Dragino Docs

SE0X-LB

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SE0X-LB





1. Introduction

1.1 What is LoRaWAN Soil Moisture & EC Sensor

The Dragino SE0X-LB is a **LoRaWAN Soil Moisture & EC Sensor** for Agri-IoT with up to 4 sensor probes. It is designed to measure the **soil moisture of saline-alkali soil and loamy soil**. The soil sensor uses **FDR method** to calculate the soil moisture with the compensation from soil temperature and conductivity. It also has been calibrated in factory for Mineral soil type.

It detects **Soil Moisture**, **Soil Temperature** and **Soil Conductivity**, and uploads the value via wireless to LoRaWAN IoT Server.

The LoRa wireless technology used in SE0X-LB allows device to send data and reach extremely long ranges at low data-rates. It provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption.

SE0X-LB **supports BLE configure** and **wireless OTA update** which make user easy to use.

SE0X-LB is powered by **8500mAh Li-SOCI2 battery ,** it is designed for long term use up to 5 years.

Each SE0X-LB is pre-load with a set of unique keys for LoRaWAN registrations, register these keys to local LoRaWAN server and it will auto connect after power on.



Green House



Orchard Nursery



Farmland



Soil Research

1.2 Features

- LoRaWAN 1.0.3 Class A
- Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865
- Ultra-low power consumption
- Up to 4 external sensor probes, probe length: 3.5 meters
- Monitor Soil Moisture
- Monitor Soil Temperature
- Monitor Soil Conductivity
- Support Bluetooth v5.1 and LoRaWAN remote configure
- Support wireless OTA update firmware
- AT Commands to change parameters
- Downlink to change configure
- IP66 Waterproof Enclosure
- 8500mAh Li/SOCI2 Battery

1.3 Specification

Common DC Characteristics:

- Supply Voltage: Built-in Battery , 2.5v ~ 3.6v
- Operating Temperature: -40 ~ 85°C

Soil Moisture:

- Range: 0-100.00 V/V %
- Resolution: 0.01 V/V %
- Accuracy: ±3% (0-53%)V/V %, ±5% (>53%) V/V %
- Measure Method: FDR , with temperature &EC compensate

Soil Temperature

- Range: -40.00℃ ~ 85.00℃
- Resolution: 0.01℃
- Accuracy: -10℃ ~ 50℃:<0.3℃ ,All other: <0.6℃
- Measure Method: RTD, and calibrate

Soil Conductivity

- Range: 0-20000 uS/cm(25℃)(0-20.0EC)
- Resolution: 1 uS/cm
- Accuracy: 2%FS
- Measure Method: Conductivity , with temperature compensate

LoRa Spec:

- Frequency Range, Band 1 (HF): 862 ~ 1020 Mhz
- Max +22 dBm constant RF output vs.
- RX sensitivity: down to -139 dBm.
- Excellent blocking immunity

Battery:

- Li/SOCI2 un-chargeable battery
- Capacity: 8500mAh
- Self-Discharge: <1% / Year @ 25°C
- Max continuously current: 130mA
- Max boost current: 2A, 1 second

Power Consumption

- Sleep Mode: 5uA @ 3.3v
- LoRa Transmit Mode: 125mA @ 20dBm, 82mA @ 14dBm

1.4 Applications

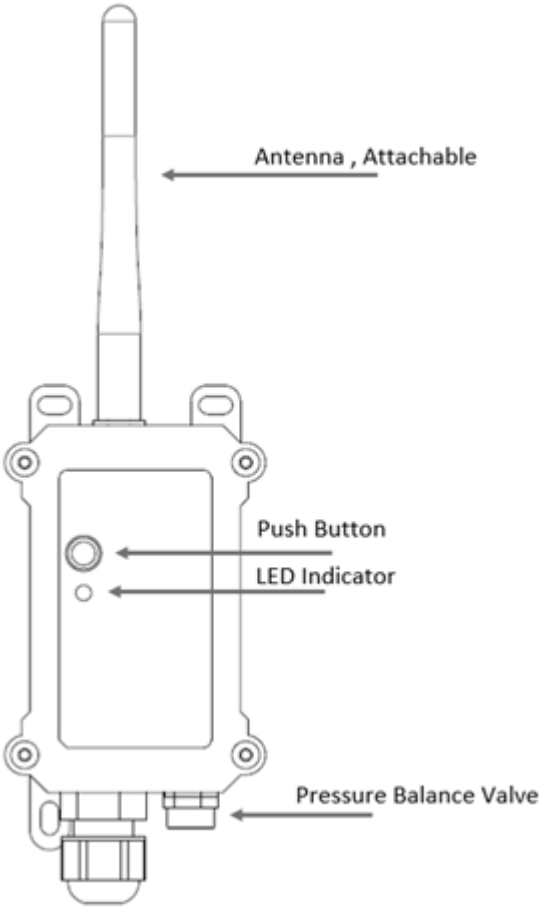
- Smart Agriculture

1.5 Sleep mode and working mode

Deep Sleep Mode: Sensor doesn't have any LoRaWAN activate. This mode is used for storage and shipping to save battery life.

Working Mode: In this mode, Sensor will work as LoRaWAN Sensor to Join LoRaWAN network and send out sensor data to server. Between each sampling/tx/rx periodically, sensor will be in IDLE mode), in IDLE mode, sensor has the same power consumption as Deep Sleep mode.

1.6 Button & LEDs



Behavior on ACT	Function	Action
 1~3s	Send an uplink	If sensor is already Joined to LoRaWAN network, sensor will send an uplink packet, **blue led** will blink once. Meanwhile, BLE module will be active and user can connect via BLE to configure device.
 >3s	Active Device	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. Once sensor is active, BLE module will be active and user can connect via BLE to configure device, no matter if device join or not join LoRaWAN network.
 x5	Deactivate Device	Red led will solid on for 5 seconds. Means device is in Deep Sleep Mode.

1.7 BLE connection

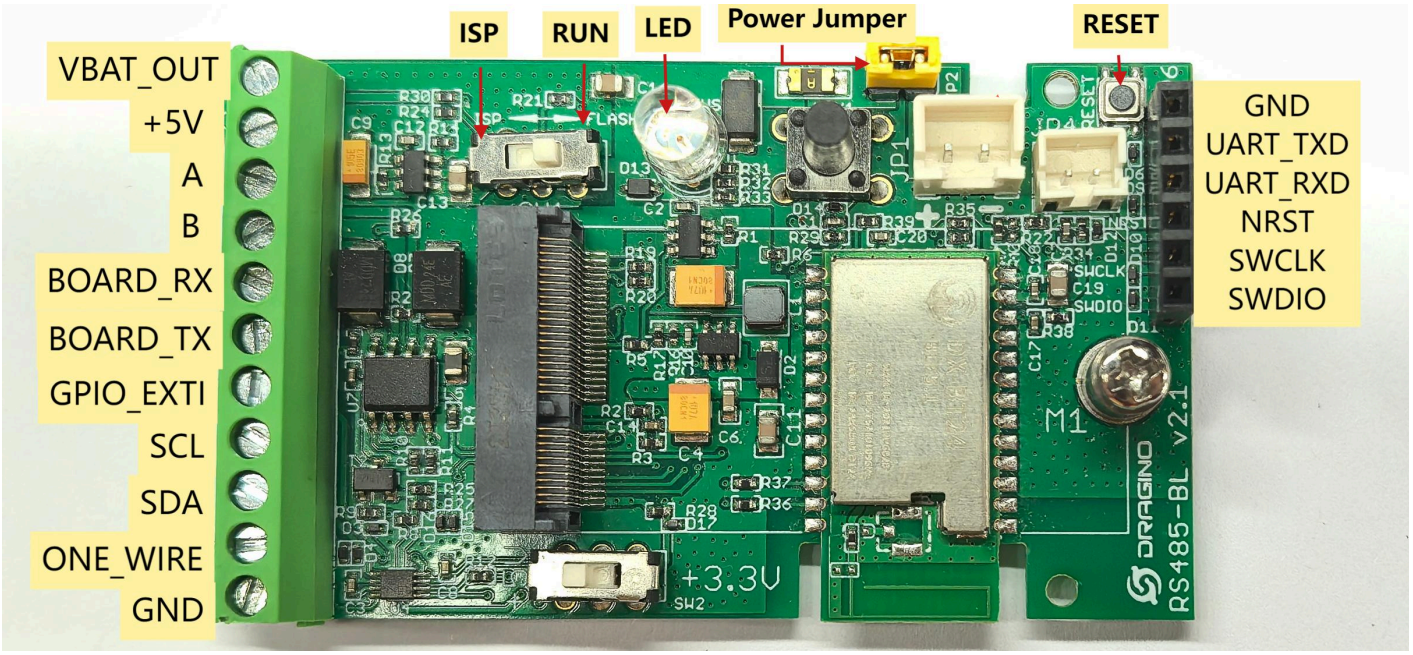
SE0X-LB support BLE remote configure.

BLE can be used to configure the parameter of sensor or see the console output from sensor. BLE will be only activate on below case:

- Press button to send an uplink
- Press button to active device.
- Device Power on or reset.

