-D2x has max 3 probes which measure maximum 3 temperature points.

LSN50v2-D2x is powered by 8500mAh Li/SOCI2 Battery, it is designed for long term use up to 10 years. (Actually Battery life depends on the use environment, update period. Please check related Power Analyze report).

Each LSN50v2-D2x is pre-load with a set of unique keys for LoRaWAN registration, register these keys to local LoRaWAN server and it will auto connect after power on.



1.2 Specifications

Common DC Characteristics:

- Supply Voltage: built in 8500mAh Li-SOCI2 battery
- Operating Temperature: -40 ~ 85°C

Temperature Sensor:

- Range: -55 to + 125°C
- Accuracy ±0.5°C (max ±2.0 °C).

LoRa Spec:

- Frequency Range,
  - ✓ Band 1 (HF): 862 ~ 1020 Mhz
- 168 dB maximum link budget.
- High sensitivity: down to -148 dBm.
- Bullet-proof front end: IIP3 = -12.5 dBm.
- Excellent blocking immunity.
- Built-in bit synchronizer for clock recovery.
- Preamble detection.
- 127 dB Dynamic Range RSSI.
- Automatic RF Sense and CAD with ultra-fast AFC.
- LoRaWAN 1.0.3 Specification

Power Consumption

- Sleeping Mode: 20uA
- LoRaWAN Transmit Mode: 125mA @ 20dBm 44mA @ 14dBm

1.3 Features

- ✓ LoRaWAN v1.0.3 Class A
- ✓ Ultra-low power consumption
- ✓ 1 ~ 3 External Temperature Probes
- ✓ Measure range -55°C ~ 125°C
- ✓ Temperature alarm
- ✓ Bands: CN470/EU433/KR920/US915 EU868/AS923/AU915/IN865
- ✓ AT Commands to change parameters
- ✓ Uplink on periodically or Interrupt
- ✓ Downlink to change configure

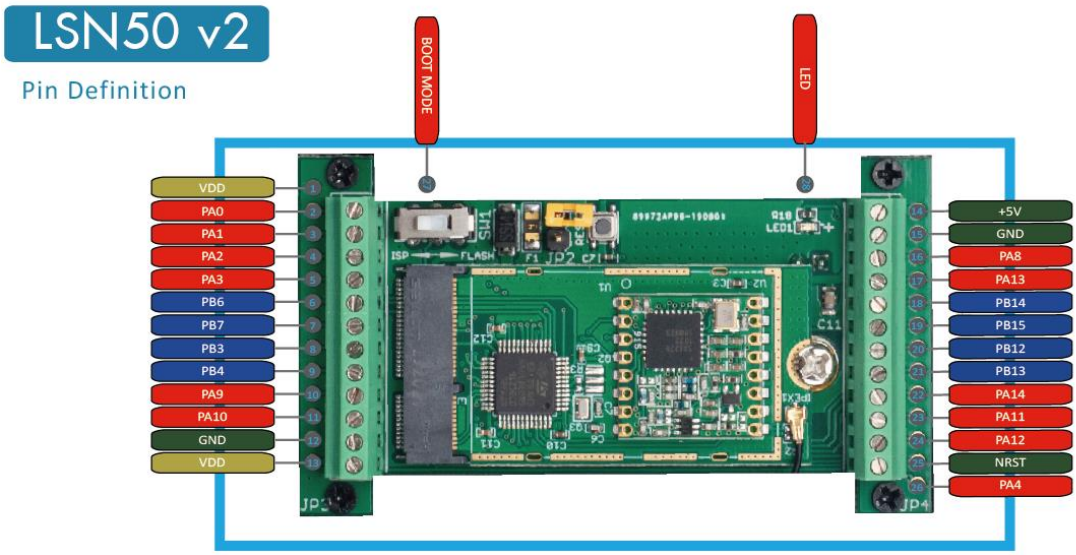
1.4 Applications

- ✓ Wireless Alarm and Security Systems
- ✓ Home and Building Automation
- ✓ Industrial Monitoring and Control
- ✓ Long range Irrigation Systems.

1.5 Hardware Variant

Model	Photo	Probe Info
LSN50v2 D20		1 x DS28B20 Probe Cable Length : 2 meters sensor cable is made by Silica Gel for higher temperature tolerance.
LSN50v2 D22		2 x DS28B20 Probes Cable lengths total 1.5meters per probe Cable Drawing: See This Link
LSN50v2 D23		3 x DS28B20 Probes Cable lengths total 1.5meters per probe Cable Drawing: See This Link

1.6 Pin Definitions and Switch



1.6.1 Pin Definition

The device is pre-configured to connect to temperature sensor. The other pins are not used. If user want to know more about other pins, please refer the user manual of LSn50v2 at: http://www.dragino.com/downloads/index.php?dir=LSN50-LoRaST/

1.6.2 Jumper JP2

Power on Device when put this jumper.

