SE01-LB -- LoRaWAN Soil Moisture & EC Sensor User Manual

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1. Introduction

1.1 What is LoRaWAN Soil Moisture & EC Sensor

The Dragino SE01-LB is a **LoRaWAN Soil Moisture & EC Sensor** for IoT of Agriculture. It is designed to measure the **soil moisture of saline-alkali soil and loamy soi** 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 Minera type.

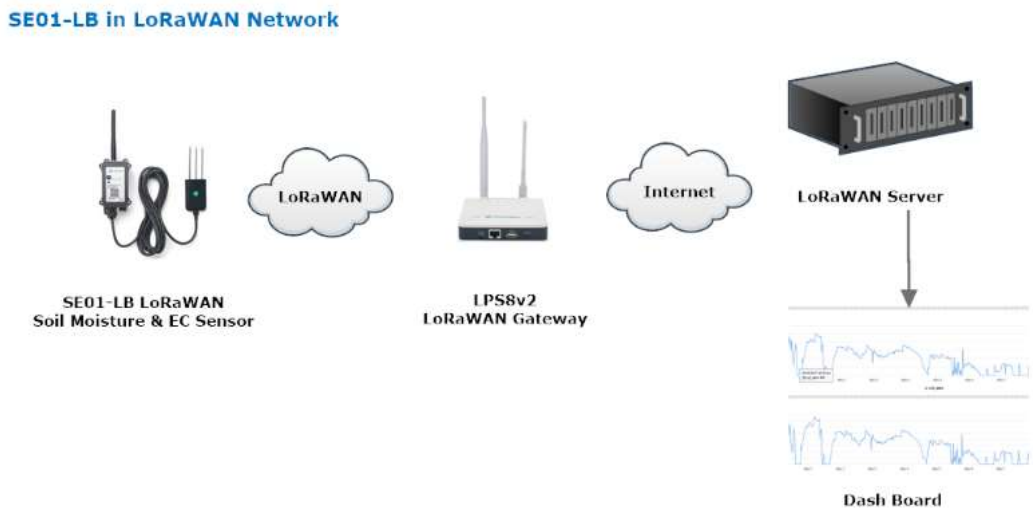
It detects **Soil Moisture**, **Soil Temperature** and **Soil Conductivity**, and uploads the value via wireless to LoRaWAN IoT Server.

The LoRa wireless technology used in SE01-LB allows device to send data and reach extremely long ranges at low data-rates. It provides ultra-long range spread spectru communication and high interference immunity whilst minimizing current consumption.

SE01-LB **supports BLE configure** and **wireless OTA update** which make user easy to use.

SE01-LB is powered by **8500mAh Li-SOCI2 battery**, it is designed for long term use up to 5 years.

Each SE01-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.



1.2 Features

- LoRaWAN 1.0.3 Class A
- Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915/IN865
- Ultra-low power consumption
- 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 Battery for long term use

1.3 Specification

Common DC Characteristics:

- Supply Voltage: built in 8500mAh Li-SOCI2 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

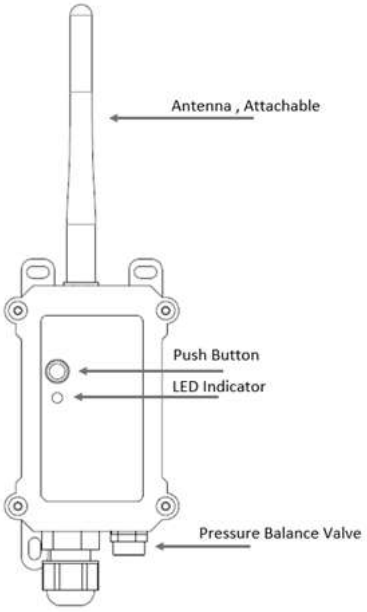
- Smart Agriculture

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 periodic 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
Pressing ACT between 1s < time < 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.
Pressing ACT for more than 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.
Fast press ACT 5 times.	Deactivate Device	**Red led** will solid on for 5 seconds. Means device is in Deep Sleep Mode.

