CS01-LB -- LoRaWAN 4 Channels Current Sensor Converter User Manual

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1. Introduction

1.1 What is the LoRaWAN 4 Channel Current Sensor Converter

The **Dragino CS01-LB** is a **LoRaWAN 4-channel current sensor converter** designed to transmit readings from current sensors to an IoT platform via a LoRaWAN network. This device is ideal for **monitoring machine operating conditions and analyzing power consumption trends**.

The CS01-LB can support up to four detachable current sensors, which can be swapped for sensors with different measurement scales as needed. It features **BLE configuration** and **wireless OTA updates**, simplifying setup and maintenance for users.

Powered by an **8500mAh Li-SOCI2 battery**, the CS01-LB is engineered for long-term usage, lasting several years under typical operating conditions.

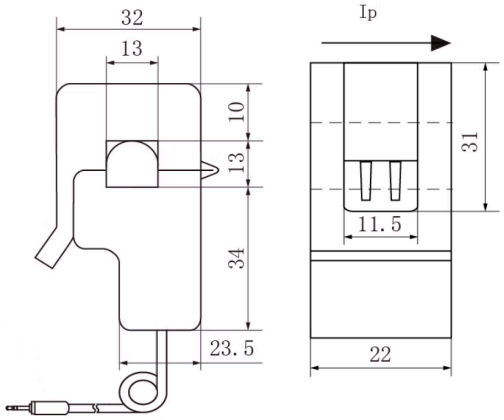
Each unit comes pre-loaded with unique keys for LoRaWAN registration. By registering these keys with a local LoRaWAN network server, the CS01-LB can automatically connect once powered on.

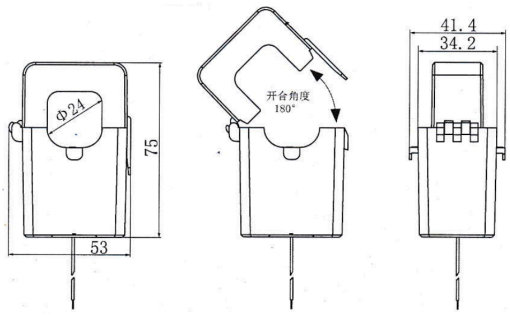
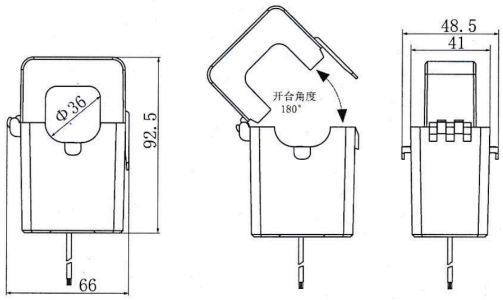
1.2 Features

- LoRaWAN 1.0.3 Class A
- Supported Bands: CN470, EU433, KR920, US915, EU868, AS923, AU915, IN865
- Ultra-low power consumption
- Supports up to 4 current sensors
- Compatible with various current sensor ratios: 50A, 100A, etc.
- Monitors machine operating status
- Analyzes power consumption trends
- Provides current alarms
- Supports Bluetooth v5.1 and LoRaWAN remote configuration
- Supports wireless OTA firmware updates
- Periodic uplink transmissions
- Downlink capability to modify configurations
- 8500mAh Li/SOCl2 battery

1.3 Current Sensor Specification

The current sensors listed below are not shipped with the CS01-LB. You need to order them separately.

Model	Photo	Specification	Dimension(Unit:mm±0.5)
SCT013G-D-100		* Split core current transformer * Spec: 100A/50mA * φ16mm Aperture * Accuracy: ±1% *Wire length: 100cm; Wire length Accuracy: ±3cm	

SCT024-300		* Split core current transformer * Spec: 300A/50mA * φ24mm Aperture * Accuracy: ±0.5% /Class 0.2 *Wire length: 100cm; Wire length Accuracy: ±3cm	
SCT036-600		* Split core current transformer * Spec: 600A/50mA * φ36mm Aperture * Accuracy: ±0.5% / Class 0.2 *Wire length: 100cm; Wire length Accuracy: ±3cm	

Note for Accuracy Specification:

The accuracy values listed in the table represent the current clamp's intrinsic accuracy only.
For the CS01-LB system, the overall measurement accuracy includes both the current clamp and the current sampling module. The current sampling module has an accuracy of ±1%.
Therefore, the total system accuracy will be a combination of both.

