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LSN50v2-S31-S31B LoRaWAN Temperature & Humidity Sensor User Manual

last modified by Xiaoling

on 2023/04/28 10:19

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1. Introduction

1.1 What is LSN50V2-S31 LoRaWAN Temperature & Humidity Sensor

The Dragino LSN50v2-S31 is a **LoRaWAN Temperature and Humidity Sensor** for Internet of Things solution. It is used to measure the **surrounding environment temperature and relative air humidity precisely**, and then upload to IoT server via LoRaWAN wireless protocol.

The temperature & humidity sensor used in LSN50v2-S31 is SHT31, which is fully calibrated, linearized, and temperature compensated digital output from Sensirion, it provides a strong reliability and long-term stability. The SHT31 is fixed in a **waterproof anti-condensation casing** for long term use.

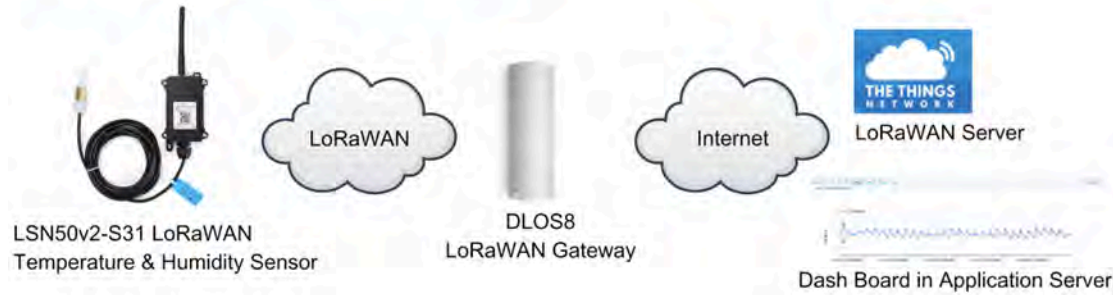
LSN50v2-S31 supports **temperature and humidity alarm feature**, user can get alarm for instant notice.

User Manual for LoRaWAN End Nodes - LSN50v2-S31- S31B LoRaWAN Temperature & Humidity Sensor User Manual

LSN50v2-S31 is powered by **8500mAh Li-SOCI2 battery**, It is designed for long term use up to 10 years. (Real-world battery life depends on the use environment, update period. Please check related Power Analyze report).

Each LSN50v2-S31 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.

LSN50v2-S31 in a LoRaWAN Network



1.2 Specifications

Micro Controller:

- MCU: STM32L072xxxx
- Flash:128KB
- RAM:20KB
- EEPROM: 6KB
- Clock Speed: 32Mhz

Common DC Characteristics:

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

Temperature Sensor:

- Range: -40 to + 80°C
- Accuracy: ± 0.2 @ 0-90 °C
- Resolution: 0.1°C
- Long Term Shift: <0.03 °C/yr

Humidity Sensor:

- Range: 0 ~ 99.9% RH
- Accuracy: $\pm 2\%$ RH (0 ~ 100%RH)
- Resolution: 0.01% RH
- Long Term Shift: <0.25 %RH/yr

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

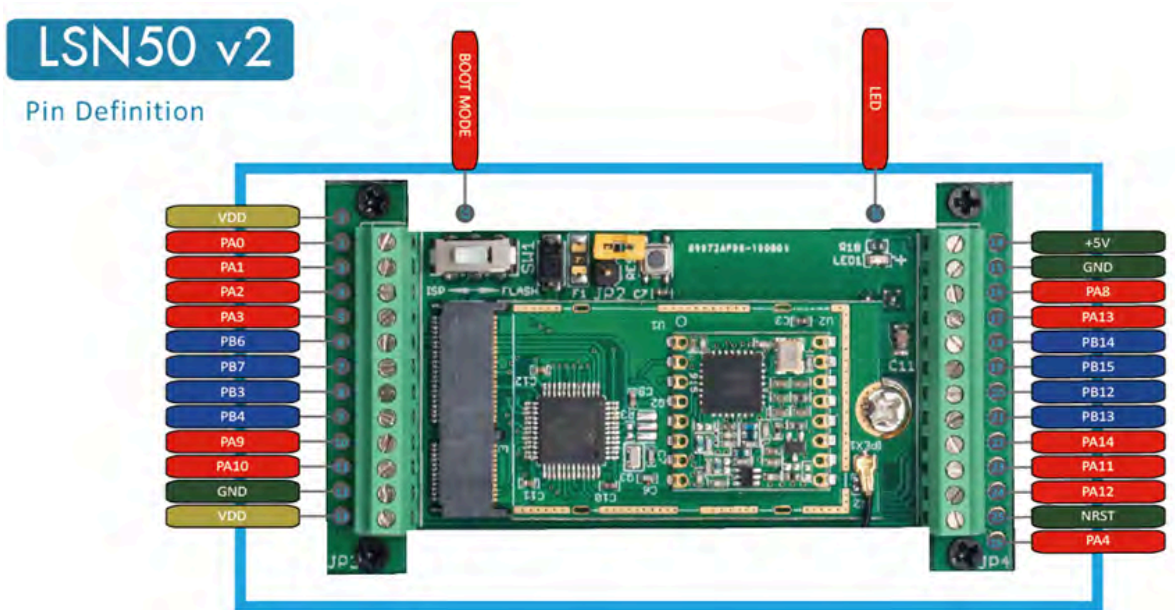
1.3 Features

- LoRaWAN v1.0.3 Class A
- Ultra-low power consumption
- External 3 meters SHT31 probe
- Measure range -55°C ~ 125°C
- Temperature & Humidity alarm
- Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865
- AT Commands to change parameters
- Uplink on periodically or Interrupt
- Downlink to change configure
- 8500mAh Battery for long term use