1.6.3 BOOT MODE / SW1

1) ISP: upgrade mode, device won't have any signal in this mode. but ready for upgrade firmware. LED won't work. Firmware won't run.
2) Flash: work mode, device starts to work and send out console output for further debug

1.6.4 Reset Button

Press to reboot the device.

1.6.5 LED

It will flash:

1) When boot the device in flash mode

2) Send an uplink packet

1.7 Hardware Change log

LSN50v2-D20 v1.0:

Release.

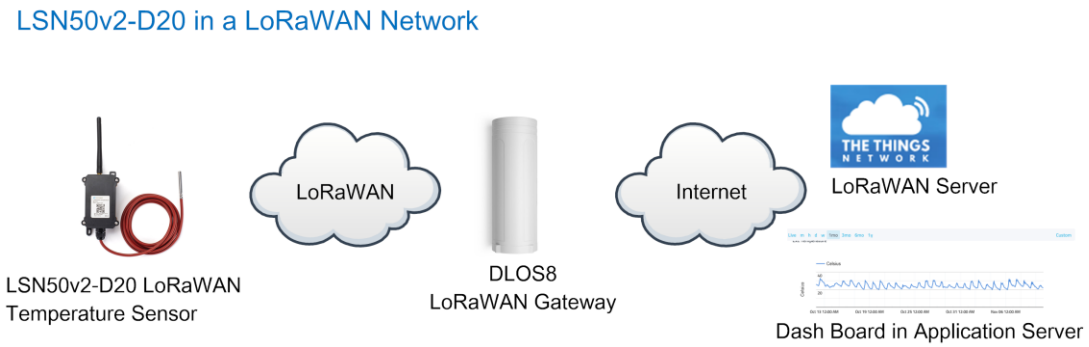
2. How to use LSN50v2-D20?

2.1 How it works?

The LSN50v2-D20 is working as LoRaWAN OTAA Class A end node. Each LSN50v2-D20 is shipped with a worldwide unique set of OTAA and ABP keys. User needs to input the OTAA or ABP keys in the LoRaWAN network server to register. Open the enclosure and power on the LSN50v2-D20, it will join the LoRaWAN network and start to transmit data. The default period for each uplink is 20 minutes.

2.2 Quick guide to connect to LoRaWAN server (OTAA)

Here is an example for how to join the TTN LoRaWAN Server. Below is the network structure, in this demo we use DLOS8 as LoRaWAN gateway.

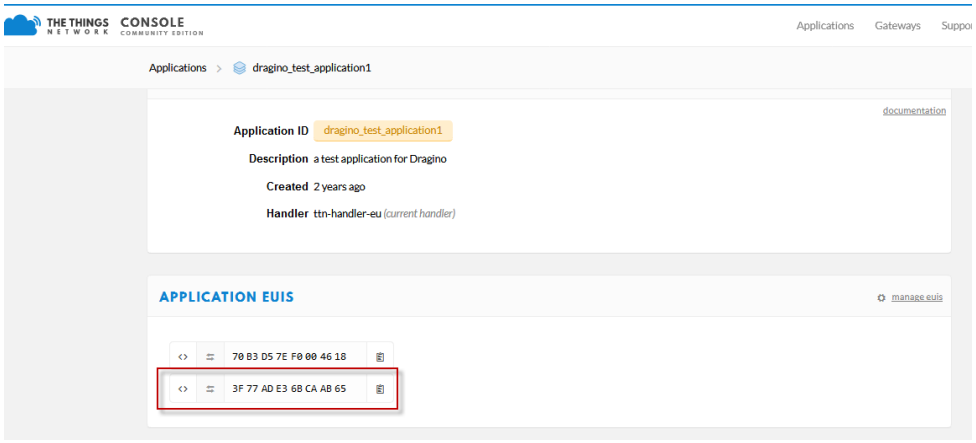


The DLOS8 is already set to connect to TTN . What the rest we need to is register the LSN50V2-D20 to TTN:

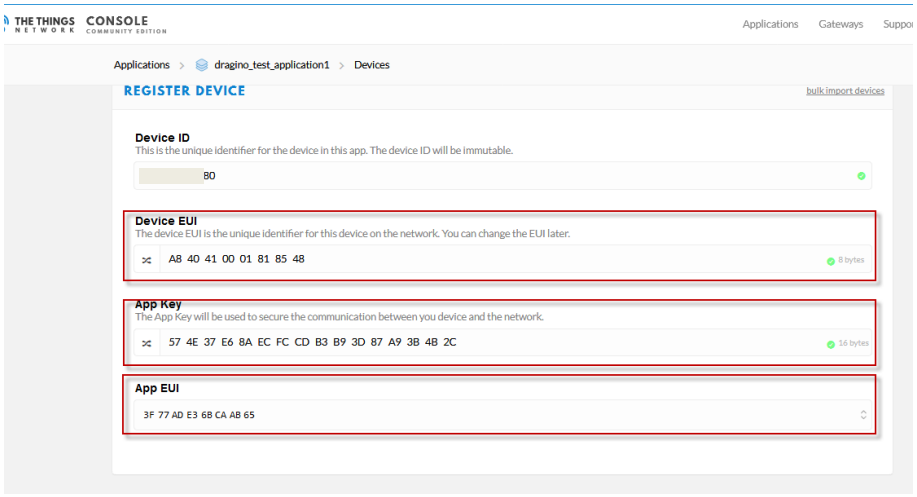
Step 1: Create a device in TTN with the OTAA keys from LSN50V2-D20.
Each LSN50V2-D20 is shipped with a sticker with the default device EUI as below:

Input these keys in their LoRaWAN Server portal. Below is TTN screen shot:

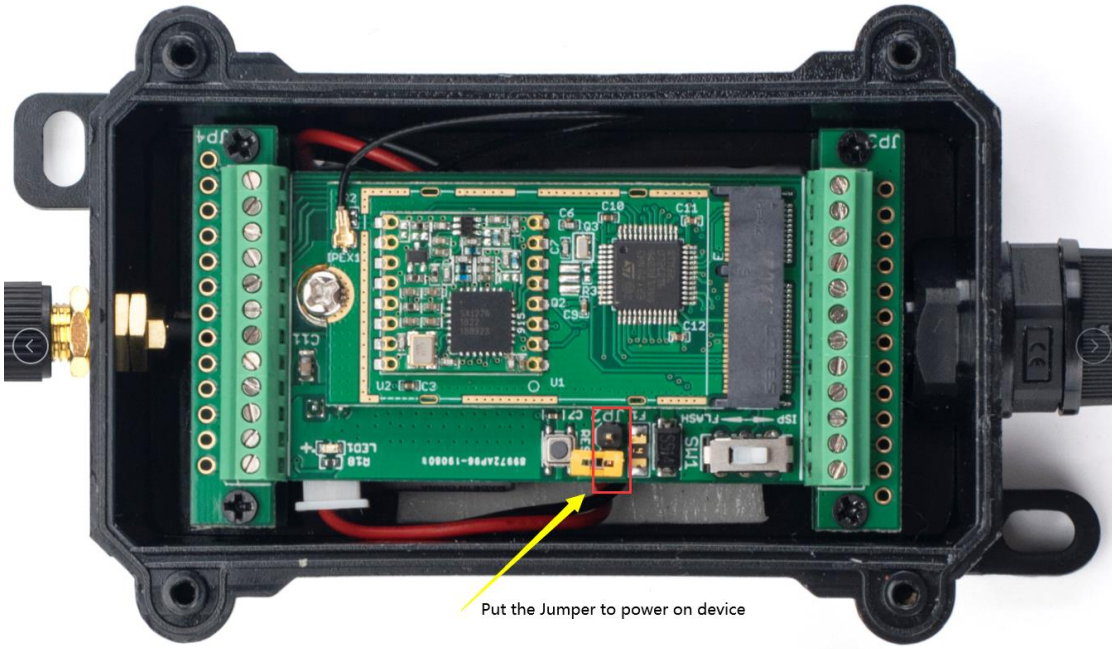
Add APP EUI in the application



Add APP KEY and DEV EUI



Step 2: Power on LSN50V2-D20



Step 3: LSN50V2-D20 will auto join to TTN network via the LoRaWAN coverage by DLOS8. After join success, LSN50V2-D20 will start to uplink temperature value to server.

2.3 Uplink Payload

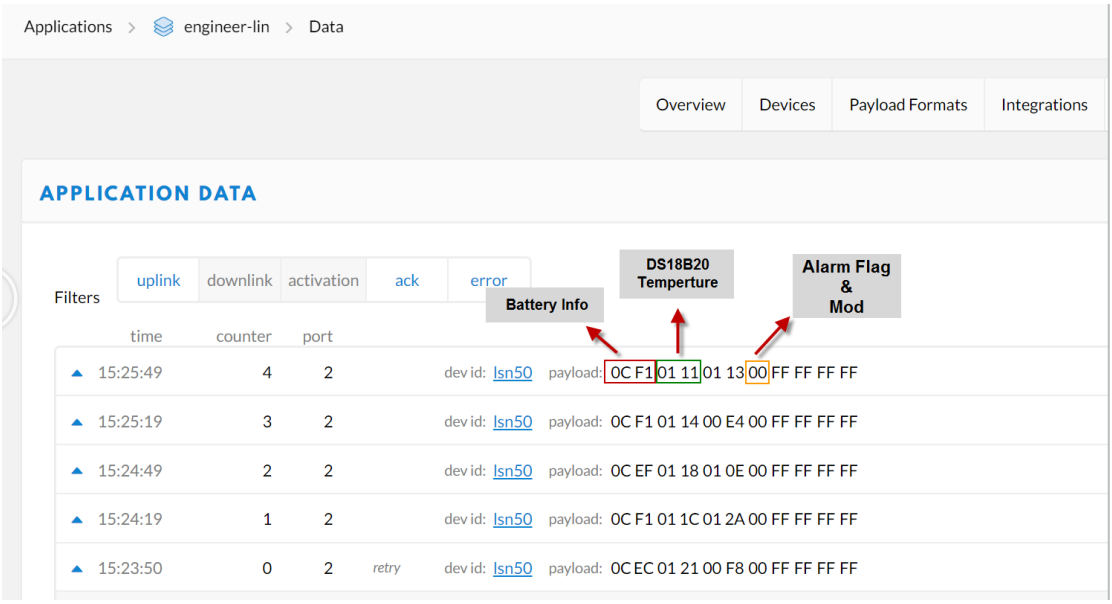
2.3.1 Payload Analyze

Normal Upload Payload:

LSN50v2-D2x use the same payload as LSn50v2 mod1, as below.