If there is no activity connection on BLE in 60 seconds, sensor will shut down BLE module to enter low power mode.

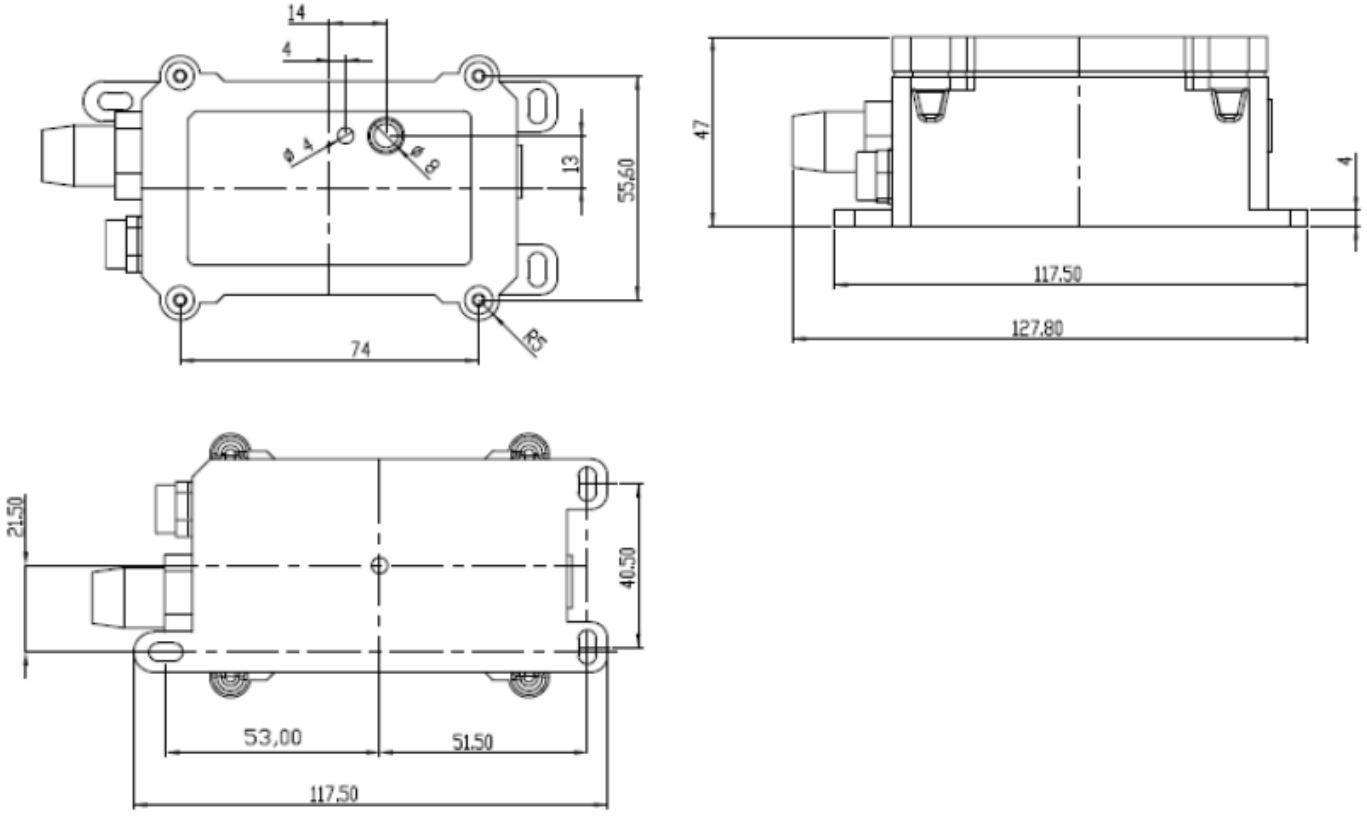
1.8 Pin Definitions



1.9 Mechanical

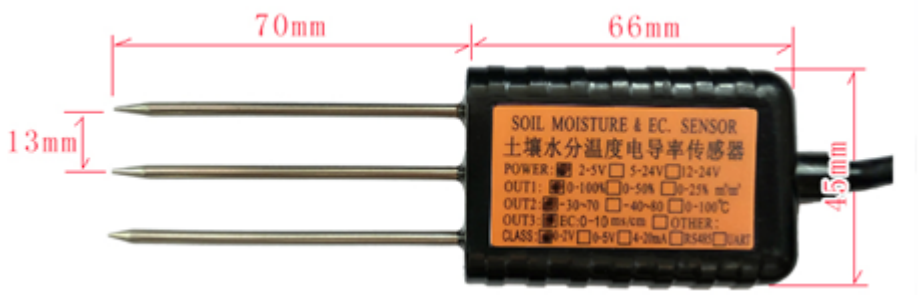
1.9.1 for LB version

Main Device Dimension:



1.9.2 for sensor

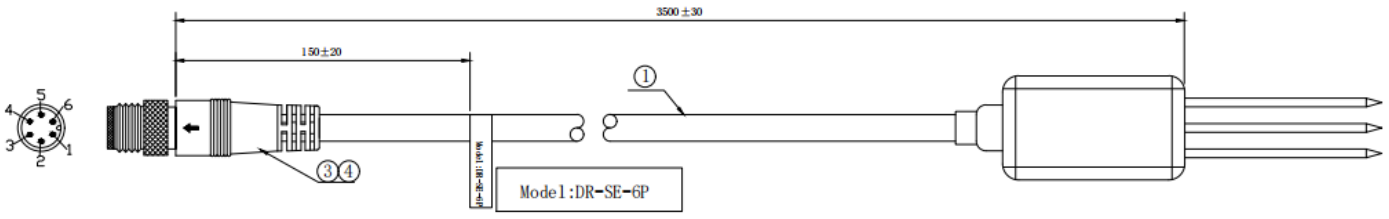
Probe Dimension:



1.9.3 for sensor cable

Cable size:

Total cable length: 3500mm, deviation ±30mm



2. Configure SE0X-LB to connect to LoRaWAN network

2.1 How it works

The SE0X-LB 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 SE0X-LB. It will automatically join the network via OTAA and start to send the sensor value. The default uplink interval is 20 minutes.

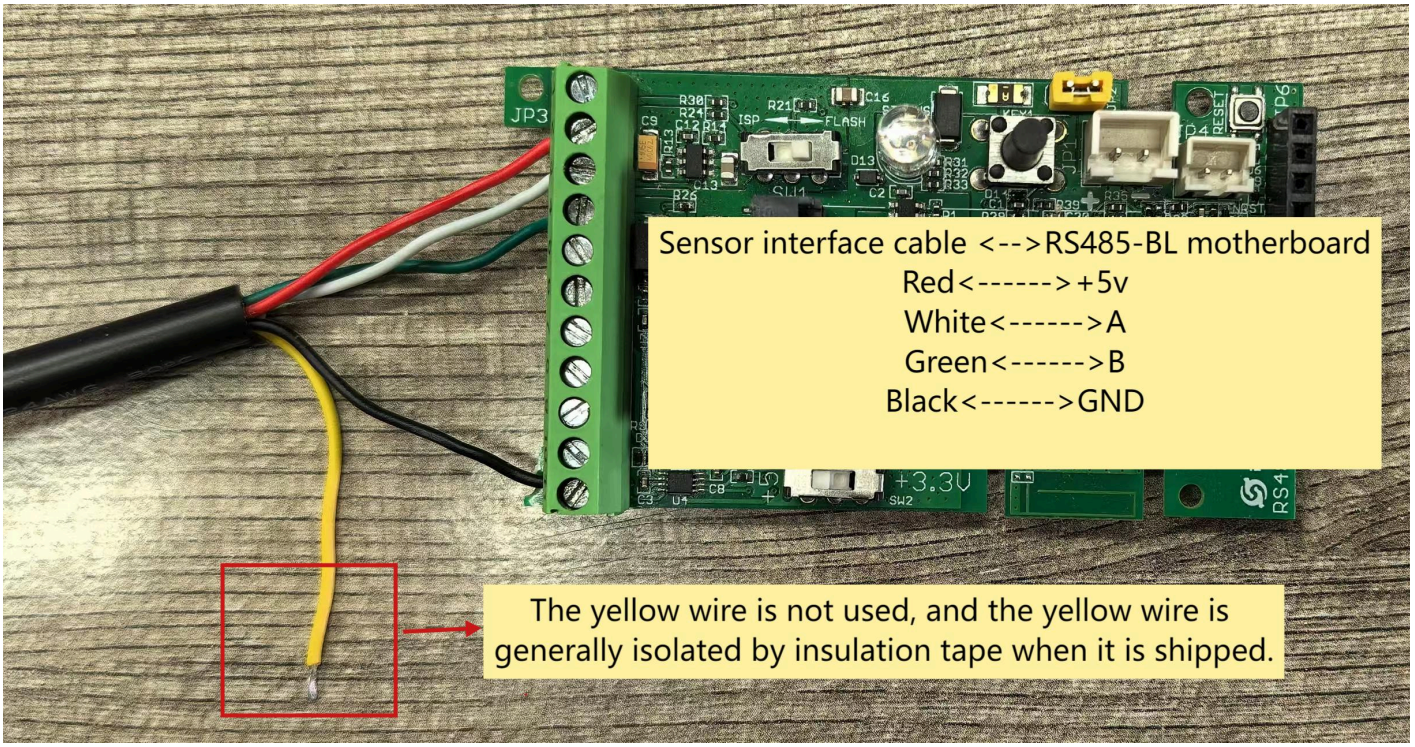
Soil Sensor Address Configuration

All soil sensors are shipped with **default address 0x01**.