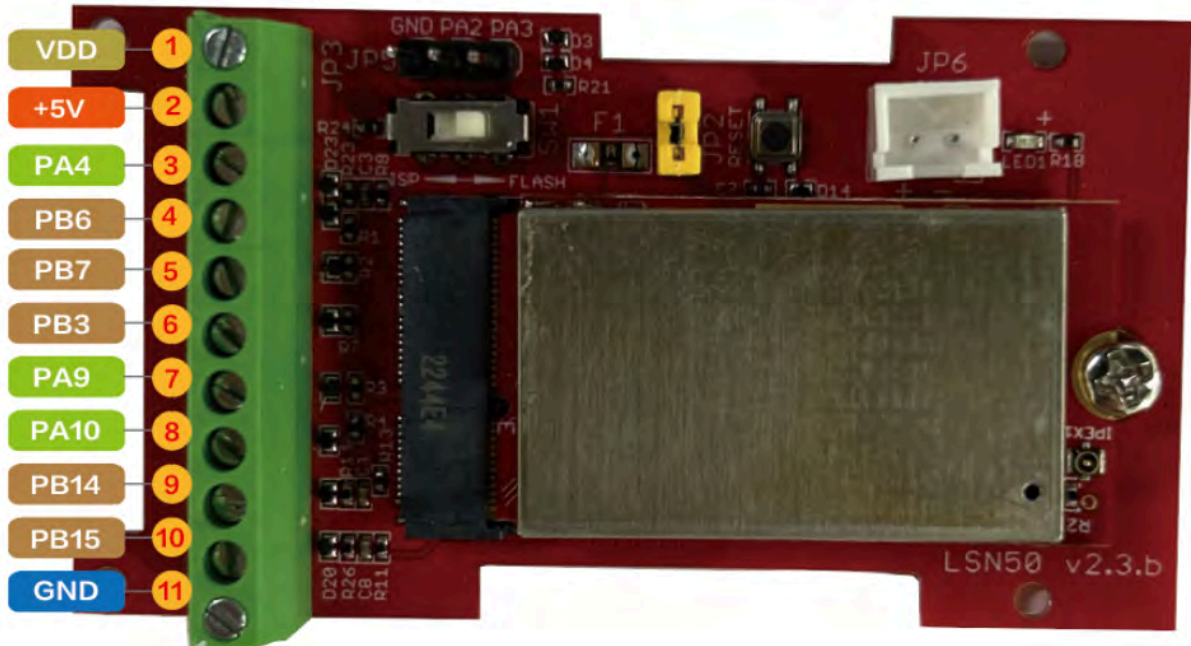
1.4 Applications

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

1.5 Pin Definitions and Switch



The latest mother board for LSN50v2-S31 is :



1.5.1 Pin Definition

The device is pre-configured to connect to SHT31 sensor. The other pins are not used. If user want to know more about other pins, please refer the user manual of LSn50v2 at: <https://www.dropbox.com/sh/djks7mr17y94mi/AABVIWbM9uzK9OA3mXyAT10Za?dl=0>

1.5.2 Jumper JP2

Power on Device when put this jumper.

1.5.3 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

1.5.4 Reset Button

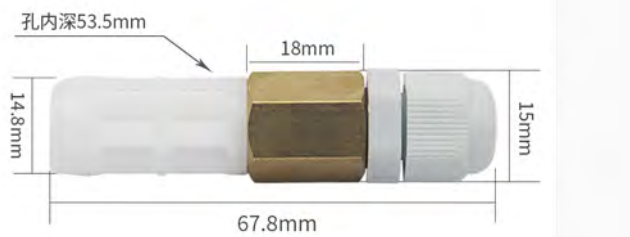
Press to reboot the device.

1.5.5 LED



It will flash:

1. When boot the device in flash mode
2. Send an uplink packet

1.5.6 Probe Dimension



1.6 Hardware Variant

Model	Photo	Description
LSN50v2-S31		External 3 meters SHT31 probe
LSN50v2 -S31B		On device SHT31 Probe

2. How to use LSN50v2-S31?

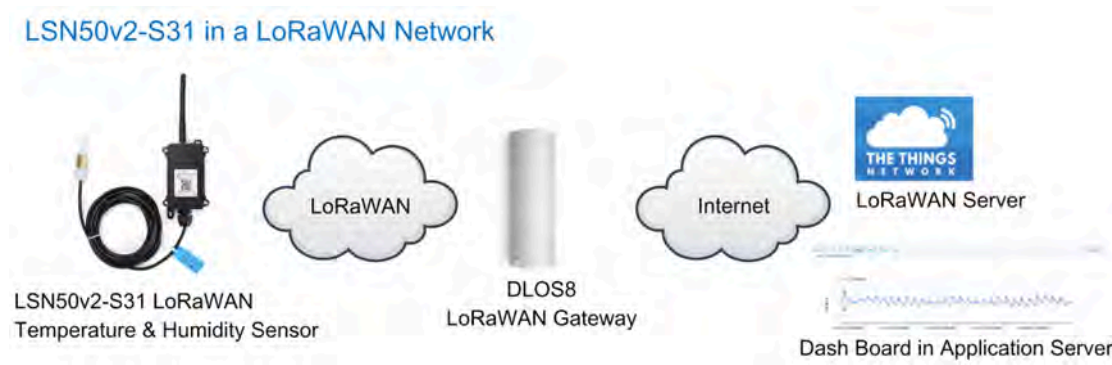
2.1 How it works

The LSN50v2-S31 is working as LoRaWAN OTAA Class A end node. Each LSN50v2-S31 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-S31, 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)