1.7 BLE connection

SE01-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:

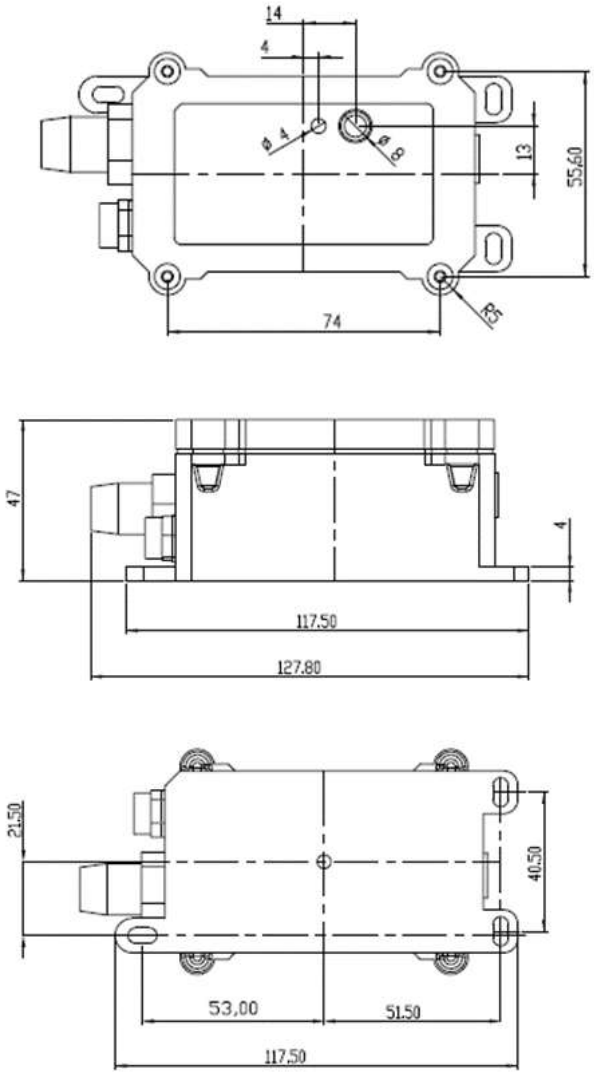
- Press button to send an uplink
- Press button to active device.
- Device Power on or reset.

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

Main Device Dimension:



Probe Dimension:

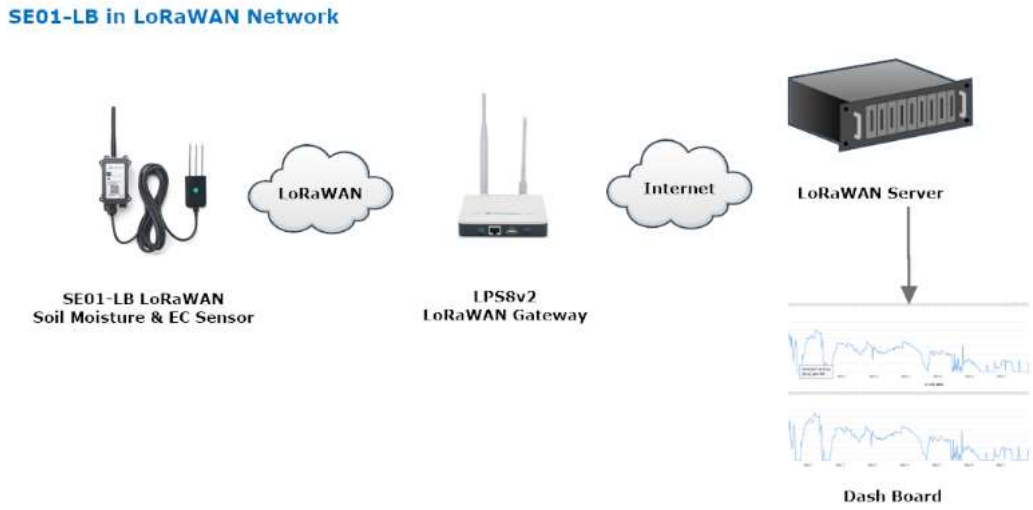
2. Configure SE01-LB to connect to LoRaWAN network

2.1 How it works

The SE01-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 SE01-LB. 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 (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.