1.4 Specification

Common DC Characteristics:

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

LoRa Specification:

- Frequency Range, Band 1 (HF): 862 ~ 1020 MHz
- Maximum RF Output: +22 dBm constant
- RX Sensitivity: Down to -139 dBm
- Excellent blocking immunity

Battery:

- Type: Li/SOCl2 non-rechargeable battery
- Capacity: 8500mAh
- Self-Discharge: <1% per year @ 25°C

- Maximum Continuous Current: 130mA
- Maximum Boost Current: 2A for 1 second

Power Consumption:

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

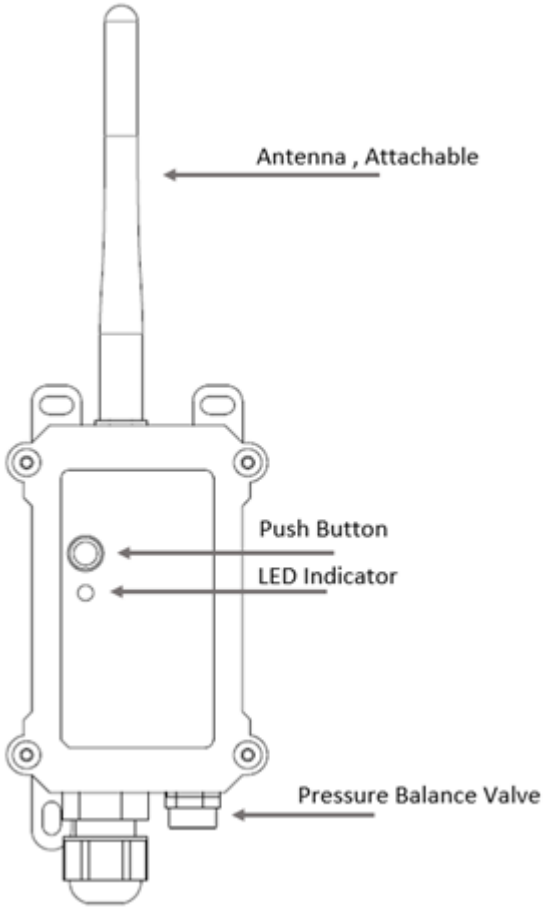
1.5 Deep Sleep Mode and Working Mode

Deep Sleep Mode: The sensor does not perform any LoRaWAN activity. This mode is intended for storage and shipping to conserve battery life.

Working Mode: In this mode, the sensor operates as a LoRaWAN sensor, joining the LoRaWAN network and transmitting data to the server. Between each sampling, transmission, and reception period, the sensor enters IDLE mode. In IDLE mode, the sensor consumes the same amount of power as in Deep Sleep mode.

1.6 Button & LEDs

The CS01-LB has push button labelled as ACT and a LED indicator.



Behavior on ACT	Function	Action

 1 ~ 3s	Send an uplink	If the sensor is already joined to the LoRaWAN network, it will send an uplink packet, and the **Blue LED** will blink once. Meanwhile, the BLE module will be activated, allowing the user to connect via BLE to configure the device.
 >3s	Active Device	The **Green LED** will blink rapidly five times, and the device will enter **OTAA mode** for 3 seconds before starting to join the LoRaWAN network. The **Green LED** will remain solid for 5 seconds once the device successfully joins the network. After the sensor becomes active, the BLE module will be enabled, allowing the user to connect via BLE to configure the device, regardless of whether it has joined the LoRaWAN network.
 x5	Deactivate Device	The **Red LED** will stay solid for 5 seconds, indicating that the device is in Deep Sleep Mode.

1.7 BLE Connection

CS01-LB supports BLE (Bluetooth Low Energy) remote configuration.