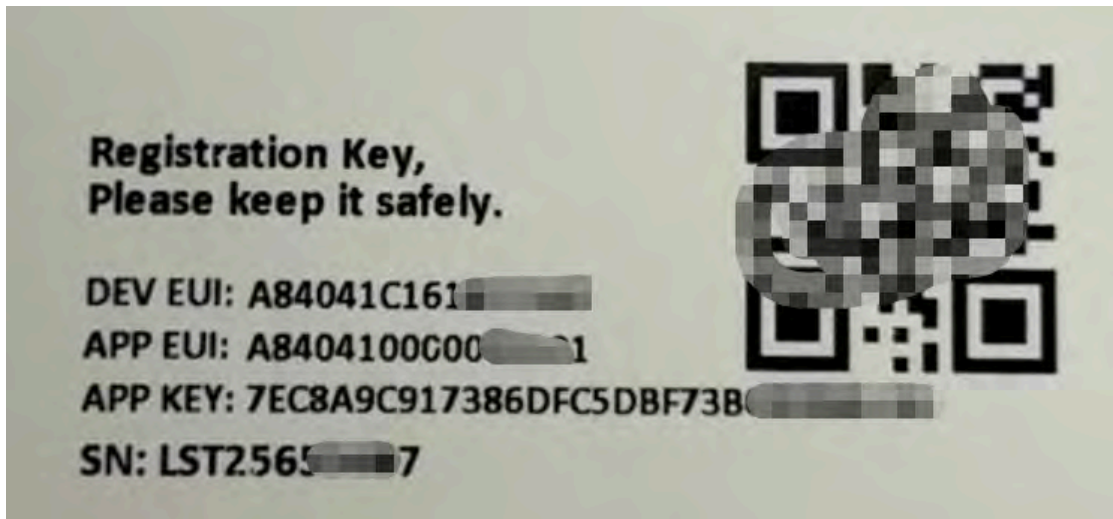
Here is an example for how to join the [TTN LoRaWAN](#) Server. Below is the network structure, in this demo we use [DLOS8](#) as LoRaWAN gateway.



The DLOS8 is already set to connect to [TTN](#). What the rest we need to is register the LSN50V2-S31 to TTN:

Step 1: Create a device in TTN with the OTAA keys from LSN50V2-S31.

Each LSN50V2-S31 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 screen shot:

Register the device:

Register end device

From The LoRaWAN Device Repository [Manually](#)

Preparation

Activation mode *

- Over the air activation (OTAA)
- Activation by personalization (ABP)
- Multicast
- Do not configure activation

LoRaWAN version ⓘ *

MAC V1.0.3 1

Network Server address
eu1.cloud.thethings.network

Application Server address
eu1.cloud.thethings.network

External Join Server ⓘ

Enabled

Join Server address
eu1.cloud.thethings.network

2

Add APP EUI and DEV EUI:

Register end device

From The LoRaWAN Device Repository [Manually](#)

- 1 Basic settings**
End device ID's, Name and Description
- 2 Network layer settings**
Frequency plan, regional parameters, end device class and session keys.
- 3 Join settings**
Root keys, NetID and kek labels.

End device ID ^{*}

lsnpk01

AppEUI ^{*}

..... 00

DevEUI ^{*}

.....

End device name

LSNPK01

End device description

Description for my new end device

Optional end device description; can also be used to save notes about the end device

[Network layer settings >](#)

Add APP EUI in the application:

Register end device

From The LoRaWAN Device Repository [Manually](#)

- ✓ **Basic settings**
End device ID's, Name and Description
- 2 Network layer settings**
Frequency plan, regional parameters, end device class and session keys.
- 3 **Join settings**
Root keys, NetID and kek labels.

Frequency plan ⓘ *

Europe 863-870 MHz (SF12 for RX2) ▼

LoRaWAN version ⓘ *

MAC V1.0.3 ▼

Regional Parameters version ⓘ *

PHY V1.0.3 REV A ▼

LoRaWAN class capabilities ⓘ

- Supports class B
- Supports class C

Advanced settings ▼

< Basic settings

Join settings >

Add APP KEY

Register end device

From The LoRaWAN Device Repository [Manually](#)

- ✓ **Basic settings**
End device ID's, Name and Description
- ✓ **Network layer settings**
Frequency plan, regional parameters, end device class and session keys.
- 3 Join settings**
Root keys, NetID and kek labels.

Root keys

AppKey ⓘ *

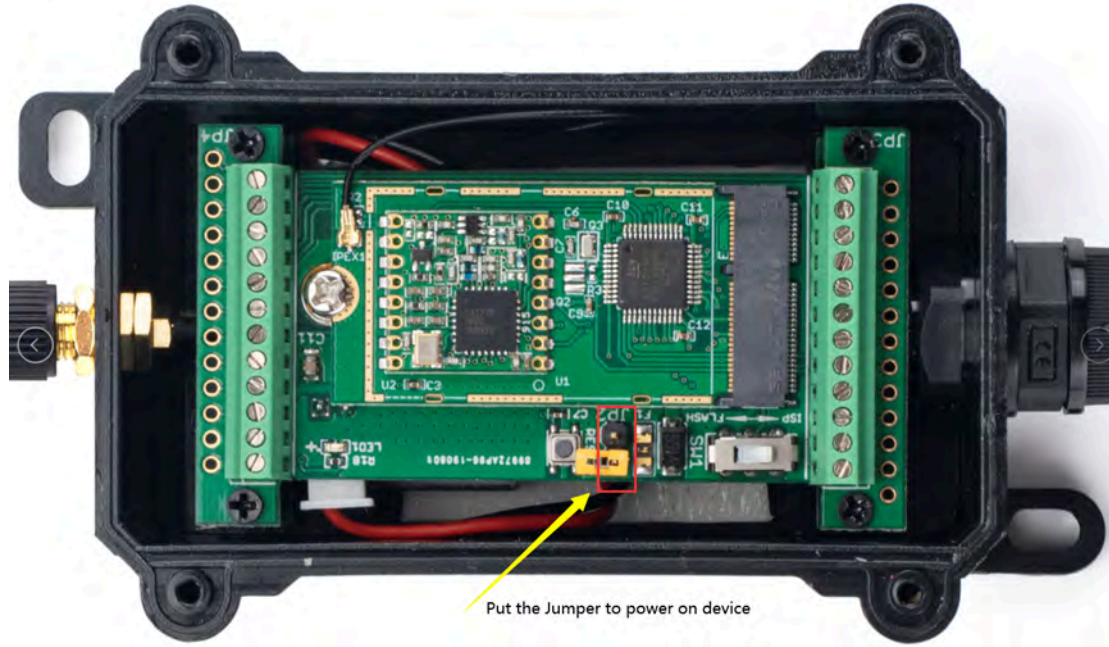
BD 72 1D AC F3 CC AB 67 72 8D 7A F5 4D DF 30 8B 

Advanced settings ▾

[← Network layer settings](#)

[Add end device](#)

Step 2: Power on LSN50v2-S31



Step 3: LSN50V2-S31 will auto join to TTN network via the LoRaWAN coverage by DLOS8. After join success, LSN50V2-S31 will start to uplink temperature value to server.