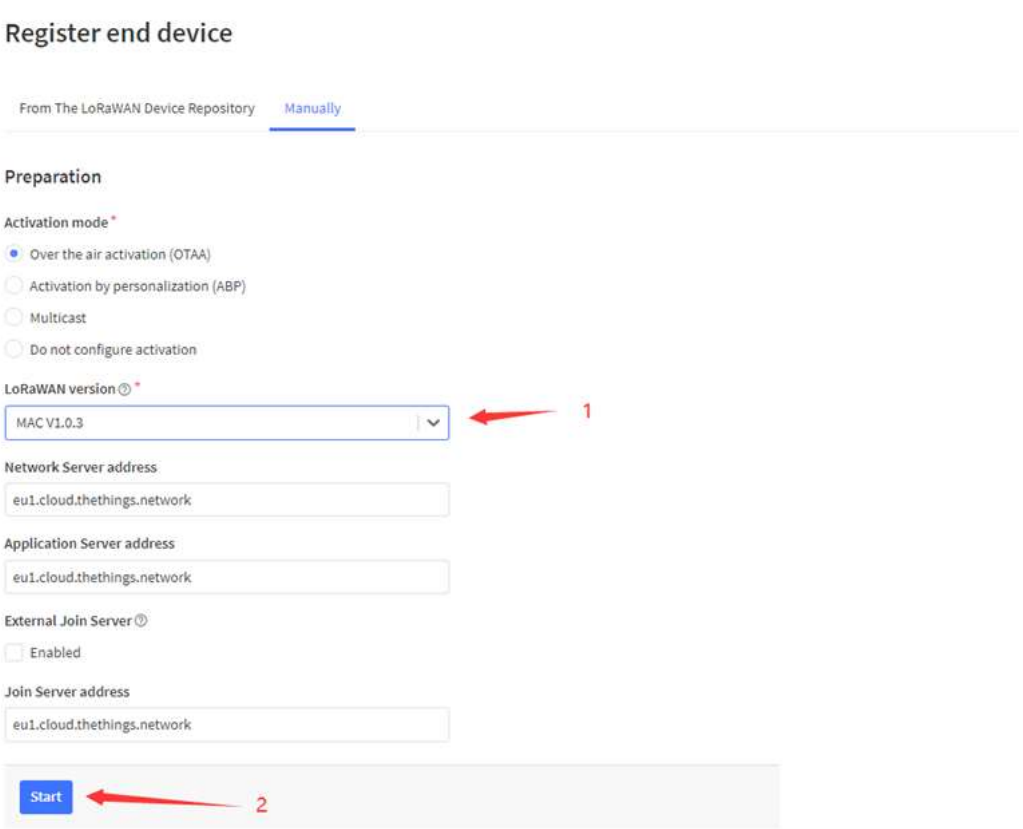
The LPS8v2 is already set to connected to TTN network (https://console.cloud.thethings.network/) , so what we need to now is configure the TTN server.

Step 1: Create a device in TTN with the OTAA keys from SE01-LB.