Size(bytes)	2	2	2	1	2	2
Value	Battery	Temp Red or Temp White	Ignore	Alarm Flag	Temp_White	Temp_Black

改为 TTNV3



Battery:

Check the battery voltage.

Ex1: 0x0B45 = 2885mV

Ex2: 0x0B49 = 2889mV

Temperature RED or Temperature White :

This point to the Red probe in LSN50 v2-D20 or the probe of LSN50v2- D22/D23 White

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.

Temperature White:

This point to the Red probe in LSN50 v2-D22/D23

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.

Temperature Black:

This point to the BLACK probe in LSN50 v2-D23

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.

Alarm Flag & MOD:

Example:

If payload & 0x01 = 0x01 → This is an Alarm Message

If payload & 0x01 = 0x00 → This is a normal uplink message, no alarm

If payload >> 2 = 0x00 → means MOD=1, This is a sampling uplink message

If payload >> 2 = 0x31 → means MOD=31, this message is a reply message for polling, this message contains the alarm settings. see this link for detail.

2.3.2 Payload Decoder file

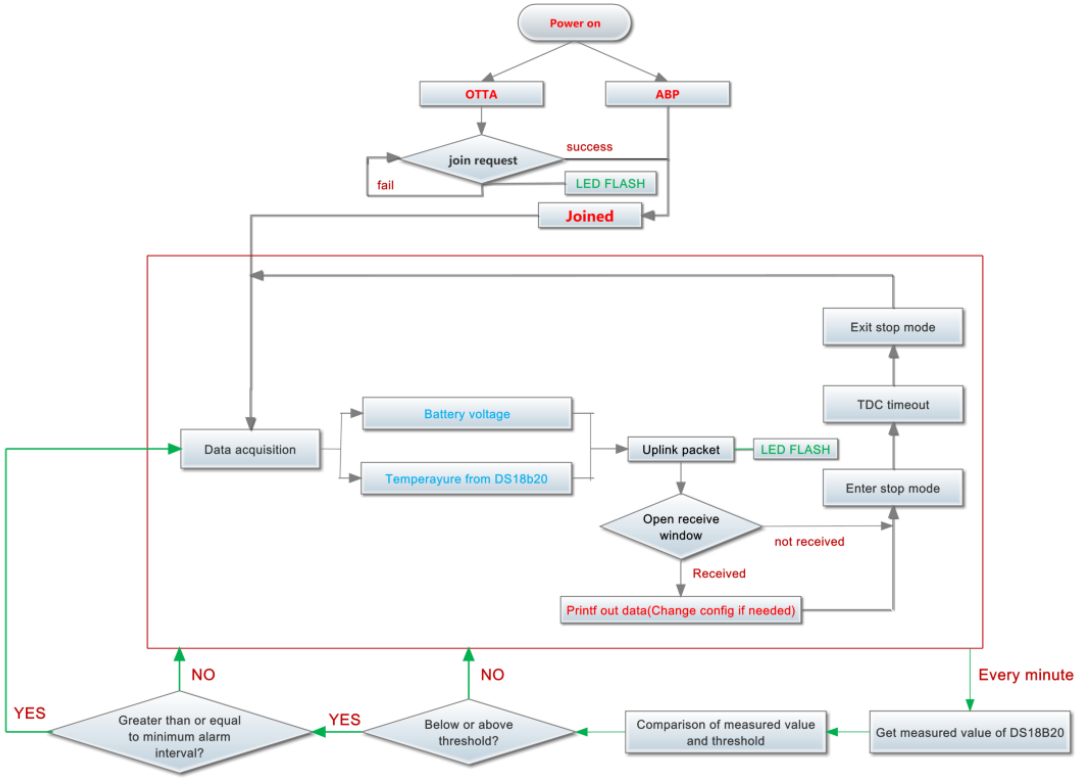
In TTN, use can add a custom payload so it shows friendly.