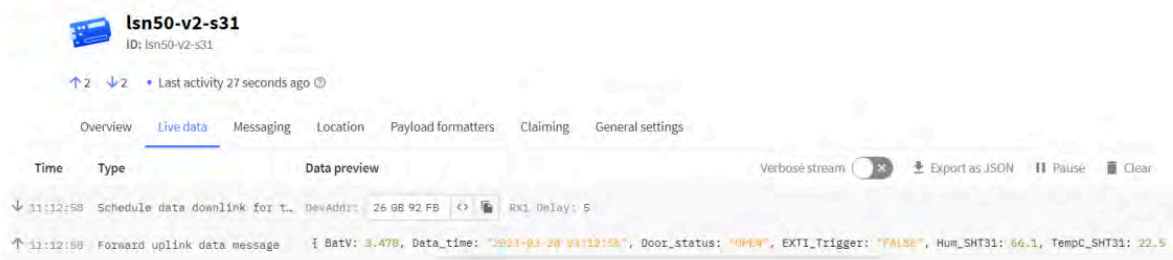
2.3 Uplink Payload

2.3.1 Payload Analyze

Normal Upload Payload:

LSN50v2-S31 use the same payload as LSn50v2 mod1, as below. (Since firmware version 1.8.0, the third to sixth bytes are timestamps)

Size(bytes)	2	4	1	2	2
Value	Battery	Unix TimeStamp	Alarm Flag	Temperature	Humidity



Battery:

Check the battery voltage.

Ex1: 0x0B45 = 2885mV

Ex2: 0x0B49 = 2889mV

Temperature:

Example:

If payload is: 0105H: (0105 & 8000 == 0), temp = 0105H / 10 = 26.1 degree

If payload is: FF3FH : (FF3F & 8000 == 1) , temp = (FF3FH - 65536) / 10 = -19.3 degrees.

(FF3F & 8000: Judge whether the highest bit is 1, when the highest bit is 1, it is *negative*)

Humidity:

Read:0x(0197)=412 Value: 412 / 10=41.2, So 41.2%

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-S31/Decoder/

2.3.3 Historical Temperature and humidity of S31, FPORT=3 (Since **firmware** 1.8.0)

S31 stores sensor values and users can retrieve these history values via the [downlink command](#).

The historical payload includes one or multiplies entries and every entry has the same payload as Real-Time water flow status.

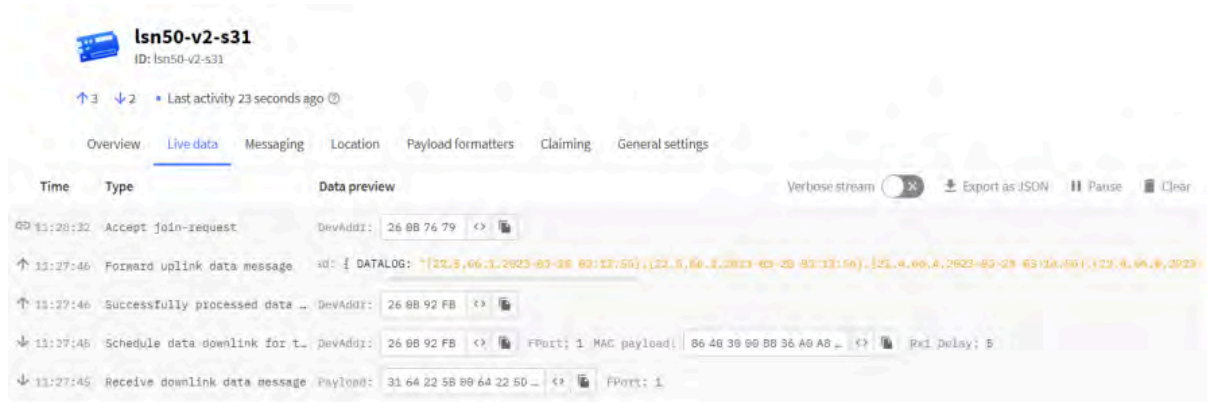
- Each data entry is 11 bytes and has the same structure as real time water flow status, to save airtime and battery, S31 will send max bytes according to the current DR and Frequency bands.

For example, in the US915 band, the max payload for different DR is:

- DR0:** max is 11 bytes so one entry of data
- DR1:** max is 53 bytes so devices will upload 4 entries of data (total 44 bytes)
- DR2:** total payload includes 11 entries of data
- DR3:** total payload includes 22 entries of data.