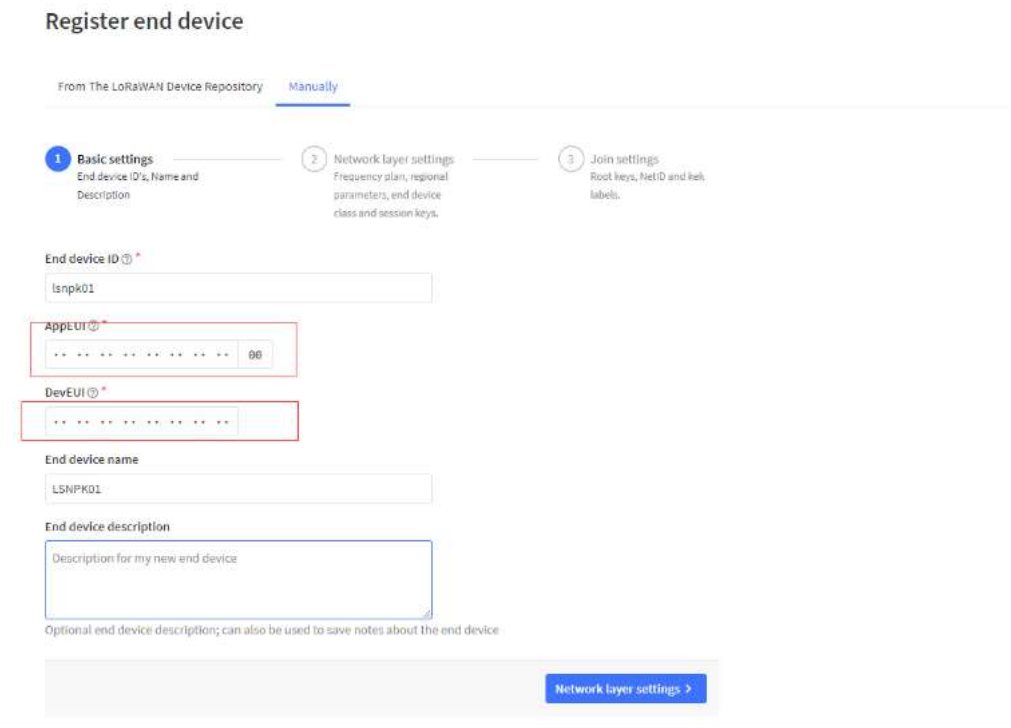
Each SE01-LB is shipped with a sticker with the default device EUI as below:

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

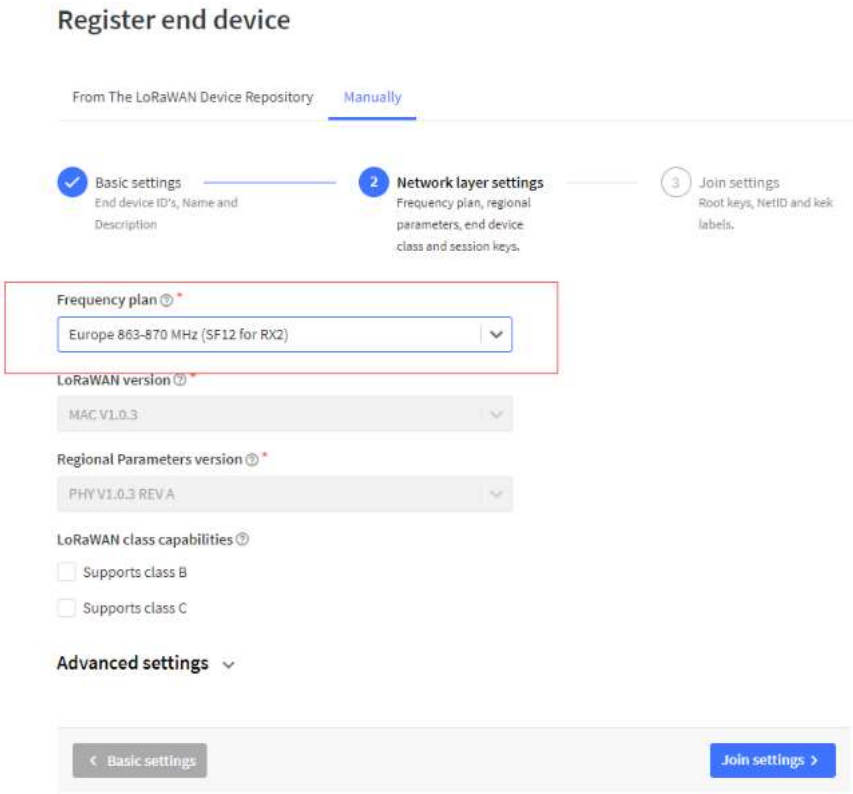
Register the device



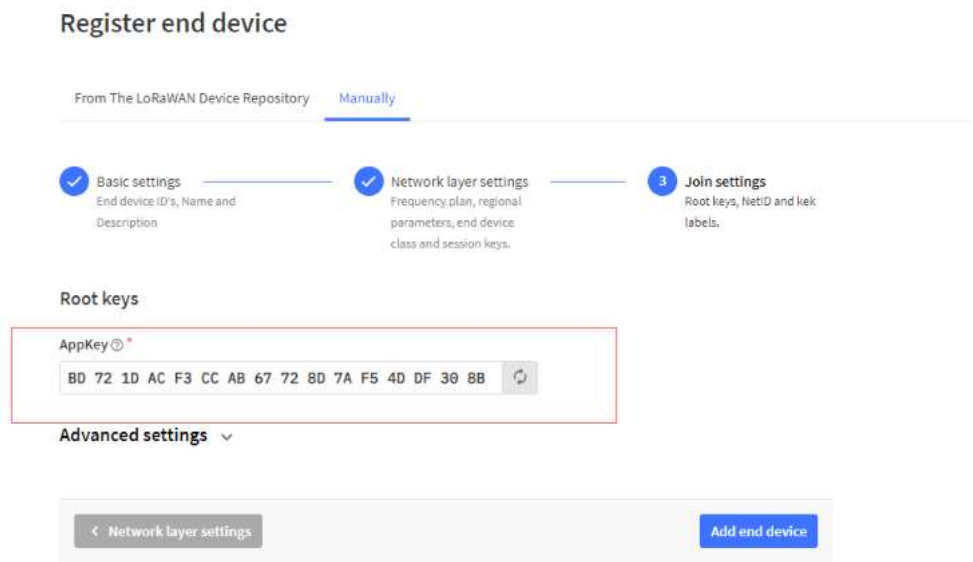
Add APP EUI and DEV EUI



Add APP EUI in the application



Add APP KEY



Step 2: Activate on SE01-LB

Press the button for 5 seconds to activate the SE01-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 jo 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)

SE01-LB will uplink payload via LoRaWAN with below payload format:

Uplink payload includes in total 11 bytes.

Size(bytes)	**2**	**2**	**2**	**2**	**2**	**1**

Value	BAT	Temperature (Reserve, Ignore now)	Soil Moisture	Soil Temperature	Soil Conductivity (EC)	MOD & Digital Interrupt(Optional)

2.3.2 MOD=1(Original value)

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

Size(bytes)	**2**	**2**	**2**	**2**	**2**	**1**
Value	BAT	Temperature (Reserve, Ignore now)	Soil Conductivity (EC)(raw)	Soil Moisture(raw)	Dielectric constant(raw)	MOD & Digital Interrupt(Optional)

2.3.3 Device Status, FPORT=5

Users can use the downlink command(**0x26 01**) to ask SE01-LB to send device configure detail, include device configure status. SE01-LB will uplink a payload via FPort=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 SE01-LB, this value is 0x26
- **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

2.3.4 Battery Info

Check the battery voltage for SE01-LB.

Ex1: 0x0B45 = 2885mV

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 dat 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)(C 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

Firmware version at least v2.1 supports changing mode.

For example, bytes[10]=90

mod=(bytes[10]>>7)&0x01=1.