In the page Applications --> Payload Formats --> Custom --> decoder to add the decoder from:

http://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/LSN50v2-D20/Decoder/

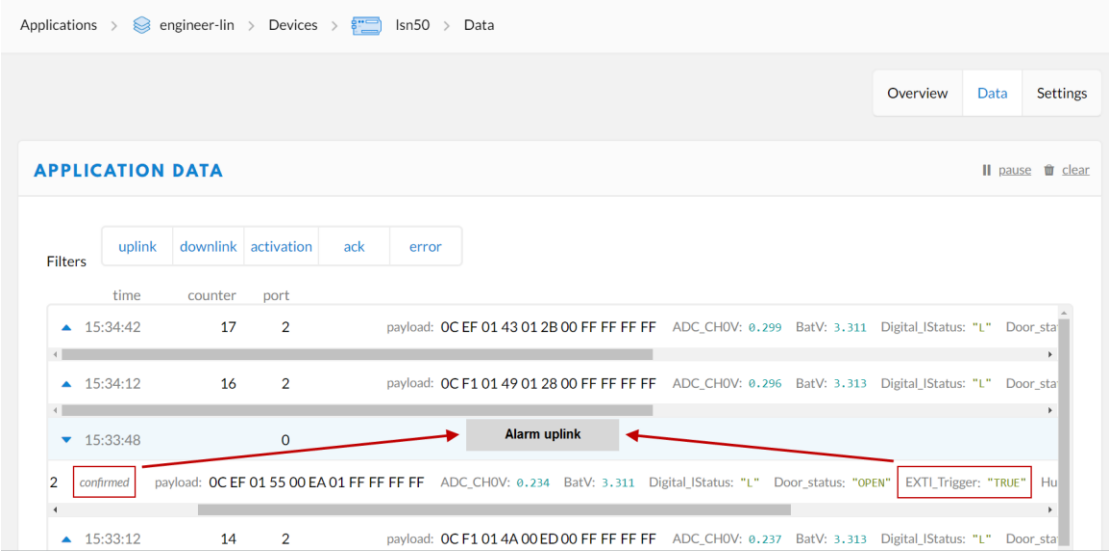
2.4 Temperature Alarm Feature

LSN50V2-D20 work flow with Alarm feature.



User can use **AT+18ALARM** command to set the alarm low limit or high limit. Device will check the temperature every minute, if the temperature lower than low limit or greater than high limit. LSN50v2-D20 will send an **Alarm packet base on Confirmed Uplink Mode** to server.

Below is an example of the Alarm Packet.



2.5 Configure LSN50v2-D20

LSN50V2-D20 supports configuration via LoRaWAN downlink command or AT Commands.

- Downlink command instructions for different platform:

http://wiki.dragino.com/index.php?title=Main_Page#Use_Note_for_Server

- AT Command Access Instructions: LINK

There are two parts of commands: General one and Special for this model.

2.5.1 General Configure Commands

These commands are to configure:

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

These commands can be found on the wiki:

http://wiki.dragino.com/index.php?title=End_Device_AT_Commands_and_Downlink_Commands

2.5.2 Sensor related commands:

Set Alarm Threshold:

- AT Command:

Set All Probes:

AT+18ALARM=min,max

- ✧ When min=0, and max≠0, Alarm trigger when higher than max
- ✧ When min≠0, and max=0, Alarm trigger when lower than min
- ✧ When min≠0 and max≠0, Alarm trigger when higher than max or lower than min

Example:

AT+18ALARM=-10,30 // Alarm when < -10 or higher than 30.

- Downlink Payload:

0x(0B F6 1E) // Same as AT+18ALARM=-10,30

(note: 0x1E= 30, 0xF6 means: 0xF6-0x100 = -10)

Set Separate Probe:

AT+18ALARM=min,max,index

Index:

- 1: Temperature_Red
- 2: Temperature_White
- 3: Temperature_Black

Example:

AT+18ALARM=-10,30,1 // Alarm when temperature_red < -10 or higher than 30.

- Downlink Payload:

0x(0B F6 1E 01) // Same as AT+18ALARM=-10,30,1

(note: 0x1E= 30, 0xF6 means: 0xF6-0x100 = -10)

Set Alarm Interval:

The shortest time of two Alarm packet. (unit: min)

- AT Command:

AT+ATDC=30 // The shortest interval of two Alarm packets is 30 minutes, Means is there is an alarm packet uplink, there won't be another one in the next 30 minutes.

- Downlink Payload:

0x(0D 00 1E) ---> Set AT+ATDC=0x 00 1E = 30 minutes

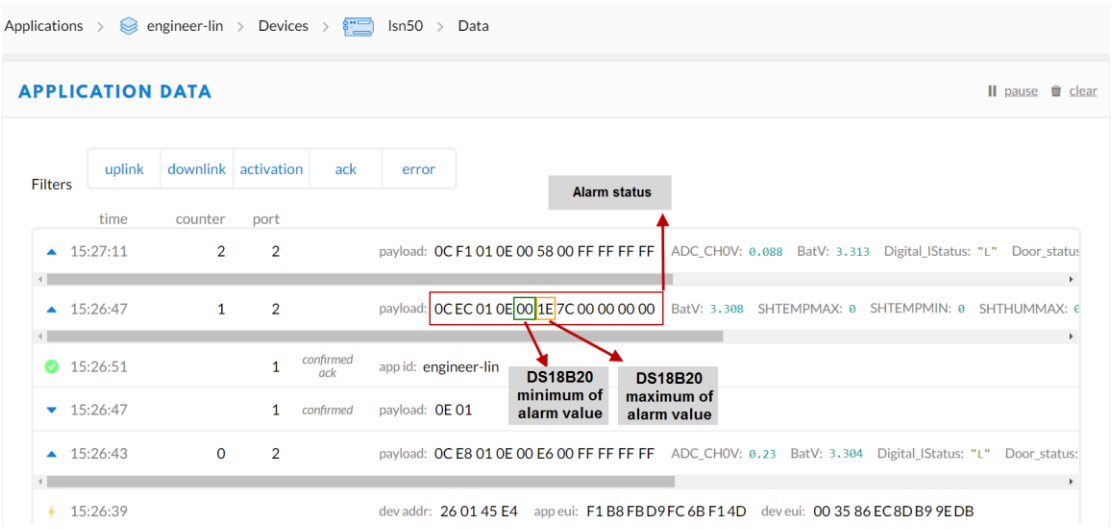
Poll the Alarm settings:

Send a LoRaWAN downlink to ask device send Alarm settings.

- Downlink Payload:

0x0E 01

Example:



Explain:

- Alarm & MOD bit is 0x7C, 0x7C >> 2 = 0x31: Means this message is the Alarm settings message.

2.6 LED Status

LSN50-v2-D20 has an internal LED, it will active in below situation:

- LED will fast blink 5 times when boot, this means the temperature sensor is detected
- After the fast blinks on boot, the LED will flash once which means device is trying to send Join Packet to the network.
- If device successful join LoRaWAN network, the LED will be solid on for 5 seconds.

2.7 Button Function

Internal RESET button:

Press this button will reboot the device. Device will process OTAA Join to network again.

2.8 Firmware Change Log

See this link.

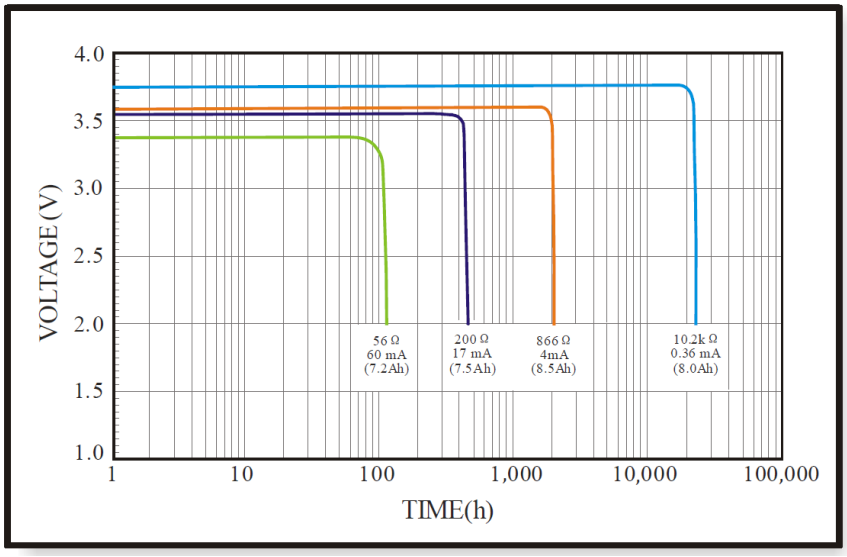
3. Battery & how to replace

3.1 Battery Type

LSN50V2-D2X is equipped with a 8500mAH ER26500 Li-SOCI2 battery. The battery is un-rechargeable battery with low discharge rate targeting for 8~10 years use. This type of battery is commonly used in IoT target for long-term running, such as water meter.

The discharge curve is not linear so can't simply use percentage to show the battery level. Below is the battery performance.

1. Typical discharge profile at +20℃(Typical value)



Minimum Working Voltage for the LSN50V2-D2X:
LSN50V2-D2X: 2.45v ~ 3.6v

3.2 Replace Battery

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

3.3 Power Consumption Analyze

Dragino Battery powered product are all runs in Low Power mode. We have an update battery calculator which base on the measurement of the real device. User can use this calculator to check the battery life and calculate the battery life if want to use different transmit interval.

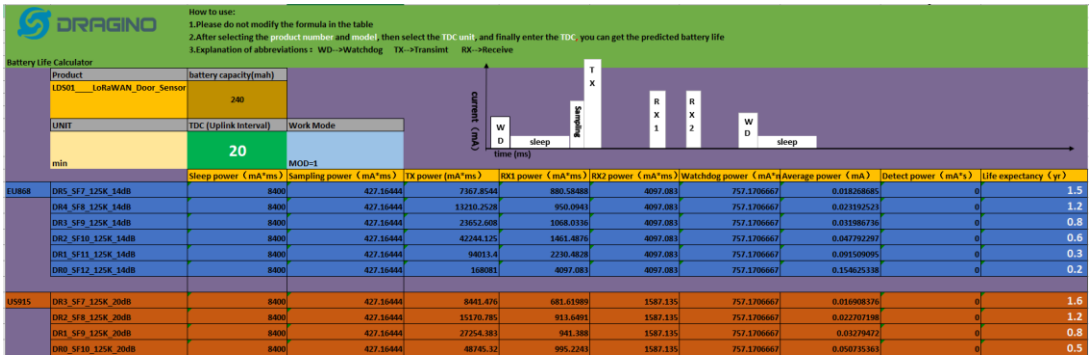
Instruction to use as below:

Step 1: Downlink the up-to-date DRAGINO_Battery_Life_Prediction_Table.xlsx from:
https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/Battery_Analyze/

Step 2: Open it and choose

- Product Model
- Uplink Interval
- Working Mode

And the Life expectation in difference case will be shown on the right.