If S31 doesn't have any data in the polling time. It will uplink 11 bytes of 0

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Downlink:

0x 31 64 22 5B 00 64 22 5D 58 05

Uplink:

00 00 00 00 E1 02 95 64 22 5B 37 00 00 00 00 E1 02 97 64 22 5B 74 00 00 00 00 E0 02 98 64 22 5B B0 00 00 00 00 E0 02 9C 64 22 5B EC 00 00 00 00 E0 02 9C 64 22 5C 28 00 00 00 00 DF 02 9D 64 22 5C 64 00 00 00 00 DF 02 9F 64 22 5C A0 00 00 00 00 DE 02 A0 64 22 5C DC 00 00 00 00 DE 02 A9 64 22 5D 18 00 00 00 00 DE 02 A4 64 22 5D 54

Parsed Value:

[Temperature, Humidity, Unix TimeStamp]

[22.5,66.1,2023-03-28 03:12:56],

[22.5,66.3,2023-03-28 03:13:56],

[22.4,66.4,2023-03-28 03:14:56],

[22.4,66.8,2023-03-28 03:15:56],

[22.4,66.8,2023-03-28 03:16:56],

[22.3,66.9,2023-03-28 03:17:56],

[22.3,67.1,2023-03-28 03:18:56]

[22.2,67.2,2023-03-28 03:19:56],

[22.2,68.1,2023-03-28 03:20:56],

[22.2,67.6,2023-03-28 03:21:56],

Serial port:

AT+PLDTA=10

Stop Tx events when read sensor data

```
1 23/3/28 03:12:55 bat:3478 temp=22.5 hum=66.1
2 23/3/28 03:13:56 bat:3468 temp=22.5 hum=66.3
3 23/3/28 03:14:56 bat:3468 temp=22.4 hum=66.4
4 23/3/28 03:15:56 bat:3468 temp=22.4 hum=66.8
5 23/3/28 03:16:56 bat:3468 temp=22.4 hum=66.8
6 23/3/28 03:17:56 bat:3468 temp=22.3 hum=66.9
7 23/3/28 03:18:56 bat:3468 temp=22.3 hum=67.1
8 23/3/28 03:19:56 bat:3468 temp=22.2 hum=67.2
9 23/3/28 03:20:56 bat:3468 temp=22.2 hum=68.1
10 23/3/28 03:21:56 bat:3468 temp=22.2 hum=67.6
```

Start Tx events

OK

2.4 Datalog Feature

2.4.1 Unix TimeStamp

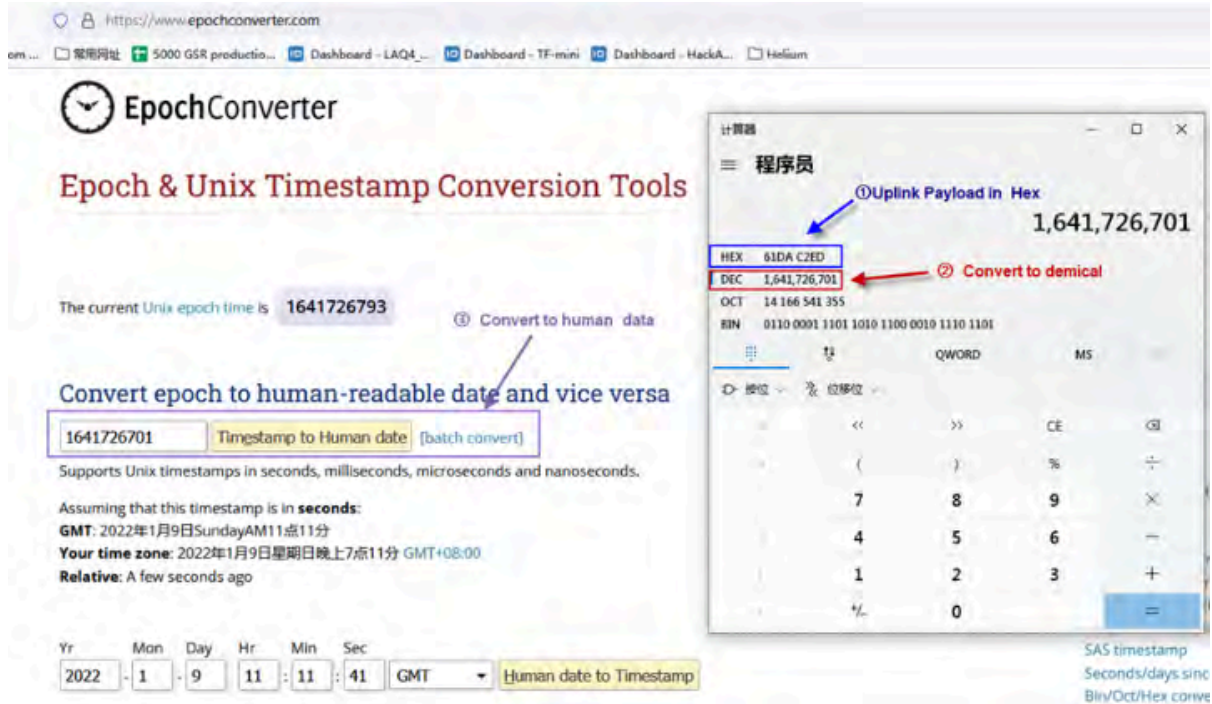
S31 uses Unix TimeStamp format based on

Size (bytes)	4	1
DeviceTimeAns Payload	32-bit unsigned integer : Seconds since epoch*	8bits unsigned integer: fractional-second in $\frac{1}{2}^8$ second steps

Figure 10 : DeviceTimeAns payload format

Users can get this time from the link: <https://www.epochconverter.com/> :

Below is the converter example



2.4.2 Set Device Time

Through LoRaWAN MAC Command

Once S31 Joined the LoRaWAN network, it will send the MAC command (DeviceTimeReq) and the server will reply with (DeviceTimeAns) to send the current time to S31. If S31 fails to get the time from the server, S31 will use the internal time and wait for the next time request.

Note: LoRaWAN Server needs to support LoRaWAN v1.0.3(MAC v1.0.3) or higher to support this MAC command feature.

2.4.3 Poll sensor value

Users can poll sensor values based on timestamps. Below is the downlink command.

Downlink Command to poll Open/Close status (0x31)			
1byte	4bytes	4bytes	1byte
31	Timestamp start	Timestamp end	Uplink Interval

Timestamp start and Timestamp end-use Unix TimeStamp format as mentioned above. Devices will reply with all data logs during this period, using the uplink interval.