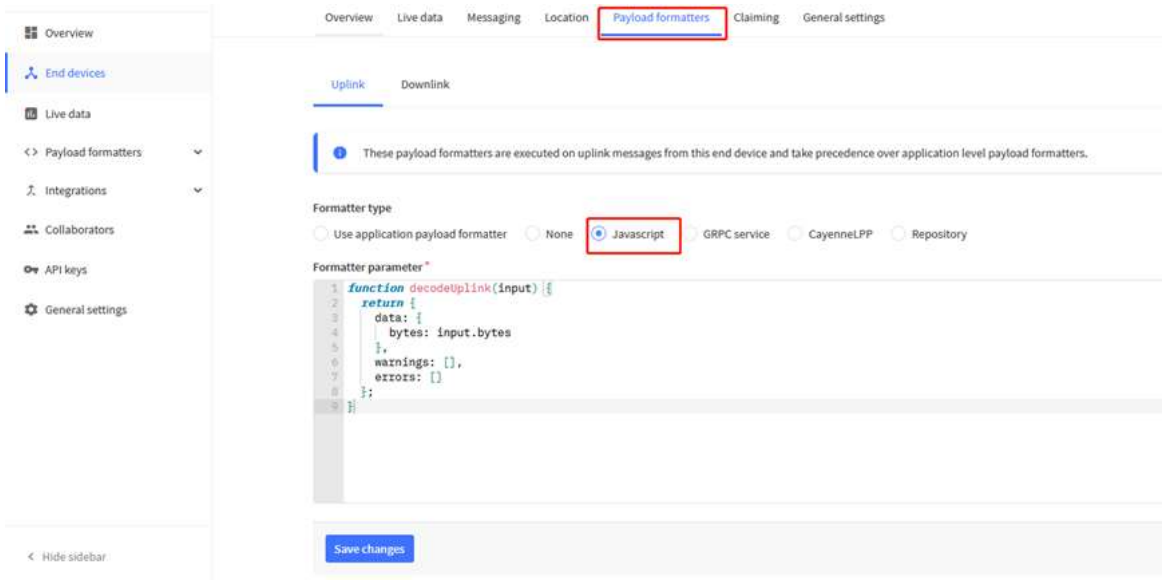
Downlink Command:

If payload = 0x0A00, workmode=0

If payload = 0x0A01, workmode=1

2.3.9 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:

SE01-LB TTN Payload Decoder: https://github.com/dragino/dragino-end-node-decoder (https://github.com/dragino/dragino-end-node-decoder)

2.4 Uplink Interval

The SE01-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 (/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/#H4.1ChangeUplinkInterval)

2.5 Downlink Payload

By default, LSE01 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 SE01-LB

- **CFM**

Downlink Payload: 05000001, Set AT+CFM=1 or 05000000 , set AT+CFM=0

2.6 Datalog Feature

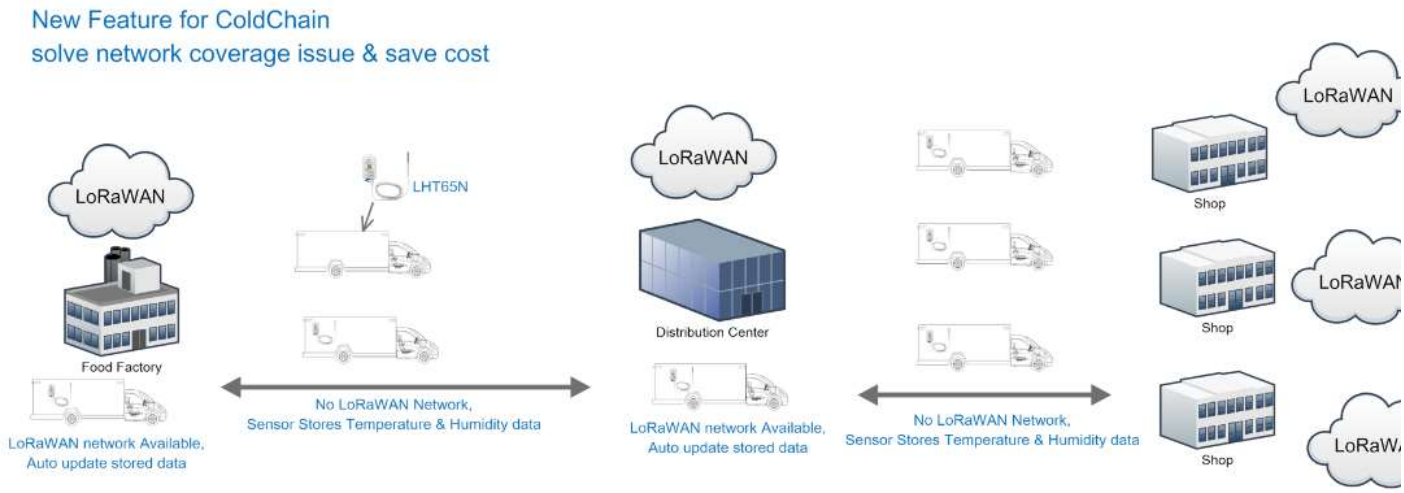
Datalog Feature is to ensure IoT Server can get all sampling data from Sensor even if the LoRaWAN network is down. For each sampling, SE01-LB will store the reading future retrieving purposes.