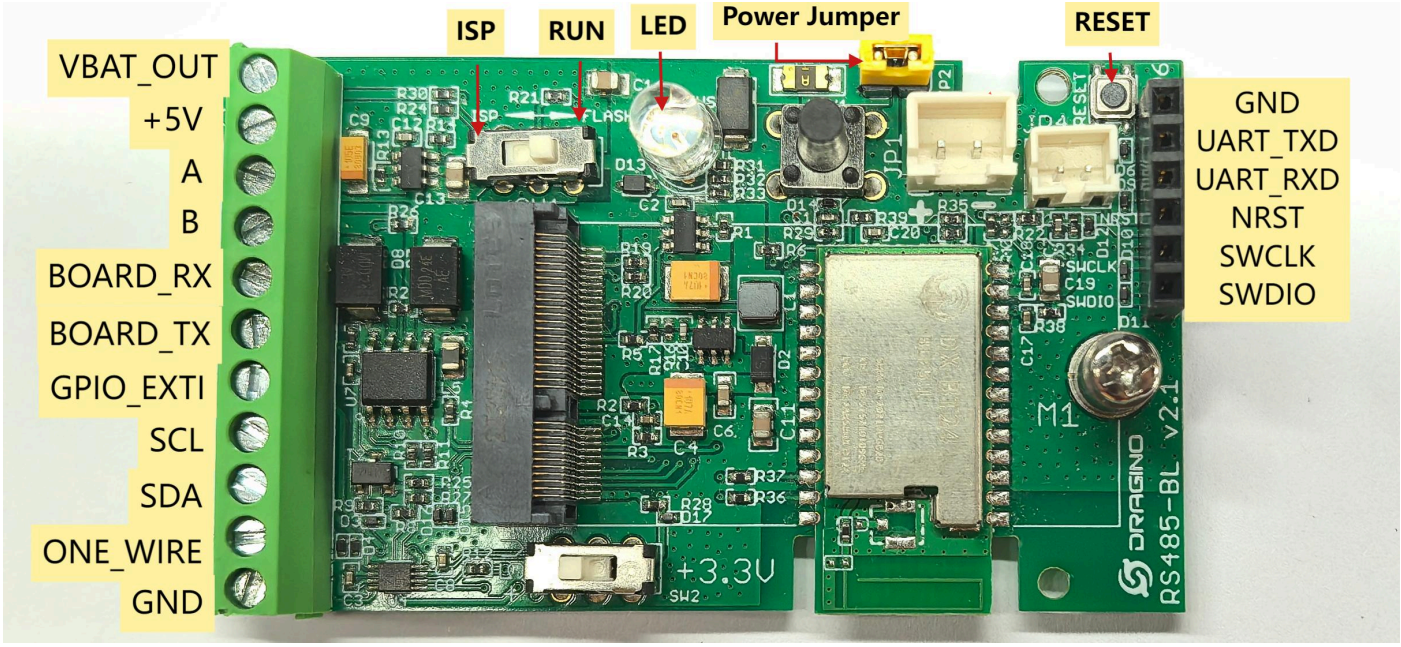
BLE can be used to configure the sensor's parameters or view the console output from the sensor. BLE will only be activated in the following cases:

- Pressing the button to send an uplink
- Pressing the button to activate the device
- Device power on or reset

If there is no activity or connection via BLE within 60 seconds, the sensor will shut down the BLE module to enter low power mode.