For example, downlink command **31 618E5740 618E8170 05**

Is to check 2021/11/12 12:00:00 to 2021/11/12 15:00:00's data

Uplink Interval =5s, means CPL01 will send one packet every 5s. range 5~255s.

2.4.4 Clear Flash Record

Feature: Clear flash storage for data log feature.

AT Command: AT+CLRDTA

Command Example	Function	Response
AT+CLRDTA	Clear date record	Clear all stored sensor data... OK

2.4.5 Set system time

Feature: Set system time, Unix format. [See here for format detail.](#)

AT Command:

Command Example	Function	Response
AT+TIMESTAMP=1611104352	Set System time to 2021-01-20 00:59:12	OK

Downlink Command:

0x306007806000 // Set timestamp to 0x(6007806000), Same as AT+TIMESTAMP=1611104352

2.4.6 Set Time Sync Mode

Feature: Enable/Disable Sync system time via LoRaWAN MAC Command (DeviceTimeReq), LoRaWAN server must support v1.0.3 protocol to reply to this command.

SYNCMOD is set to 1 by default. If user wants to set a different time from the LoRaWAN server, the user needs to set this to 0.

AT Command:

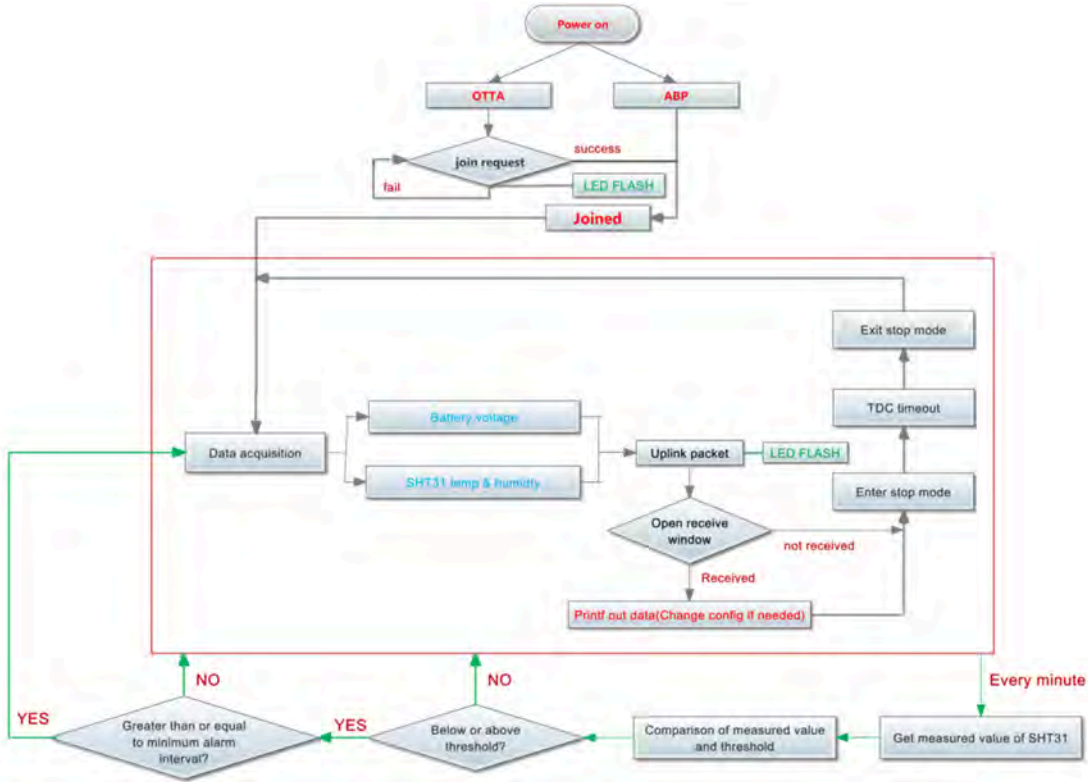
Command Example	Function	Response
AT+SYNCMOD=1	Enable Sync system time via LoRaWAN MAC Command (DeviceTimeReq) The default is zero time zone.	OK
AT+SYNCMOD=1,8	Enable Sync system time via LoRaWAN MAC Command (DeviceTimeReq) Set to East eight-time zone.	OK
AT+SYNCMOD=1,-12	Enable Sync system time via LoRaWAN MAC Command (DeviceTimeReq) Set to West Twelve Time Zone.	OK

Downlink Command:

0x28 01 // Same As AT+SYNCMOD=1
0x28 01 08 // Same As AT+SYNCMOD=1,8
0x28 01 F4 // Same As AT+SYNCMOD=1,-12
0x28 00 // Same As AT+SYNCMOD=0

2.5 Temperature & Humidity Alarm Feature

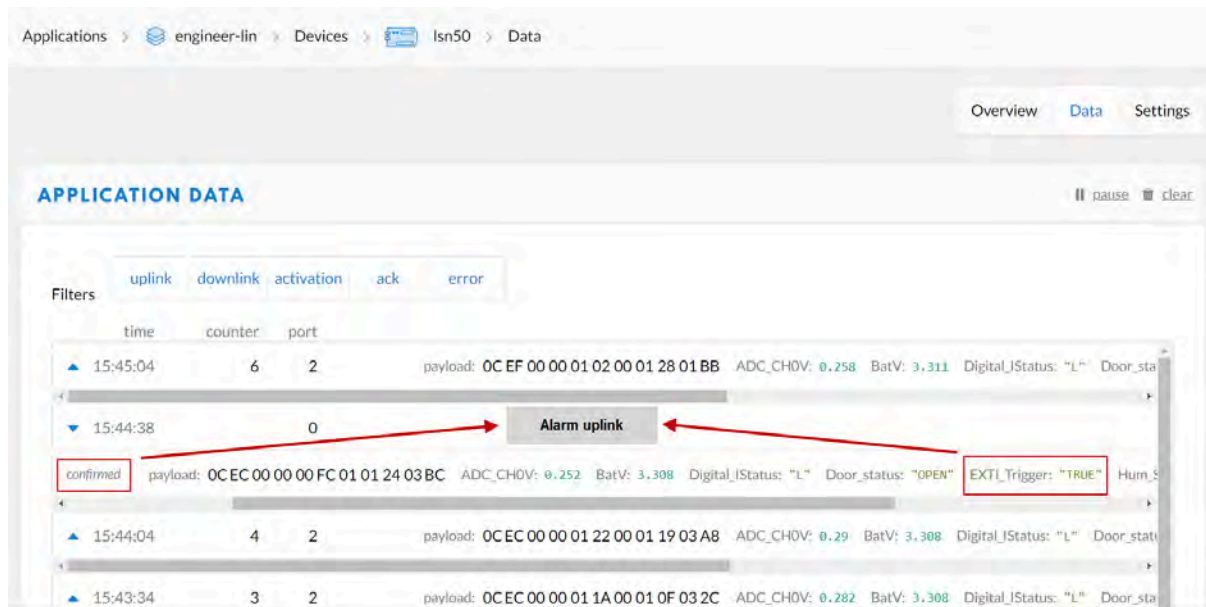
LSN50V2-S31 work flow with Alarm feature.