2.6.1 Ways to get datalog via LoRaWAN

Set PNACKMD=1, SE01-LB will wait for ACK for every uplink, when there is no LoRaWAN network,SE01-LB will mark these records with non-ack messages and store the sensor data, and it will send all messages (10s interval) after the network recovery.

- a) SE01-LB will do an ACK check for data records sending to make sure every data arrive server.
- b) SE01-LB will send data in **CONFIRMED Mode** when PNACKMD=1, but SE01-LB won't re-transmit the packet if it doesn't get ACK, it will just mark it as a NONE-message. In a future uplink if SE01-LB gets a ACK, SE01-LB will consider there is a network connection and resend all NONE-ACK messages.

Below is the typical case for the auto-update datalog feature (Set PNACKMD=1)



2.6.2 Unix TimeStamp

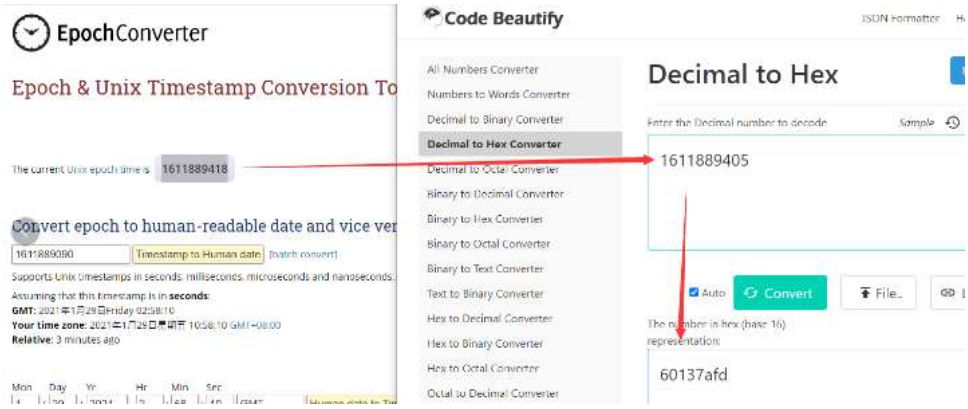
SE01-LB uses Unix TimeStamp format based on

Size (bytes)	4	1
DeviceTimeAns Payload	32-bit unsigned integer : Seconds since epoch*	8bits unsigned integer: fractional-second in ½^8 second steps

Figure 10 : DeviceTimeAns payload format

User can get this time from link: https://www.epochconverter.com/ (https://www.epochconverter.com/) :

Below is the converter example



So, we can use AT+TIMESTAMP=1611889405 or downlink 3060137afd00 to set the current time 2021 – Jan -- 29 Friday 03:03:25

2.6.3 Set Device Time

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

Once SE01-LB Joined LoRaWAN network, it will send the MAC command (DeviceTimeReq) and the server will reply with (DeviceTimeAns) to send the current time to SE LB. If SE01-LB fails to get the time from the server, SE01-LB will use the internal time and wait for next time request (AT+SYNCTDC to set the time request period, defaul 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 Ioriot suppo 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 tim request for TTN V3 v2 if SYNCMOD=1.

2.6.4 Datalog Uplink payload (FPORT=3)

The Datalog uplinks will use below payload format.

Retrieval data payload:

MOD=0:

Size(bytes)	**2**	**2**	**2**	**1**	**4**
Value	Humidity	Temperature	Soil Conductivity (EC)	MOD& Level of PA8	Unix Time Stamp

MOD=1:

Size(bytes)	**2**	**2**	**2**	**1**	**4**
Value	soil dielectric constant	raw water soil	raw conduct soil	MOD& Level of PA8	Unix Time Stamp

Poll Message Flag: 1: This message is a poll message reply.