DRAGINO

How to use:
1.Please do not modify the formula in the table
2.After selecting the product number and model, then select the TDC unit, and finally enter the TDC, you can get the predicted battery life
3.Explanation of abbreviations： WD-->Watchdog TX-->Transimt RX-->Receive

Battery Life Calculator

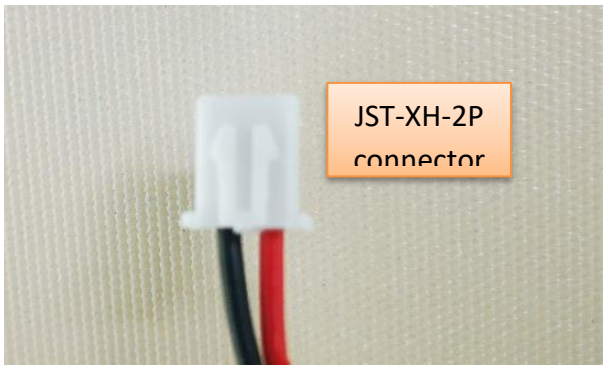
Product	battery capacity(mah)
LDS01___LoRaWAN_Door_Sensor	240

UNIT	TDC (Uplink Interval)	Work Mode
min	20	MOD=1

		Sleep power（mA*ms）	Sampling power（mA*ms）	TX power (mA*ms)	RX1 power（mA*ms）	RX2 power（mA*ms）	Watchdog power（mA*ms	Average power（mA）	Detect power（mA*s）	Life expectancy（yr）
EU868	DR5_SF7_125K_14dB	8400	427.16444	7367.8544	880.58488	4097.083	757.1706667	0.018268685	0	1.5
	DR4_SF8_125K_14dB	8400	427.16444	13210.2528	950.0941	4097.083	757.1706667	0.023192523	0	1.2
	DR3_SF9_125K_14dB	8400	427.16444	23652.608	1068.0336	4097.083	757.1706667	0.031986736	0	0.8
	DR2_SF10_125K_14dB	8400	427.16444	42244.125	1461.4876	4097.083	757.1706667	0.047792297	0	0.6
	DR1_SF11_125K_14dB	8400	427.16444	94013.4	2230.4828	4097.083	757.1706667	0.091509095	0	0.3
	DR0_SF12_125K_14dB	8400	427.16444	168081	4097.083	4097.083	757.1706667	0.154625338	0	0.2
US915	DR3_SF7_125K_20dB	8400	427.16444	8441.476	681.61989	1587.135	757.1706667	0.016908376	0	1.6
	DR2_SF8_125K_20dB	8400	427.16444	15170.785	913.6491	1587.135	757.1706667	0.022707198	0	1.2
	DR1_SF9_125K_20dB	8400	427.16444	27254.383	941.388	1587.135	757.1706667	0.03279472	0	0.8
	DR0_SF10_125K_20dB	8400	427.16444	48745.32	995.2243	1587.135	757.1706667	0.050735363	0	0.5

The battery related documents as below:

- Battery Dimension,
- Lithium-Thionyl Chloride Battery datasheet, Tech Spec
- Lithium-ion Battery-Capacitor datasheet, Tech Spec



3.3.1 Battery Note

The Li-SICO battery is designed for small current / long period application. It is not good to use a high current, short period transmit method. The recommended minimum period for use of this battery is 5 minutes. If you use a shorter period time to transmit LoRa, then the battery life may be decreased.