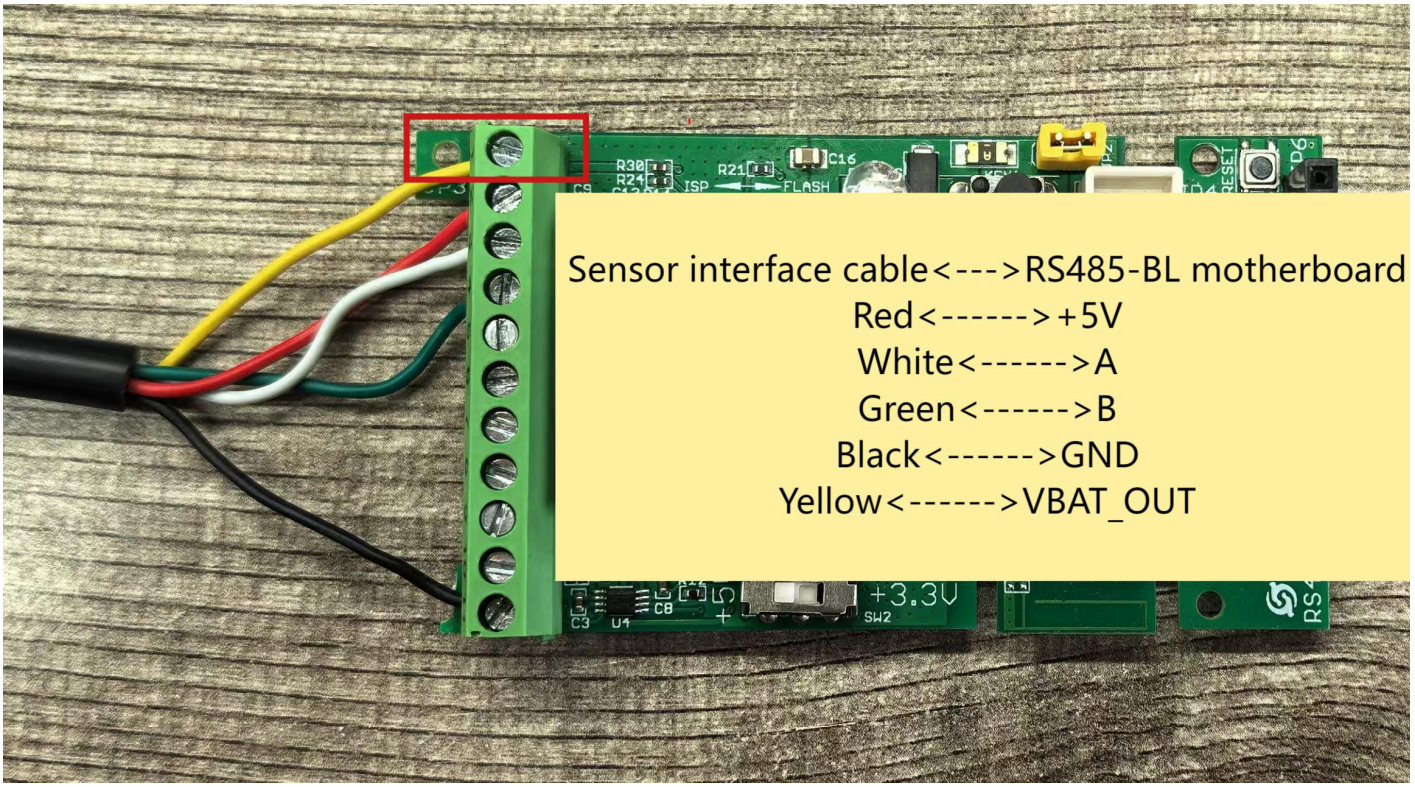
Do not use the same address repeatedly on the same node, otherwise the data will conflict, so if you connect more than 1 sensor to the SE0X-LB node, you need to follow the steps below to change the address (supported addresses: **01-04**): **Step 1**: Keep the default address **01** for the **first sensor**. No modification or operation is required. **Step 2**: Connect the **second sensor**, and change its address to **02**. **Step 3**: ** ** Disconnect the second sensor, connect the **third sensor**, and change its address to **03**. **Step 3**: Repeat Step 3 to assign address **04** to the **fourth sensor**. **For details, see Configure Methods in 3.1 and Command Description in 3.3.5.**

Connection:

- Wiring during sensor operation:



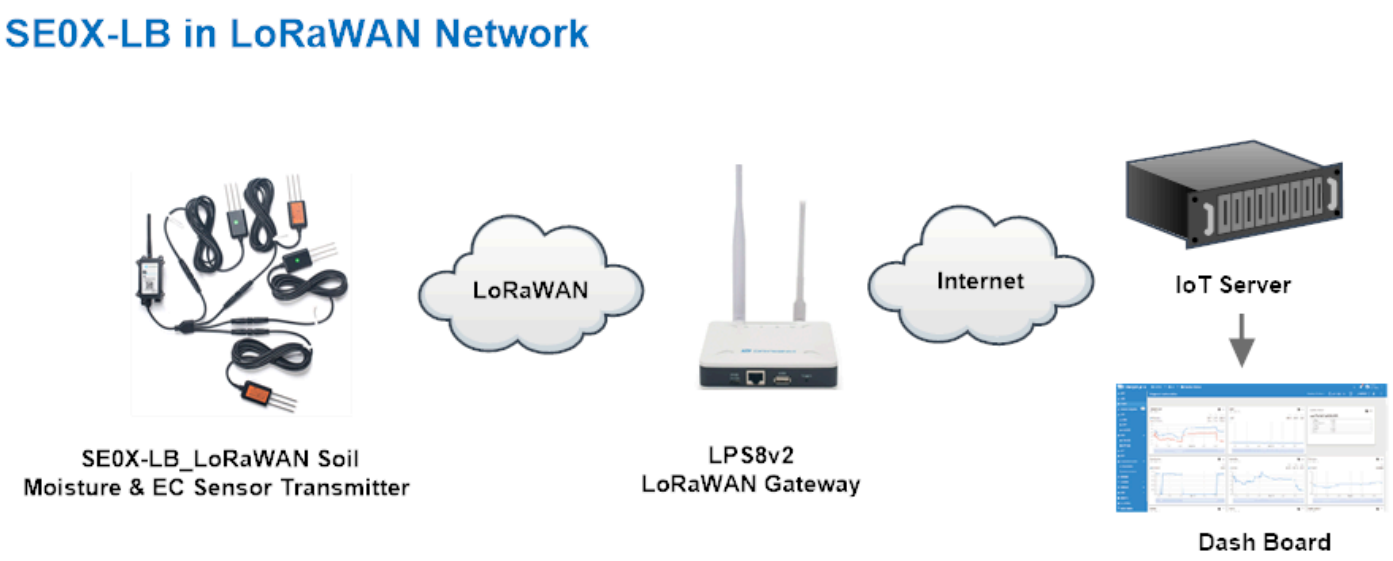
- Wiring when changing the sensor address:



📘 **Note The yellow wire is only used when the address of the sensor is modified. After the address of the sensor is successfully modified, please disconnect the yellow cable and use tape to isolate the wire core to prevent the yellow wire from touching the motherboard element and causing a short circuit.**