- Poll Message Flag is set to 1.
- Each data entry is 11 bytes, to save airtime and battery, devices will send max bytes according to the current DR and Frequency bands.

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

a) DR0: max is 11 bytes so one entry of data

b) DR1: max is 53 bytes so devices will upload 4 entries of data (total 44 bytes)

c) DR2: total payload includes 11 entries of data

d) DR3: total payload includes 22 entries of data.

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

Example:

If SE01-LB has below data inside Flash:

```
8031000 2023/6/6 07:09:17 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.36 conduct_soil=0
8031010 2023/6/6 07:10:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.42 conduct_soil=0
8031020 2023/6/6 07:11:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.42 conduct_soil=0

8031030 2023/6/6 07:12:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.35 conduct_soil=0

8031040 2023/6/6 07:13:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.31 conduct_soil=0
8031050 2023/6/6 07:14:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.21 conduct_soil=0
8031060 2023/6/6 07:15:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.28 conduct_soil=0
8031070 2023/6/6 07:16:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.34 conduct_soil=0

8031080 2023/6/6 07:17:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.41 conduct_soil=0
8031090 2023/6/6 07:18:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.52 conduct_soil=0
80310A0 2023/6/6 07:19:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.44 conduct_soil=0
80310B0 2023/6/6 07:20:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.46 conduct_soil=0

80310C0 2023/6/6 07:21:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.52 conduct_soil=0
80310D0 2023/6/6 07:22:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.56 conduct_soil=0
80310E0 2023/6/6 07:23:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.63 conduct_soil=0
80310F0 2023/6/6 07:25:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.55 conduct_soil=0
8031100 2023/6/6 07:27:31 3347 0 0 ds_temp=327.6 water_soil=0.00 temp_soil=28.42 conduct_soil=0
```

If user sends below downlink command: 31646D84E1646D856C05

Where : Start time: 646D84E1 = time 23/5/24 03:30:41

Stop time: 646D856C= time 23/5/24 03:33:00

2.6.5 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 Internal =5s，means SE01-LB will send one packet every 5s. range 5~255s.

2.7 Frequency Plans

The SE01-LB uses OTAA mode and below frequency plans by default. If user want to use it with different frequency plan, please refer the AT command sets.

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

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 origin 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.

3. Configure SE01-LB

3.1 Configure Methods

SE01-LB supports below configure method:

- AT Command via Bluetooth Connection (**Recommended**): BLE Configure Instruction (http://wiki.dragino.com/xwiki/bin/view/Main/BLE%20Bluetooth%20Remote%20Configure/) .
- AT Command via UART Connection : See UART Connection (http://wiki.dragino.com/xwiki/bin/view/Main/UART%20Access%20for%20LoRa%20ST%20v4%20base%20model/#H2.3UARTConnectionforSN50v3basemotherboa
- 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:

http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/
(http://wiki.dragino.com/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/)

3.3 Commands special design for SE01-LB

These commands only valid for SE01-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 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

3.3.4 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

4. Battery & Power Consumption

SE01-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
(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 SE01-LB 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/sl7fhggzqy0tcbx/AAAIESNEZiKyiHQQz8Xlf4e_a?dl=0)

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/#H1.LoRaSTv4baseHardware)** .

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

6.2 Can I calibrate SE01-LB to different soil types?

SE01-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 saline-alkali soil and loamy soil. The formula can be found at this link (https://www.dragino.com/downloads/downloads/LoRa_End_Node/LSE01/Calibrate_to_other_Soil_20230522.pdf) .

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

It is due to channel mapping. Please see the Eight Channel Mode (/xwiki/bin/view/Main/End%20Device%20AT%20Commands%20and%20Downlink%20Command/#H7.19EightChannelMode) section above for details.

7. Order Info

Part Number: **SE01-LB-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:

- SE01-LB LoRaWAN Soil Moisture & EC Sensor

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 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) .

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