1.8 Pin Definitions

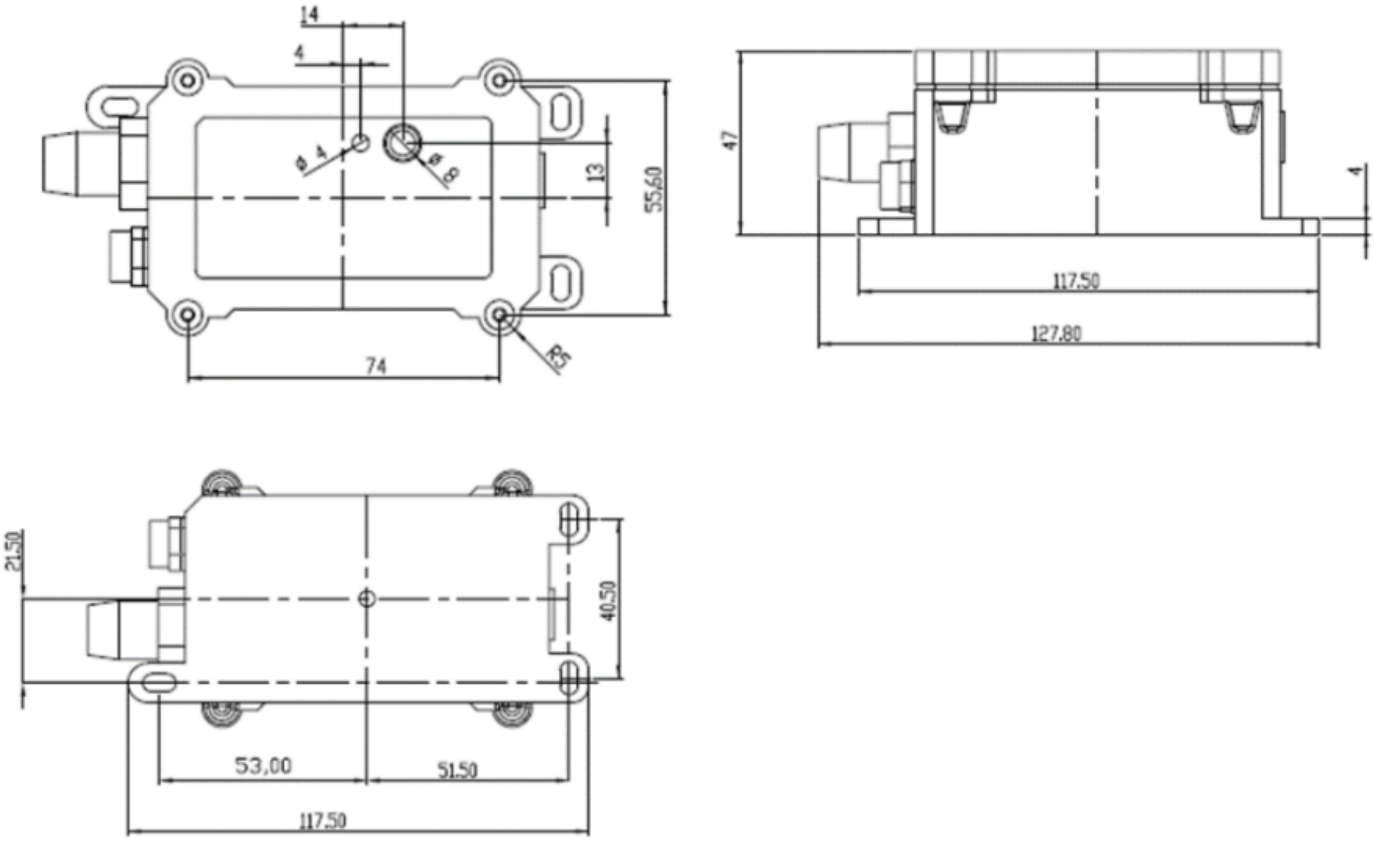
The CS01-LB has the following pin definitions.



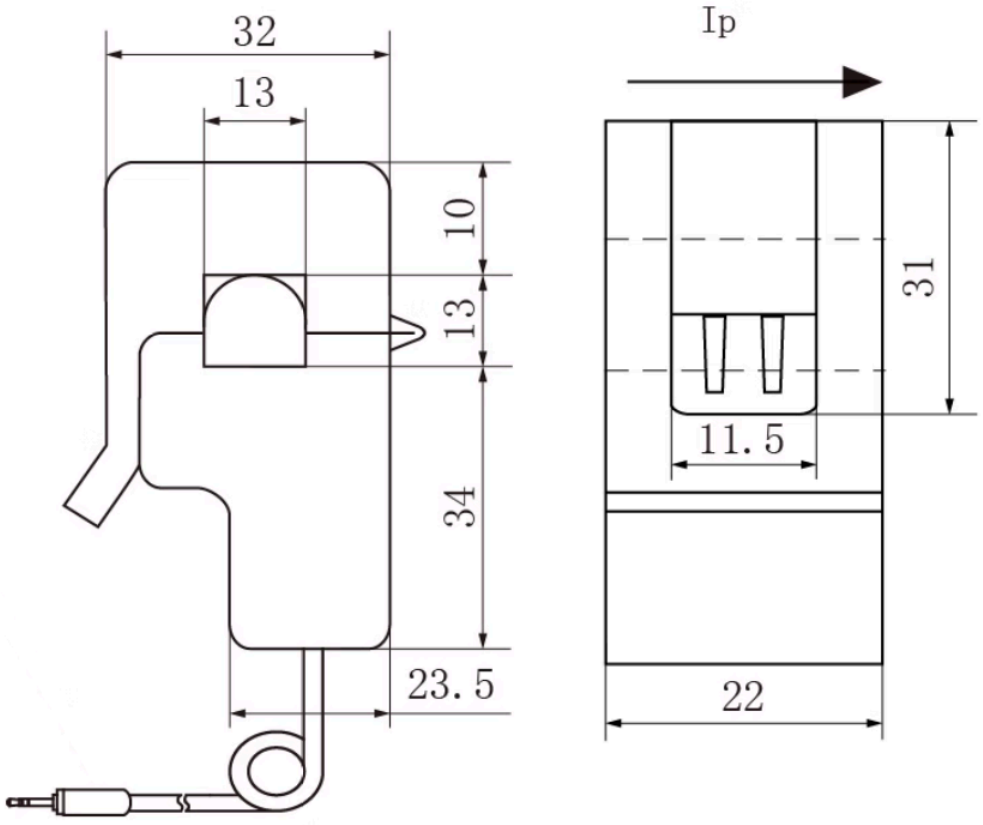
1.8.1 SW2 Jumper (Define UART level to external Sensor)

SW2 defines the voltage level of the BOARD_RX and BOARD_TX pins. It should match the external sensor's voltage level.