2.2 Quick guide to connect to LoRaWAN server (OTAA)

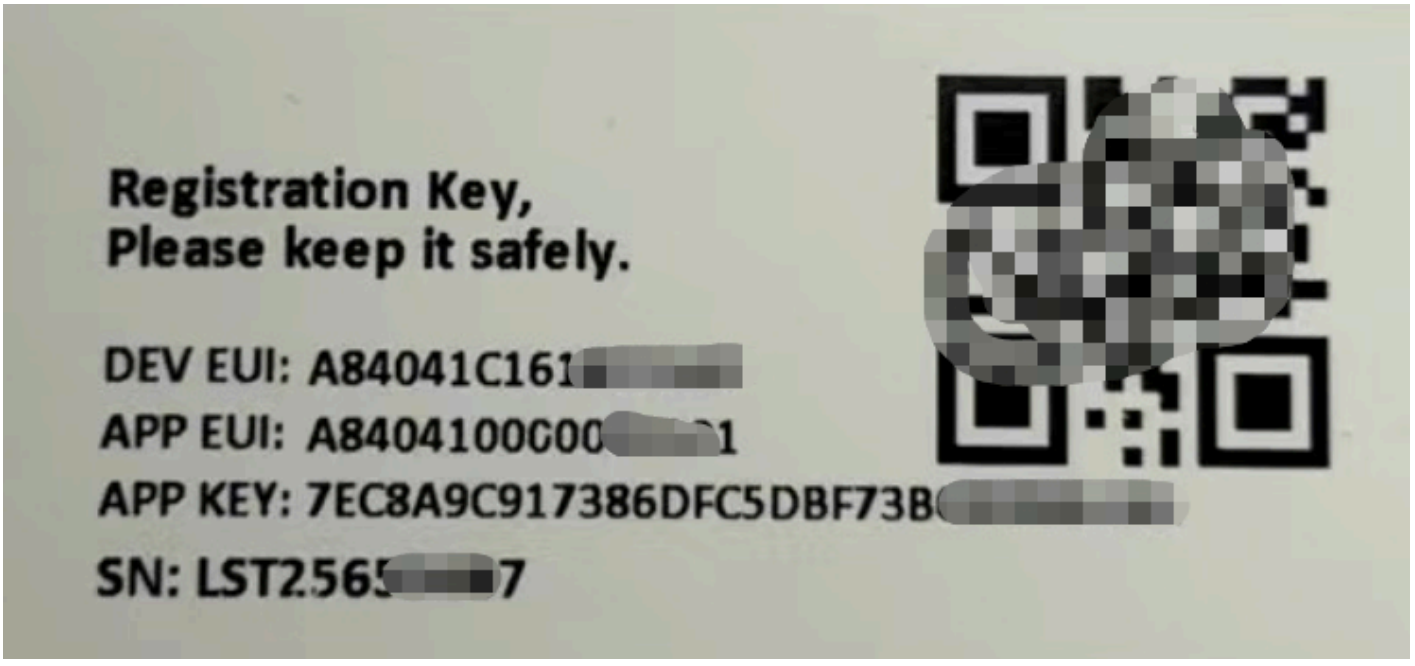
Following is an example for how to join the TTN v3 LoRaWAN Network. Below is the network structure; we use the LPS8v2 as a LoRaWAN gateway in this example.



The LPS8v2 is already set to connected to TTN network , so what we need to now is configure the TTN server.

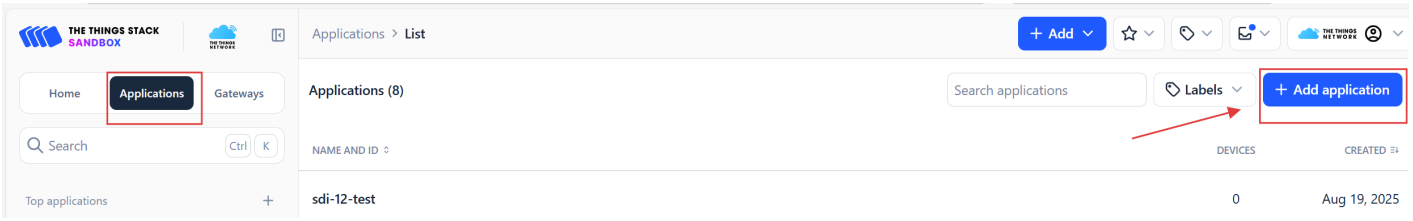
Step 1: Create a device in TTN with the OTAA keys from SE0X-LB.

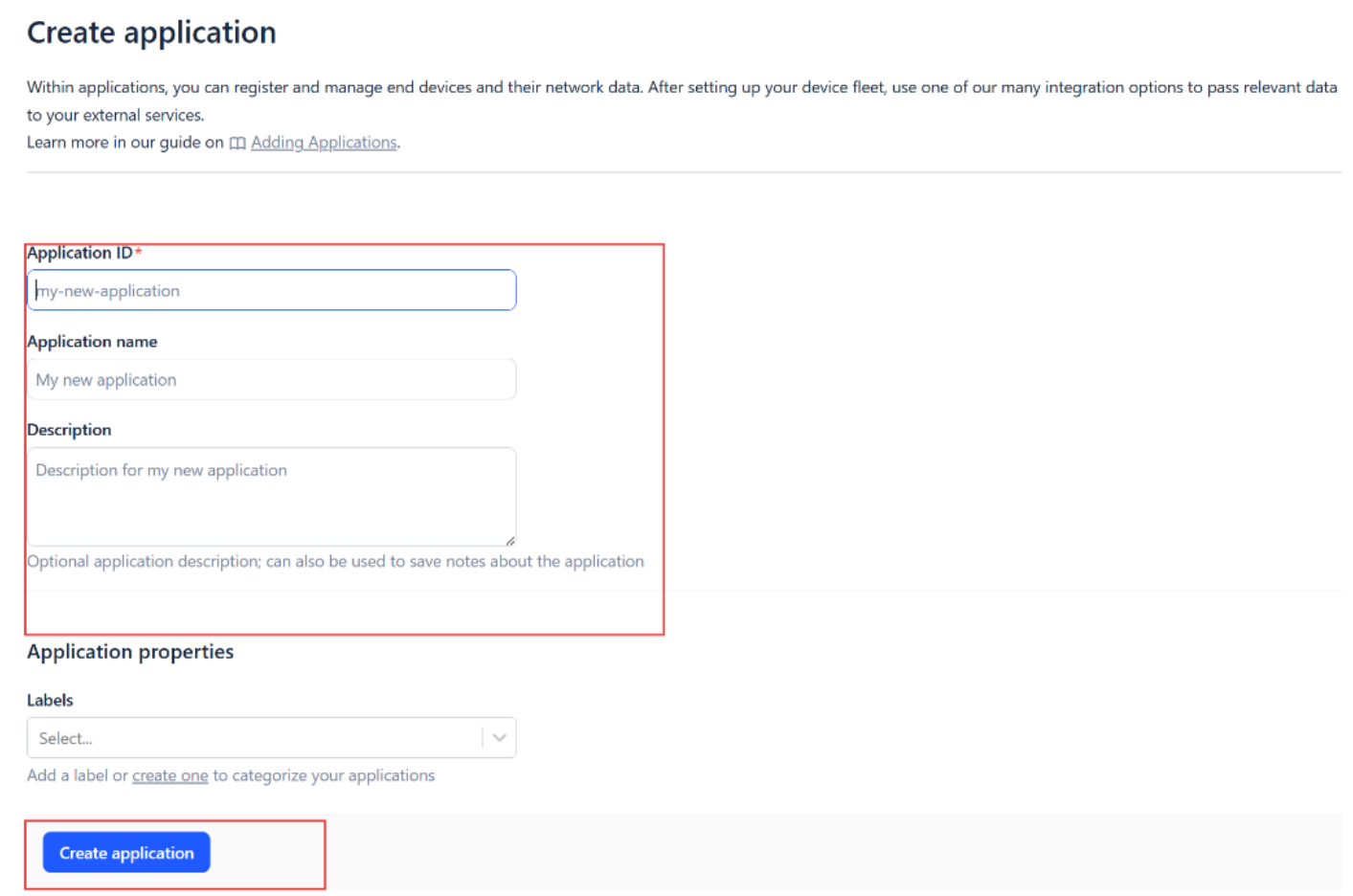
Each SE0X-LB is shipped with a sticker with the default device EUI as below:



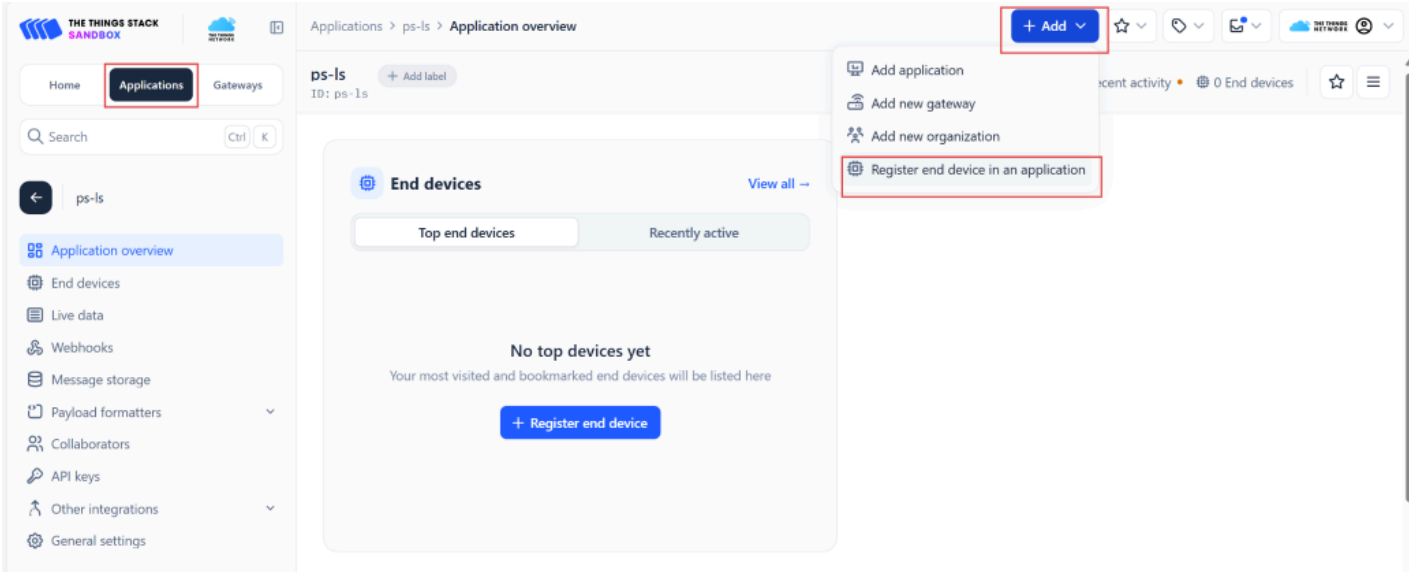
You can enter this key in the LoRaWAN Server portal. Below is TTN screen shot:

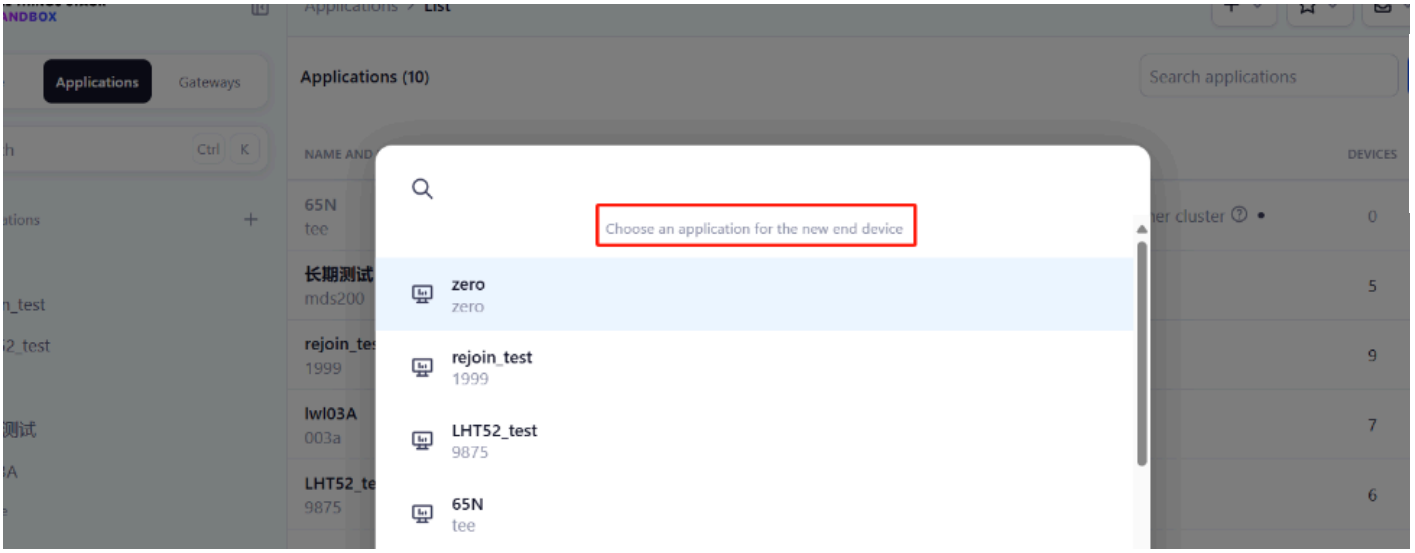
Create the application.



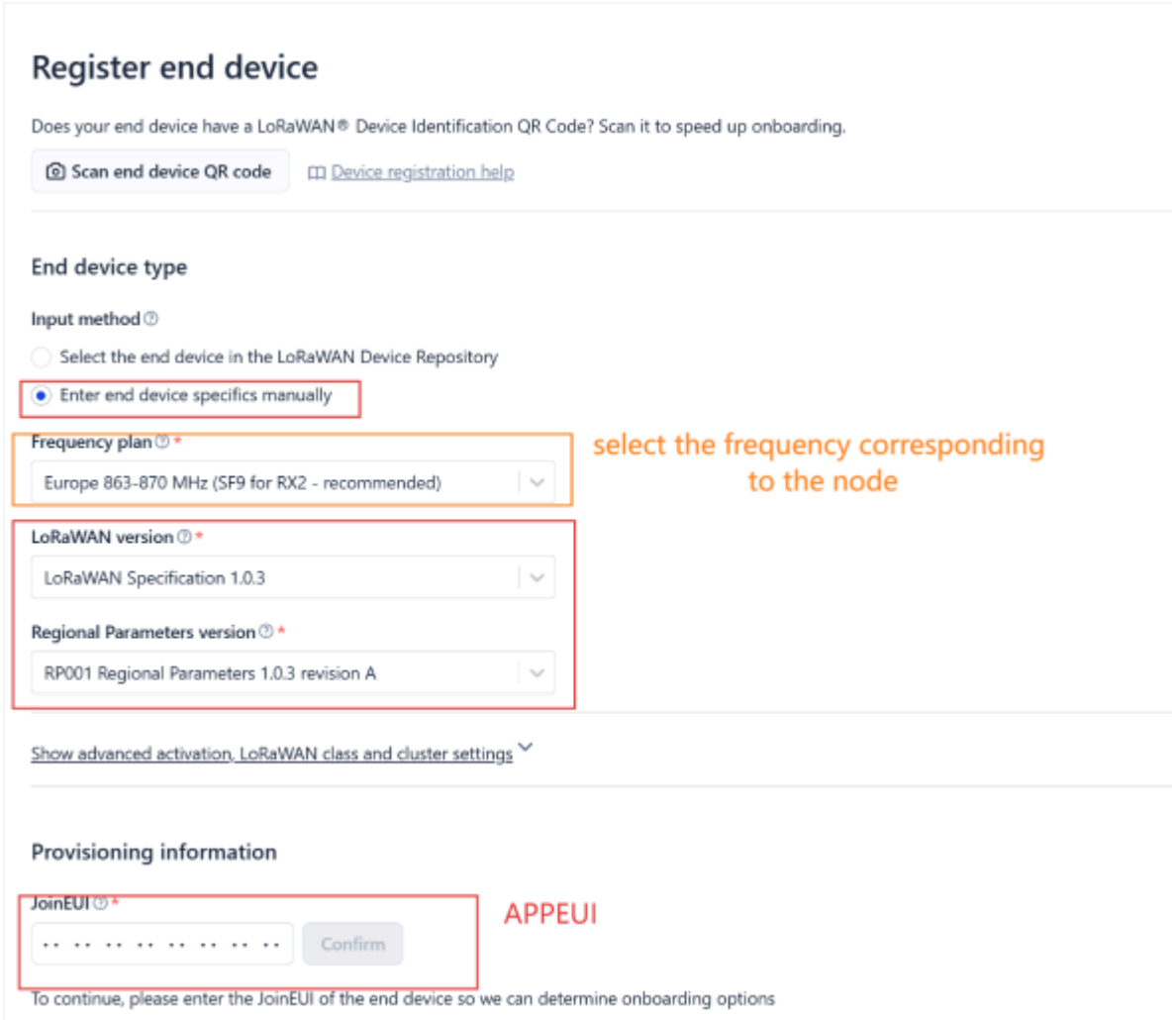


Add devices to the created Application.