User can use **AT+SHTEMP** and **AT+SHHUM** command to set the alarm low limit or high limit. Device will check the temperature & Humidity every minute, if the temperature lower than low limit or greater than high limit. LSN50v2-S31 will send an **Alarm packet base on Confirmed Uplink Mode** to server.

Below is an example of the Alarm Packet.

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2.6 Configure LSN50v2-S31

LSN50V2-S31 supports configuration via LoRaWAN downlink command or AT Commands.

- Downlink command instructions for different platform: [Use Note for Server](#)(IoT LoRaWAN Server)
- AT Command Access Instructions: [LINK](#)

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

2.6.1 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: [End Device AT Commands and Downlink Commands](#)

2.6.2 Sensor related commands

Set Temperature Alarm Threshold:

- **AT Command:**

AT+SHTEMP=min,max

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

Example:

AT+SHTEMP=0,30 // Alarm when temperature higher than 30.

- **Downlink Payload:**

0x(0C 01 00 1E) //Set AT+SHTEMP=0,30

(note: 3rd byte= 0x00 for low limit(not set), 4th byte = 0x1E for high limit: 30)

Set Humidity Alarm Threshold:

- **AT Command:**

AT+SHHUM=min,max

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

Example:

AT+SHHUM=70,0 // Alarm when humidity lower than 70%.

- **Downlink Payload:**

0x(0C 02 46 00) //Set AT+SHHUM=70,0

(note: 3rd byte= 0x46 for low limit (70%), 4th byte = 0x00 for high limit (not set))

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

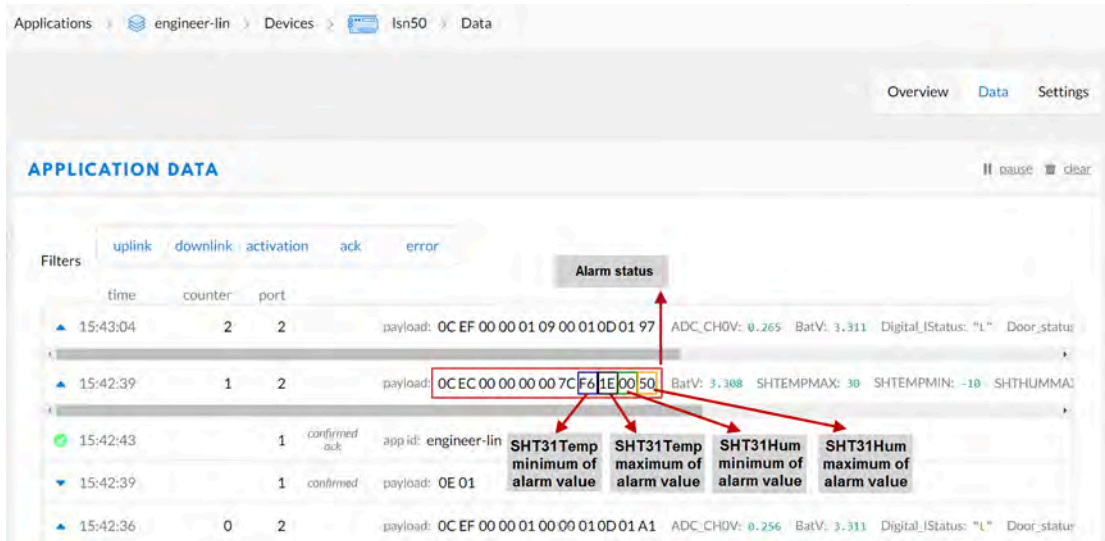
Poll the Alarm settings:

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.

2.7 LED Status

LSN50-v2-S31 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.

2.8 Button Function

Internal RESET button:

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

2.9 Firmware Change Log

Firmware version and change log please see: [See this link.](#)

3. Battery & Power Consumption

LSN50v2-S31 uses ER26500 + SPC1520 battery pack. See below link for detail information about the battery info and how to replace.