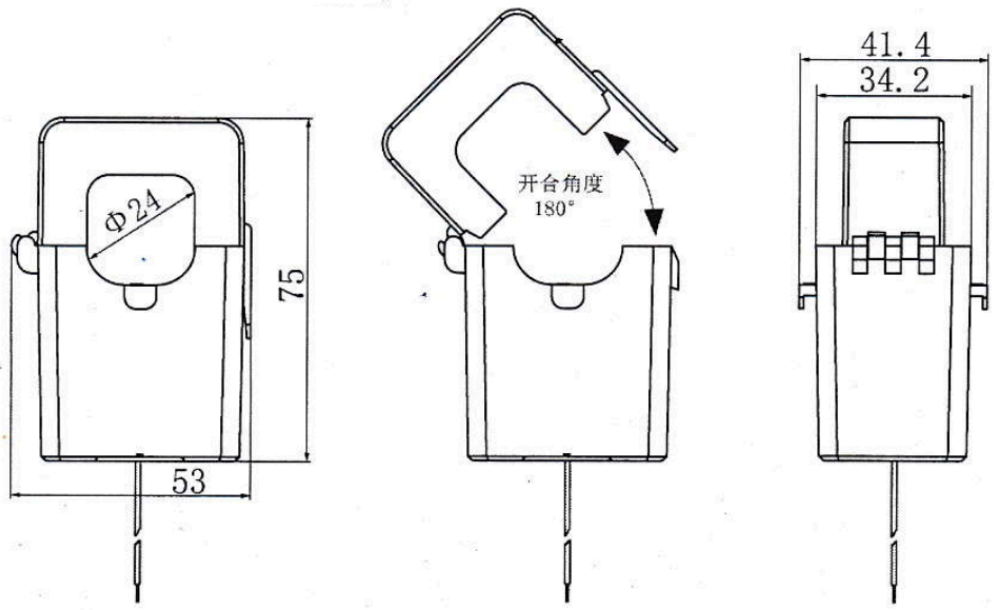
1.9 Mechanical Drawings



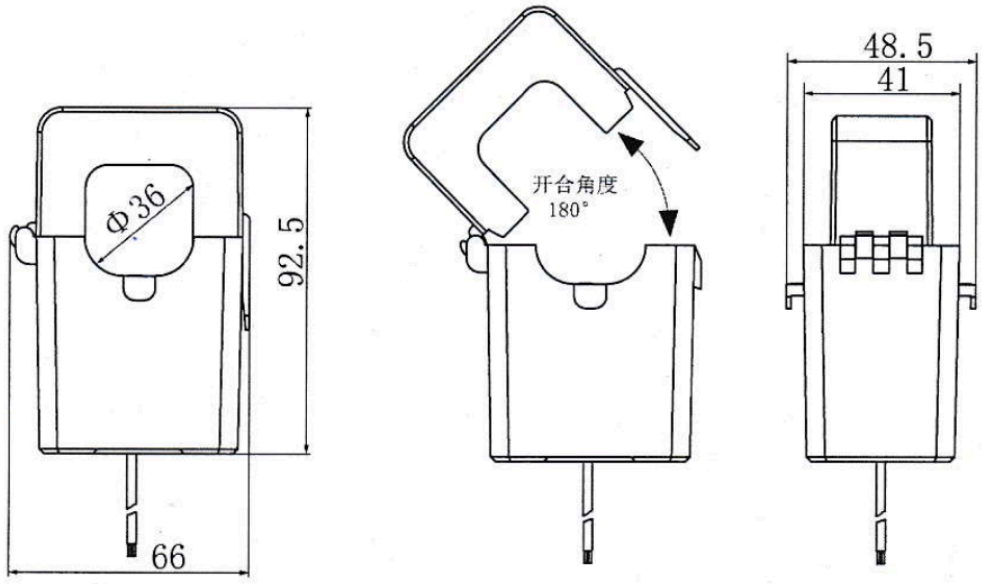
100A:



300A:



600A:



2. Configure the CS01-LB to connect to LoRaWAN network

2.1 How it works

The **CS01-LB** is configured by default as a LoRaWAN OTAA Class A device. It comes with a pre-assigned DevEUI, AppEUI, and AppKey to enable joining a LoRaWAN network using OTAA. These same DevEUI, AppEUI, and AppKey values must be registered with the LoRaWAN Network Server you plan to use.