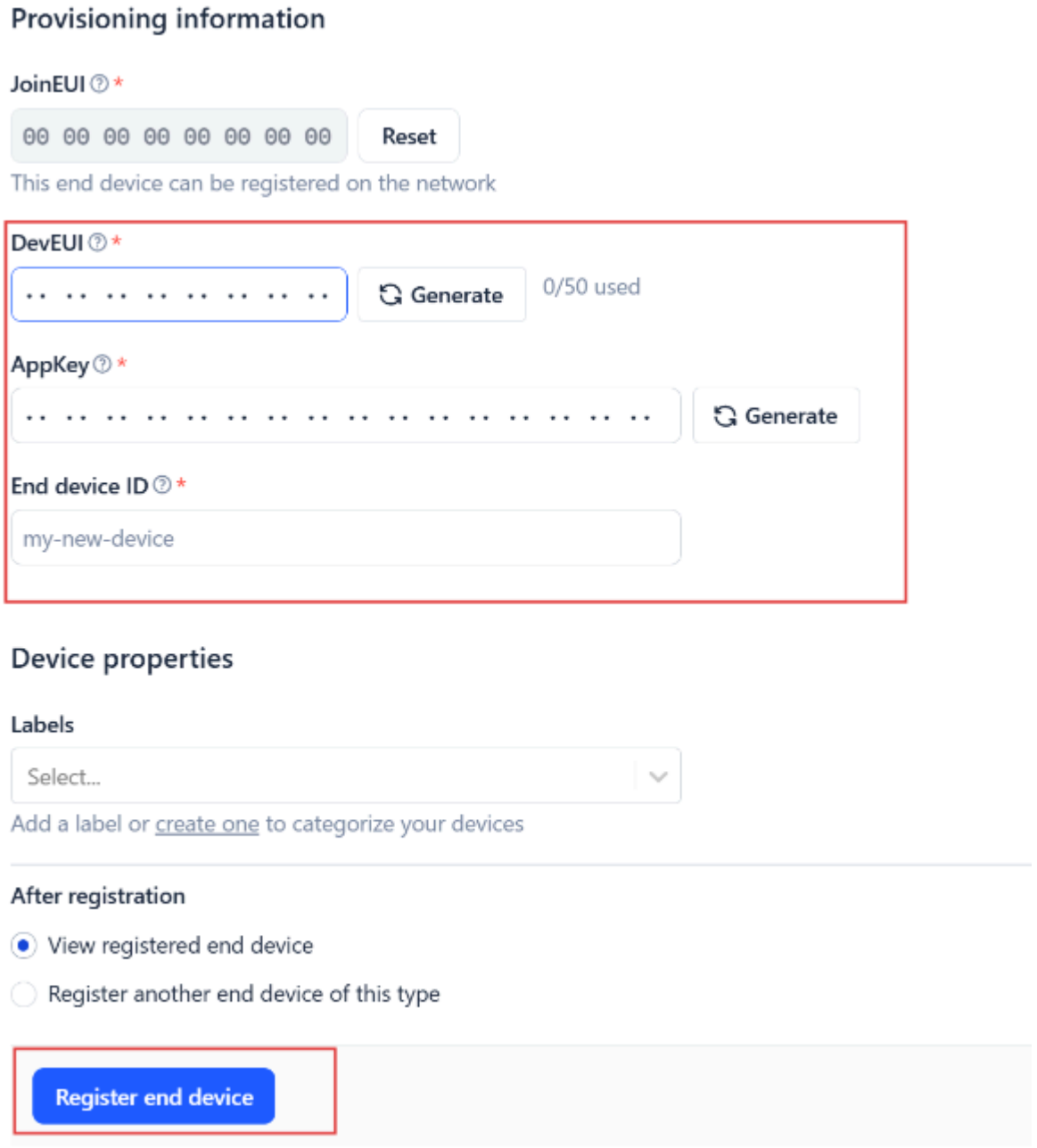




Enter end device specifics manually.



Add DevEUI and AppKey. Customize a platform ID for the device.

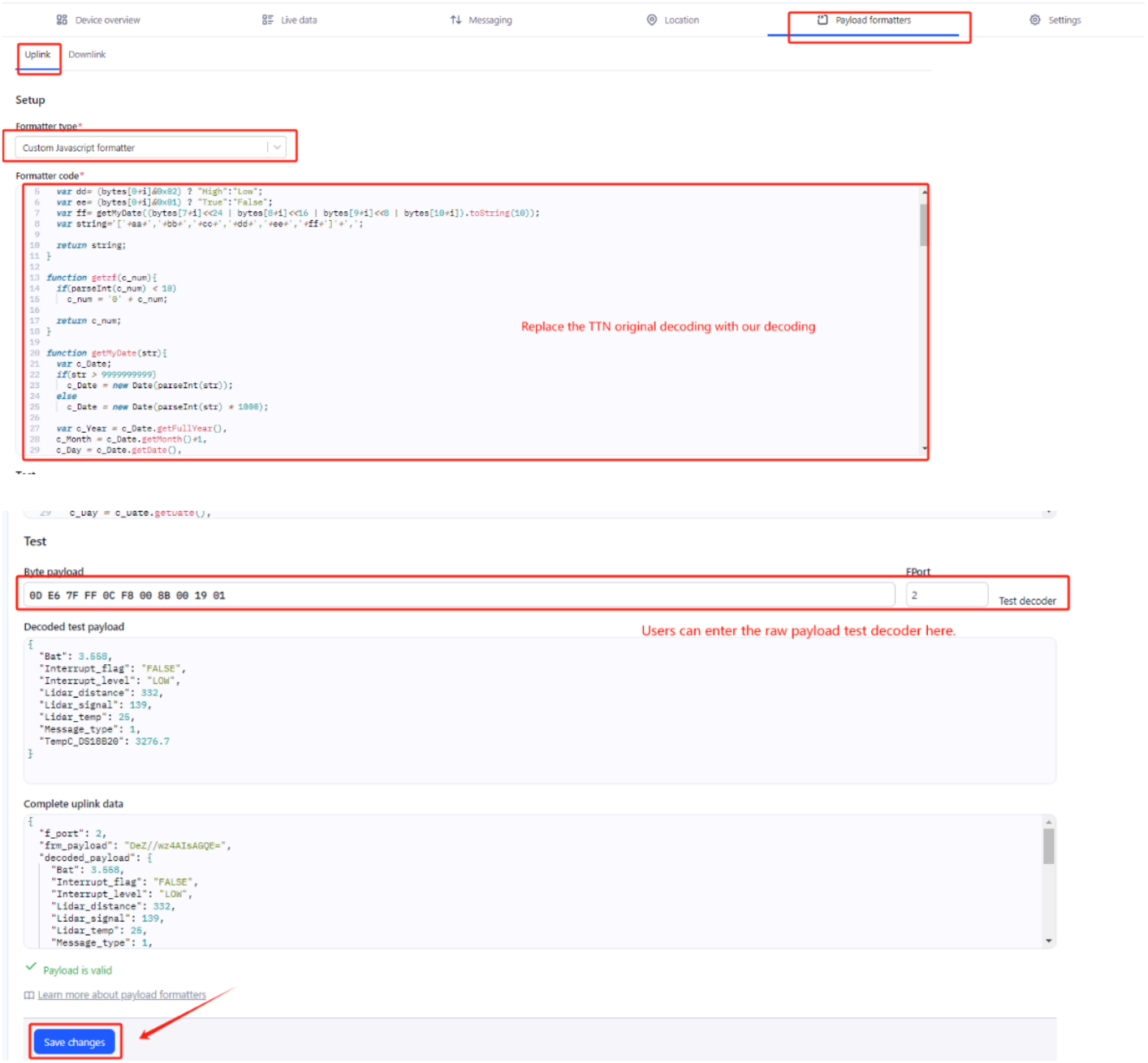


Step 2: Add decoder.

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

Click this link to get the decoder: https://github.com/dragino/dragino-end-node-decoder/tree/main/

Below is TTN screen shot:



Step 3: Activate on SE0X-LB

Press the button for 5 seconds to activate the SE0X-LB.

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 MOD=0(Default Mode), FPORT=2

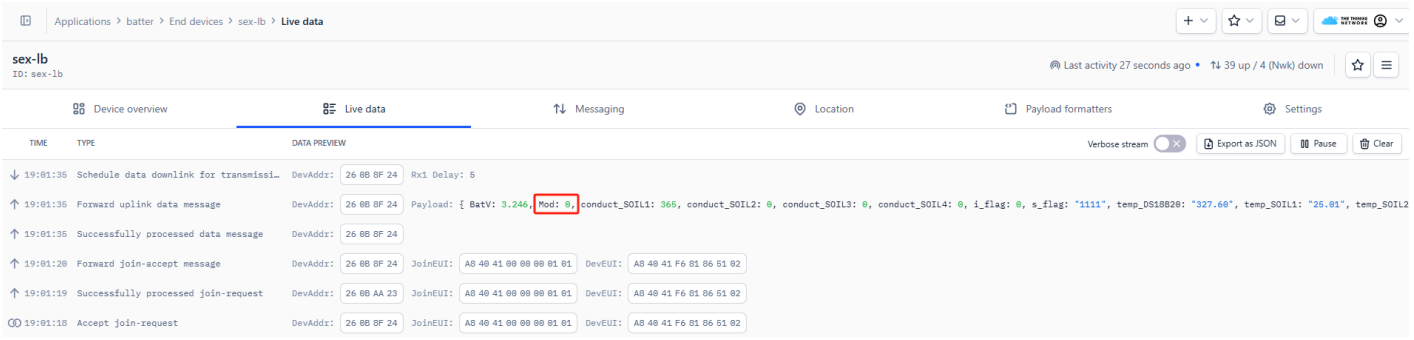
SE0X-LB will uplink payload via LoRaWAN with below payload format:

(📘 **Note When 4 sensors are recognized, the number of bytes in the uplink is 29; When 3 sensors are recognized, the number of uplink bytes is 23; When 2 sensors are recognized, the number of bytes in the upper row is 17; When 1 sensor is recognized, the number of bytes in the uplink is 11;**)

Uplink payload to recognize 4 sensors 29 bytes as an example.