3.3.2 Replace the battery

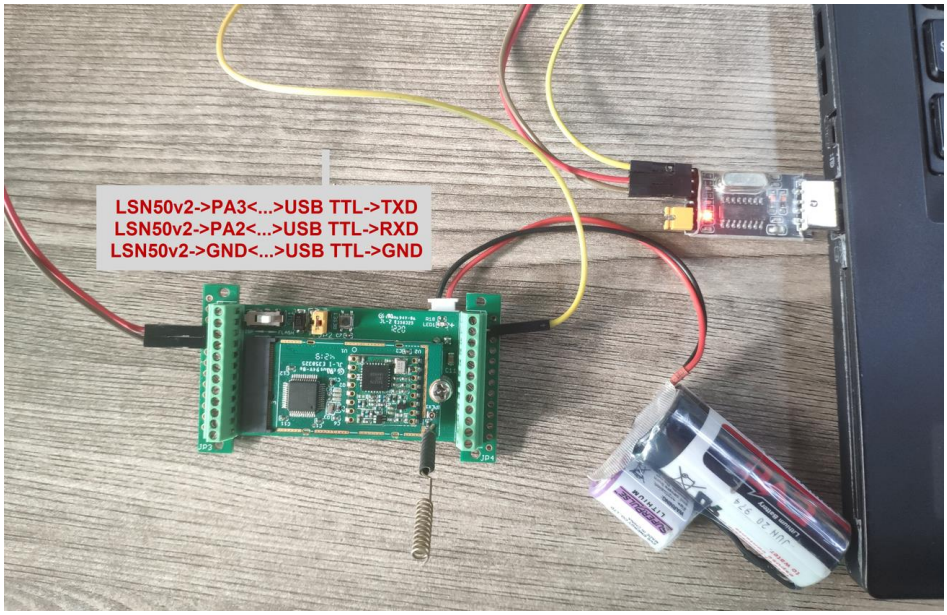
You can change the battery in the LSN50V2-D2X.The type of battery is not limited as long as the output is between 3v to 3.6v. On the main board, there is a diode (D1) between the battery and the main circuit. If you need to use a battery with less than 3.3v, please remove the D1 and shortcut the two pads of it so there won't be voltage drop between battery and main board.

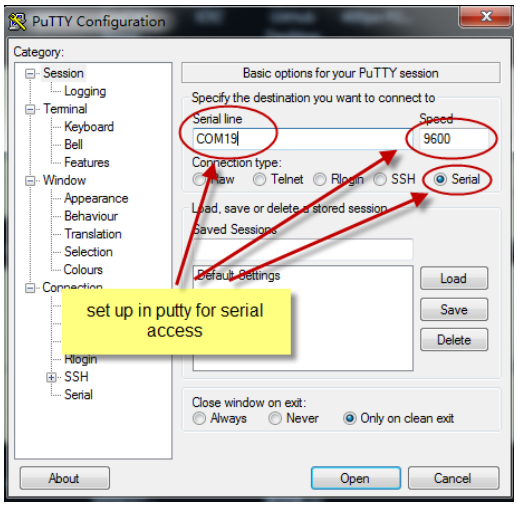
The default battery pack of LSN50V2-D2X includes a ER26500 plus super capacitor. If user can't find this pack locally, they can find ER26500 or equivalence, which will also work in most case. The SPC can enlarge the battery life for high frequency use (update period below 5 minutes)

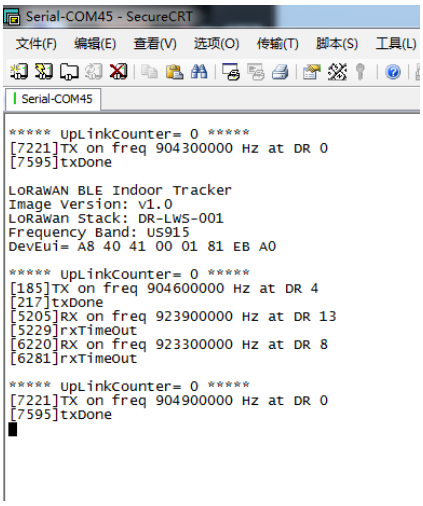
4. Use AT Command

4.1 Access AT Command

User can use a USB to TTL adapter to connect to LSN50V2-D20 to use AT command to configure the device. Example is as below:







5. FAQ

5.1 What is the frequency range of LSN50v2-D20?

Different LSN50V2-D20 version supports different frequency range, below is the table for the working frequency and recommend bands for each model:

Version	LoRa IC	Working Frequency	Best Tune Frequency	Recommend Bands
433	SX1278	Band2(LF): 410 ~525 Mhz	433Mhz	CN470/EU433
868	SX1276	Band1(HF):862~1020 Mhz	868Mhz	EU868/IN865/RU864
915	SX1276	Band1(HF):862 ~1020 Mhz	915Mhz	AS923/AU915/ KR920/US915

5.2 What is the Frequency Plan?

Please refer Dragino End Node Frequency Plan:
http://wiki.dragino.com/index.php?title=End_Device_Frequency_Band

5.3 How to update the firmware?

User can upgrade the firmware for 1) bug fix, 2) new feature release or 3) change frequency plan.
Please see this link for how to upgrade:
http://wiki.dragino.com/index.php?title=Firmware_Upgrade_Instruction_for_STM32_base_products#Hardware_Upgrade_Method_Support_List

6. Order Info

Part Number: **LSN50V2-D20-XXX (Signal Probe)**

Or LSN50V2-D22-XXX (Dual Probe)

Or LSN50V2-D23-XXX (Triple Probe)

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

7. Packing Info

Package Includes:

- ✓ LSN50v2-D2x LoRaWAN Temperature Sensor x 1

Dimension and weight:

- ✓ Device Size:
- ✓ Device Weight:
- ✓ Package Size:
- ✓ Package Weight:

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