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 CS01-LB. It will automatically join the network via OTAA and start to send the sensor value. The default uplink interval is 20 minutes.

Then press the ACT button for more than 3 seconds to activate the CS01-LB. It will automatically join the network via OTAA and begin sending sensor values. The default uplink interval is 20 minutes.

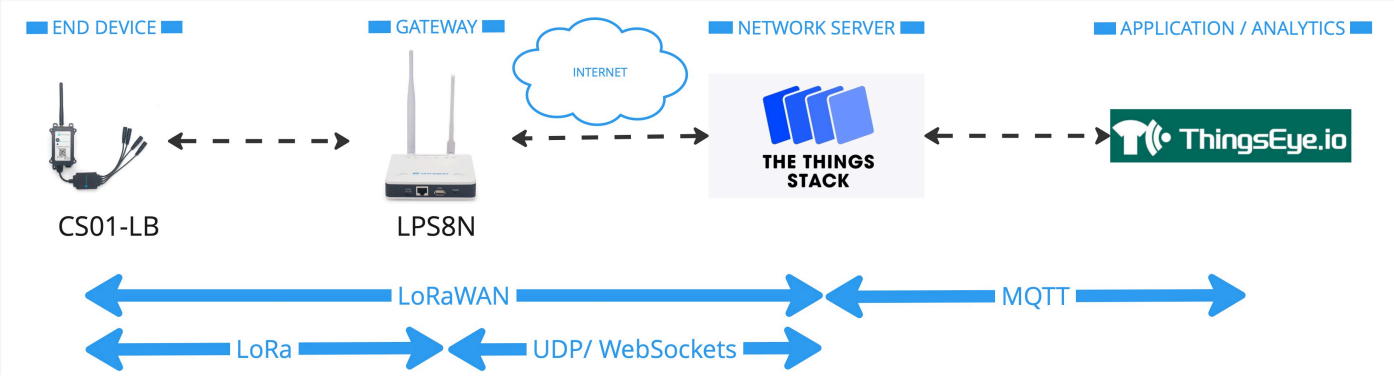
" class="xwiki-metadata-container">The CS01-LB does not include a current sensor. The user needs to obtain the current sensor separately and attach it to the CS01-LB for measurement.

The CS01-LB does not include a current sensor. The user needs to obtain the current sensor separately and attach it to the CS01-LB for measurement.

2.2 Quick Guide to Connect to LoRaWAN Network Server (OTAA)

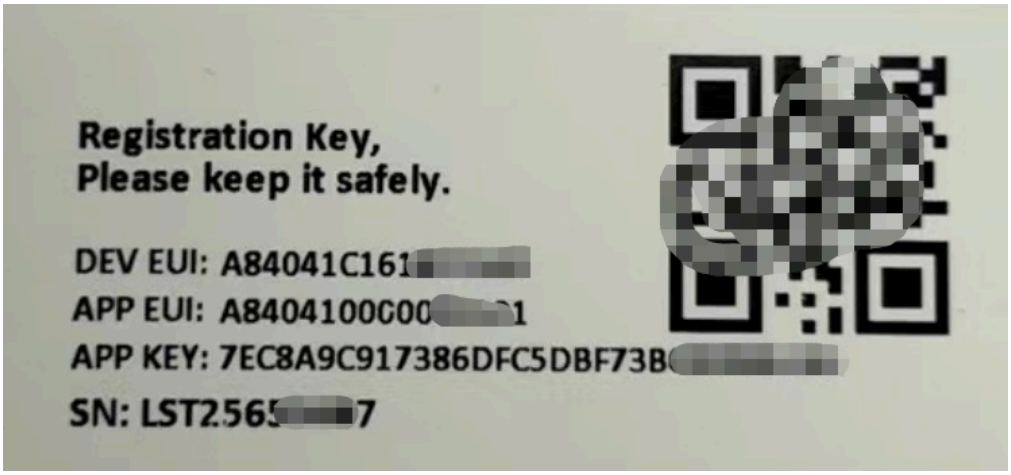
The following figure shows how the CS01-LB connects to The Things Stack. The CB01-LB sends messages (uplinks) to The Things Stack via a LoRaWAN gateway (e.g., Dragino LPS8N) and can also receive messages (downlinks) from The Things Stack. The Things Stack can be integrated with ThingsEye, allowing it to forward

uplinks to ThingsEye. ThingsEye is an IoT platform used for visualizing and analyzing sensor data. You can also send downlinks from ThingsEye (via The Things Stack) to the CS01-LB.