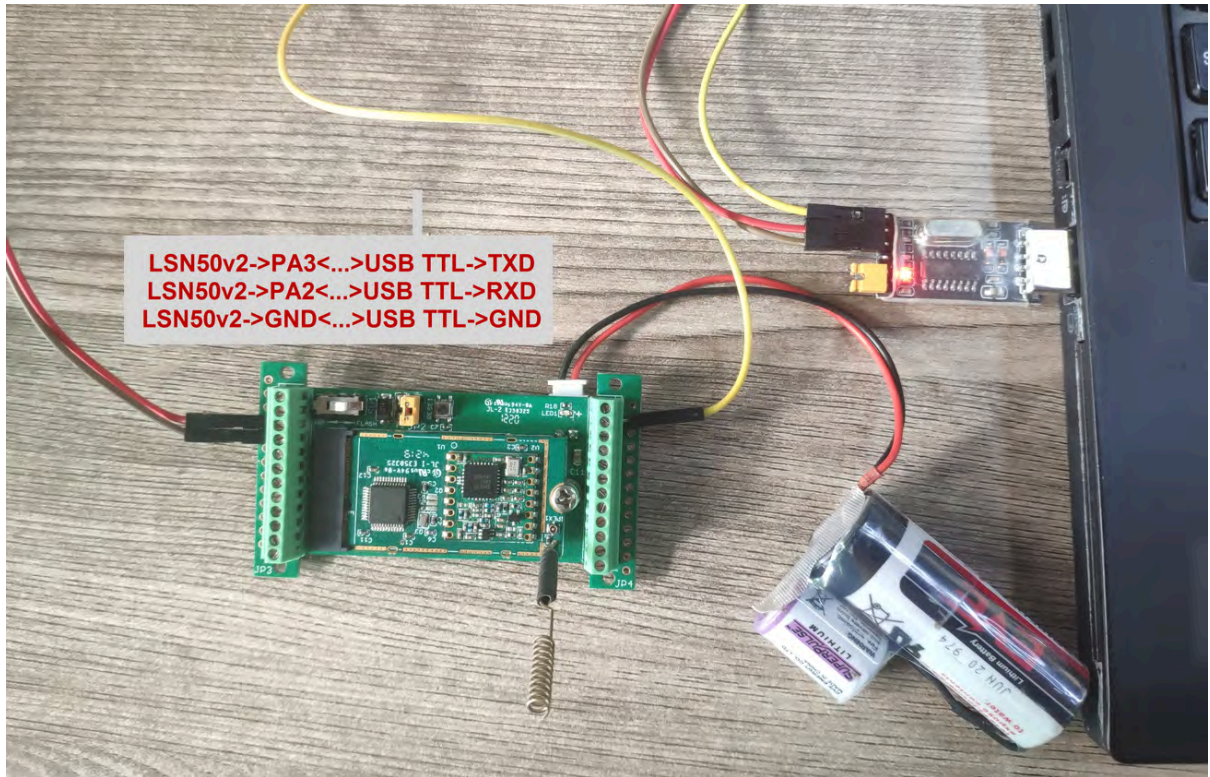
[Battery Info & Power Consumption Analyze](#) .

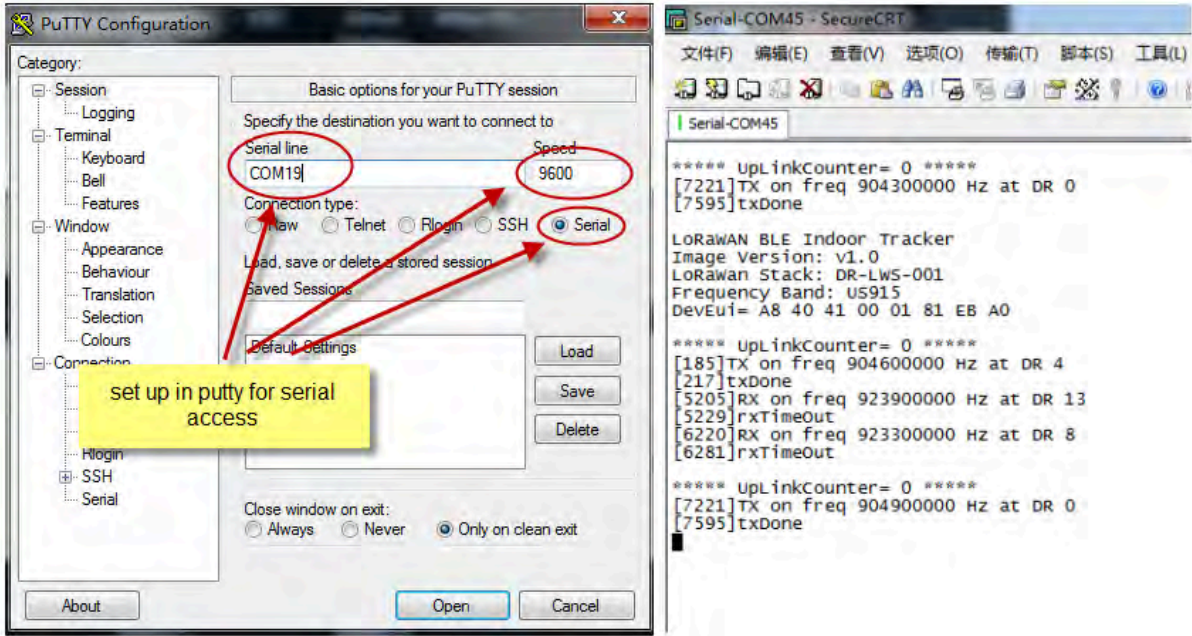
4. Use AT Command

4.1 Access AT Commands

User Manual for LoRaWAN End Nodes - LSN50v2-S31- S31B LoRaWAN Temperature & Humidity Sensor User Manual

User can use a USB to TTL adapter to connect to LSN50V2-S31 to use AT command to configure the device.
Example is as below:





5. FAQ

5.1 What is the frequency range of LSN50v2-S31?

Different LSN50V2-S31 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: [End Device Frequency Band](#)

5.3 How to update the firmware?

User can upgrade the firmware for:

- Support new features
- For bug fix
- Change LoRaWAN bands.

Please see this link for how to upgrade: [Firmware Upgrade Instruction](#)

6. Trouble Shooting

6.1 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.

6.2 Abnormal temperature

When the temperature is displayed as - 0.1, it means that the sensor is not connected.

Please check whether the wiring is loose/Blocked by the insulation layer of the wire/pin damaged

7. Order Info

Part Number: **LSN50V2-S31-XXX** Or **LSN50V2-S31B-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

8. Packing Info

Package Includes:

- **LSN50V2-S31** or **LSN50V2-S31B** LoRaWAN Temperature Sensor x 1

Dimension and weight:

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

9. 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.