Size(bytes)	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2
value	BAT	DS18B20_ Temperature	MOD & Interrupt_flag & Sensor_flag	Soil Moisture 1	Soil Temperature 1	Soil Conductivity 1 (EC)	Soil Moisture 2	Soil Temperature 2	Soil Conductivity 2 (EC)	Soil Moisture 3	Soil Temperature 3	Soil Conductivity3 (EC)	Soil Moisture 4	Soil Temperature 4	Soil Conductivity4 (EC)

Example in TTN:

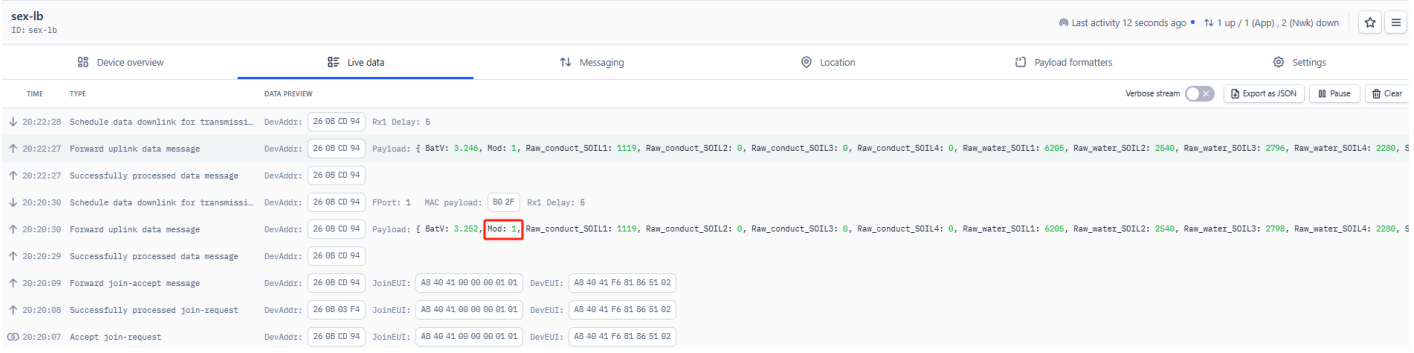


2.3.2 MOD=1(Original value), FPORT=2

This mode can get the original AD value of moisture and original conductivity (with temperature drift compensation).

Size(bytes)	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2
value	BAT	DS18B20_ Temperature	MOD & Interrupt_flag & Sensor_flag	Soil_dielectric _constant1	Raw_water_ SOIL1	Raw_conduct_ SOIL1	Soil_dielectric _constant2	Raw_water_ SOIL2	Raw_conduct_ SOIL2	Soil_dielectric _constant3	Raw_water_ SOIL3	Raw_conduct_ SOIL3	Soil_dielectric _constant4	Raw_water_ SOIL4	Raw_conduct _SOIL4

Example in TTN:



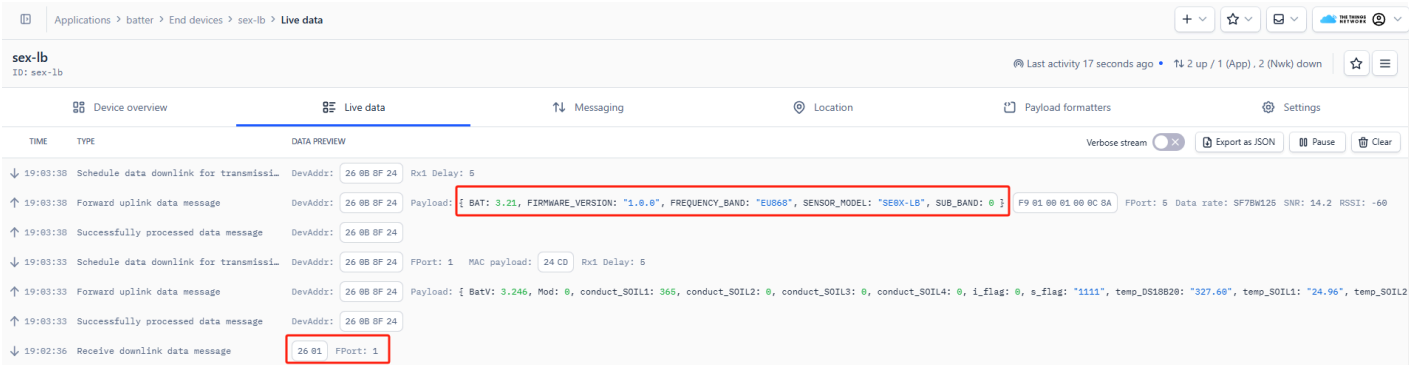
2.3.3 Device Status, FPORT=5

Users can use the downlink command(**0x26 01**) to ask SE0X-LB to send device configure detail, include device configure status. SE0X-LB will uplink a payload via FPort=5 to server.

The Payload format is as below.

Device Status (FPORT=5)

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



- **Sensor Model:** For SE0X-LB, this value is 0xF9
- **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: 0x0C8A = 3210mV

Ex2: 0x0B49 = 2889mV

2.3.4 Battery Info

Check the battery voltage for SE0X-LB.

Ex1: 0x0C8A = 3210mV

Ex2: 0x0B49 = 2889mV

2.3.5 Soil Moisture

Get the moisture content of the soil. The value range of the register is 0-10000(Decimal), divide this value by 100 to get the percentage of moisture in the soil.

For example, if the data you get from the register is **0x05 0xDC**, the moisture content in the soil is **05DC(H) = 1500(D) /100 = 15%.**

2.3.6 Soil Temperature

Get the temperature in the soil. The value range of the register is -4000 - +800(Decimal), divide this value by 100 to get the temperature in the soil. For example, if the data you get from the register is 0x09 0xEC, the temperature content in the soil is

Example:

If payload is 0105H: ((0x0105 & 0x8000)>>15 === 0),temp = 0105(H)/100 = 2.61 °C

If payload is FF7EH: ((FF7E & 0x8000)>>15 ===1),temp = (FF7E(H)-FFFF(H))/100 = -1.29 °C

2.3.7 Soil Conductivity (EC)

Obtain **soluble salt concentration** in soil or **soluble ion concentration in liquid fertilizer** or **planting medium**. The value range of the register is 0 - 20000(Decimal)(Can be greater than 20000).

For example, if the data you get from the register is 0x00 0xC8, the soil conductivity is 00C8(H) = 200(D) = 200 uS/cm.

Generally, the EC value of irrigation water is less than 800uS / cm.

2.3.8 MOD

SE0X-LB supports changing mode.

For example, bytes[4]=0x0F

mod=(bytes[4]>>7)&0x01=0.

Downlink Command:

If payload = 0x0A00, workmode=0

If ** ** payload =** ** 0x0A01, workmode=1

2.3.9 Interrupt_flag

Displays whether upstream packets are generated by interrupt.

0: Normal uplink packet. **1:** Interrupt Uplink Packet. **For example,** bytes[4]=10

Interrupt_flag=bytes[4]&0x01=0.

2.3.10 Sensor_flag

Displays whether sensors are connected.

0: Sensor connection not detected.

1: Sensor connection detected.

For example, s_flag=1111,.Represents recognition to four sensors.

Counting from left to right,

The first number represents the **01** address sensor,

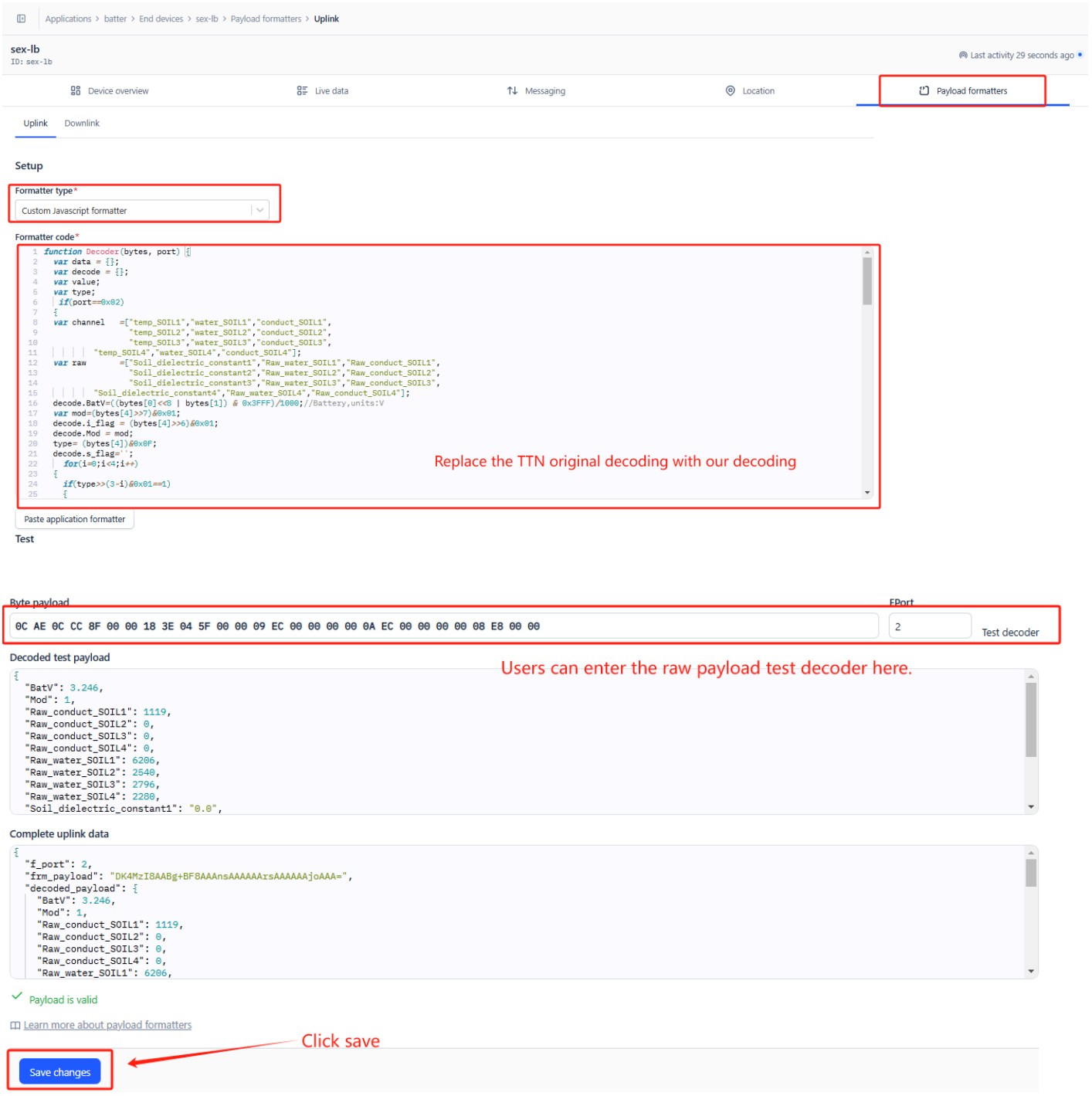
The second number represents the **02** address sensor;

The third number represents the **03** address sensor;

The fourth number represents the **04** address sensor.

2.3.11 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:

SE0X-LB TTN Payload Decoder: dragino-end-node-decoder/SE0X-LB at main · dragino/dragino-end-node-decoder · GitHub

2.4 Uplink Interval

The SE0X-LB by default uplink the sensor data every 20 minutes. User can change this interval by AT Command or LoRaWAN Downlink Command. See this link: Change Uplink Interval

2.5 Downlink Payload

By default, SE0X-LB prints the downlink payload to console port.

Downlink Control Type	FPort	Type Code	Downlink payload size(bytes)
TDC (Transmit Time Interval)	Any	01	4
RESET	Any	04	2
AT+CFM	Any	05	4
INTMOD	Any	06	4
MOD	Any	0A	2

Examples:

- **Set TDC**

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

Payload: 01 00 00 1E TDC=30S

Payload: 01 00 00 3C TDC=60S

- **Reset**

If payload = 0x04FF, it will reset the SE0X-LB

- **CFM**

Downlink Payload: 05010101, Set AT+CFM=1 or 05000000 , set AT+CFM=1,1,1

2.6 Set Device Time

User need to set **SYNCMOD=1** to enable sync time via MAC command.

Once SE0X-LB Joined LoRaWAN network, it will send the MAC command (DeviceTimeReq) and the server will reply with (DeviceTimeAns) to send the current time to SE0X-LB. If SE01-LB fails to get the time from the server, SE0X-LB will use the internal time and wait for next time request (AT+SYNCTDC to set the time request period, default is 10 days).

> 📘 **Note LoRaWAN Server need to support LoRaWAN v1.0.3(MAC v1.0.3) or higher to support this MAC command feature, Chirpstack,TTN V3 v3 and loriot support but TTN V3 v2 doesn't support. If server doesn't support this command, it will through away uplink packet with this command, so user will lose the packet with time request for TTN V3 v2 if SYNCMOD=1.**

2.7 Frequency Plans

The SE0X-LB 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.

/docs/LoRaWAN-General-Configuration/frequency-band/

2.8 Installation in Soil

Measurement the soil surface



Choose the proper measuring position. Avoid the probe to touch rocks or hard things. Split the surface soil according to the measured deep. Keep the measured as original density. Vertical insert the probe into the soil to be measured. Make sure not shake when inserting.



Dig a hole with diameter > 20CM.

Horizontal insert the probe to the soil and fill the hole for long term measurement.

Install for Water Proof

The device is tested and verified to meet the IP67 water proof level.

- IP67 covers temporary immersion and normal rain, and is generally adequate for atomised pesticide mist at normal working distance.
- It does not cover close-range direct spraying. Where a nozzle may be directed at the enclosure from short range, or during machine washdown, additional shielding is required.
- The IPX7 test is conducted with water within 5K of the equipment temperature. It therefore does not represent cold liquid striking a sun-heated enclosure, which creates negative internal pressure. In orchard and greenhouse installations we recommend avoiding spraying during peak daytime heat.
- Cable glands, the probe cable entry and the pressure balance valve should be checked at installation, as penetration points are the first place ingress occurs.



3. Configure SE0X-LB

3.1 Configure Methods

SE0X-LB supports below configure method:

- AT Command via Bluetooth Connection (**Recommended**): BLE Configure Instruction.
- 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:

/docs/LoRaWAN-General-Configuration/at-commands-downlink/

3.3 Commands special design for SE0X-LB

These commands only valid for SE0X-LB, 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 Quit AT Command

Feature: Quit AT Command mode, so user needs to input the password again before using AT Commands.

AT Command: AT+DISAT

Command Example	Function	Response
AT+DISAT	Quit AT Commands mode	OK

Downlink Command:

No downlink command for this feature.

3.3.3 Set Interrupt Mode

Feature, Set Interrupt mode for GPIO_EXTI of pin.

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=2	Set Transmit Interval (Disable Interrupt), (Trigger by rising and falling edge) (Trigger by falling edge) (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

3.3.4 Set Power Output Duration

Control the output duration 5V . Before each sampling, device will

1. first enable the power output to external sensor,

2. keep it on as per duration, read sensor value and construct uplink payload

3. final, close the power output.

AT Command: AT+5VT

Command Example	Function	Response
AT+5VT=?	Show 5V open time.	0 (default) OK
AT+5VT=500	Close after a delay of 1000 milliseconds.	OK

Downlink Command: 0x07

Format: Command Code (0x07) followed by 2 bytes.

The first and second bytes are the time to turn on.

- Example 1: Downlink Payload: 070000 **—->** AT+5VT=0

- Example 2: Downlink Payload: 0701F4 **--->** AT+5VT=500

3.3.5 Setting the sensor address

Function:Change the sensor address to 0x01, 0x02, 0x03, 0x04

(Note:When setting the address of the sensor, you need to connect the device individually for each one, and when modifying the address, you can't connect more than one sensor at the same time, otherwise it will be impossible to modify it, and when modifying it, you need to connect the yellow wire to VBAT_OUT, and after modifying it, you need to disconnect it.)

AT Command: AT+MADD

Command Example	Function	Response
AT+MADD=1	Set sensor address to 01	Successfully modified sensor address to 0x01 OK
AT+MADD=2	Set sensor address to 02	Successfully modified sensor address to 0x02 OK
AT+MADD=3	Set sensor address to 03	Successfully modified sensor address to 0x03 OK
AT+MADD=4	Set sensor address to 04	Successfully modified sensor address to 0x04 OK

Downlink Command:

No downlink command for this feature.

3.3.6 Get or Set the sensor mode

Function: Set default mode or original mode

AT Command: AT+MOD

Command Example	Function	Response
AT+MOD=0	Set the operating mode to the default mode	OK
AT+MOD=1	Setting the operating mode to the original mode	OK

Downlink Command: 0x07

Format: Command Code (0x0A) followed by 1 bytes.

The second byte is the mode selection.

- Example 1: Downlink Payload: 0A00 **--->** AT+MOD=0

- Example 2: Downlink Payload: 0A01 **-->** AT+MOD=1

4. Battery & Power Consumption

SE0X-LB use ER26500 + SPC1520 battery pack. See below link for detail information about the battery info and how to replace.

Battery Info & Power Consumption Analyze.

5. OTA Firmware update

User can change firmware SE0X-LB 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: Firmware OTA Update for Sensors
- Update through UART TTL interface: Instruction.

6. FAQ

6.1 AT Commands 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 Can I calibrate SE0X-LB to different soil types?

SE0X-LB can be used to measure EC/Moisture in different type of soil event concrete.

SE0X-LB is calibrated for saline-alkali soil and loamy soil. If users want to use it for other soil, they can calibrate the value in the IoT platform base on the value measured by saline-alkali soil and loamy soil. The formula can be found at this link.

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

It is due to channel mapping. Please see the Eight Channel Mode section above for details.

6.4 Why is there no LED response when I press the button on the solar panel model?

If the LED does not light up when you press the button, it may be because the battery has entered protection mode.

Solution: To reactivate the battery, simply expose the solar panel to direct sunlight. For more details, please refer to: Battery Protection State (Apply to Solar Panel + Li-ion battery)

7. Order Info

Part Number: SE0X-LB-XX

XX : The default frequency band

- **AS923** : LoRaWAN AS923 band
- **AU915** : LoRaWAN AU915 band
- **EU433** : LoRaWAN EU433 band
- **EU868** : LoRaWAN EU868 band
- **KR920** : LoRaWAN KR920 band
- **US915** : LoRaWAN US915 band
- **IN865** : LoRaWAN IN865 band
- **CN470** : LoRaWAN CN470 band

8. Packing Info

Package Includes:

- SE0X-LB LoRaWAN Soil Moisture & EC Sensor Transmitter

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.cc.

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Created by Xiaoling on 2024/11/04 09:19