2.3 Registration Information

Each CS01-LB is shipped with registration information, including a unique **DevEUI**, **AppEUI**, and **AppKey**.

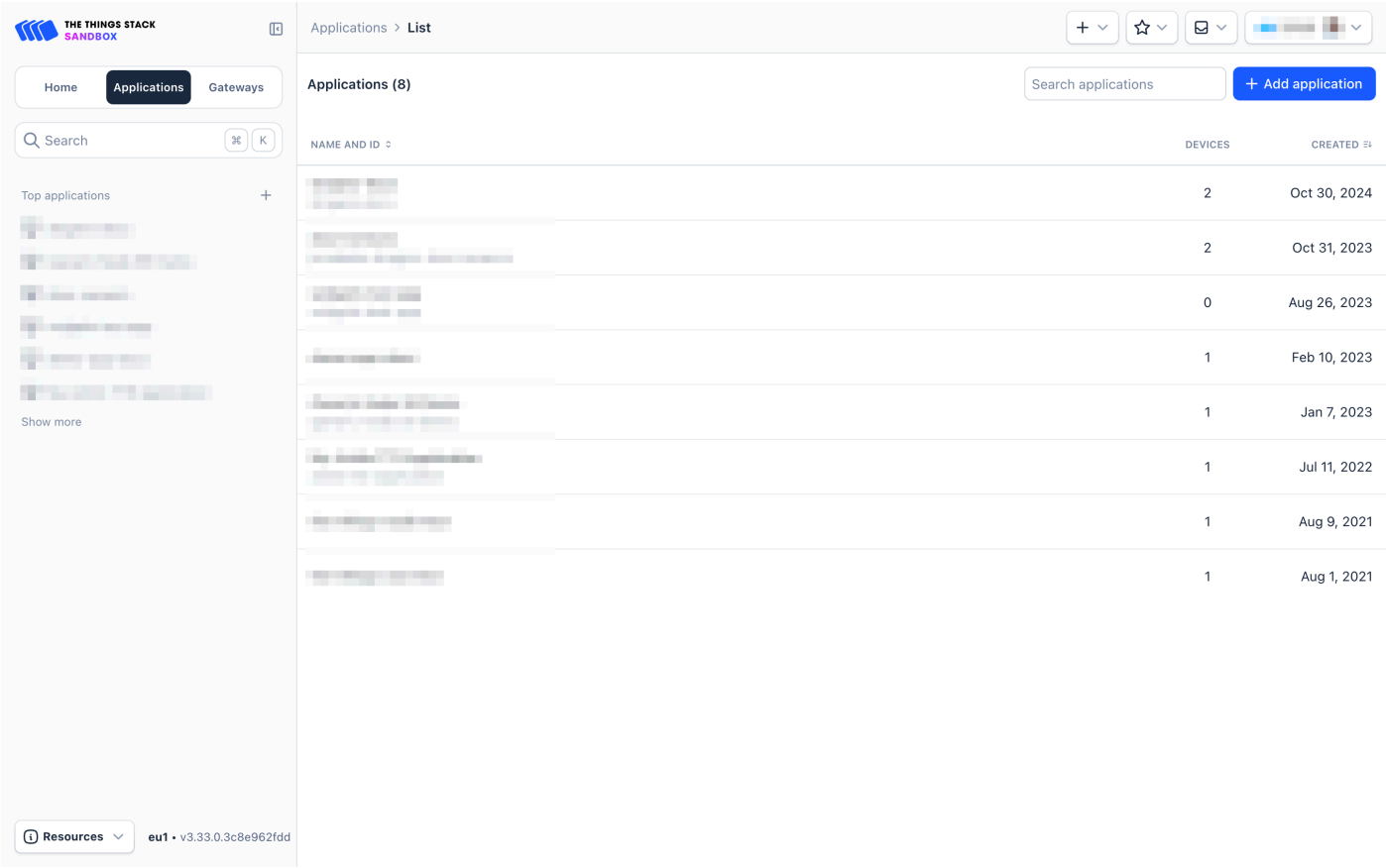


2.4 Registering with The Things Stack

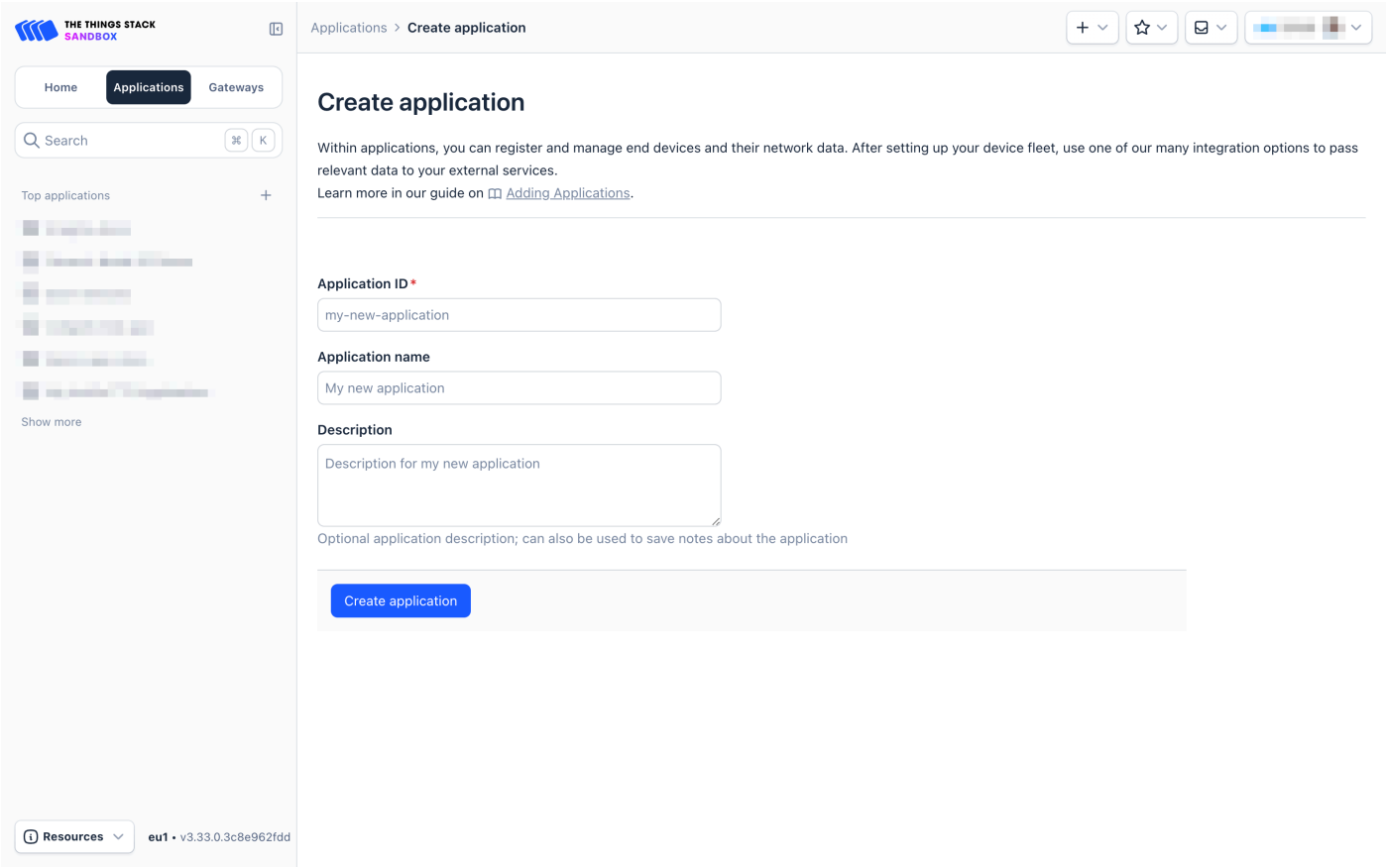
The CS01-LB can be registered with The Things Stack for **OTAA activation**. It currently supports only manual registration with The Things Stack. The following steps explain how to register the CS01-LB with The Things Stack.

2.4.1 Create an Application

- Sign up for a free account with The Things Stack Sandbox if you do not have one yet.
- Log in to your **The Things Stack** account.
- Create an **application** with The Things Stack if you do not have one yet.
  - On the left navigation, click **Applications**.
  - Then click **+ Add Application** button.

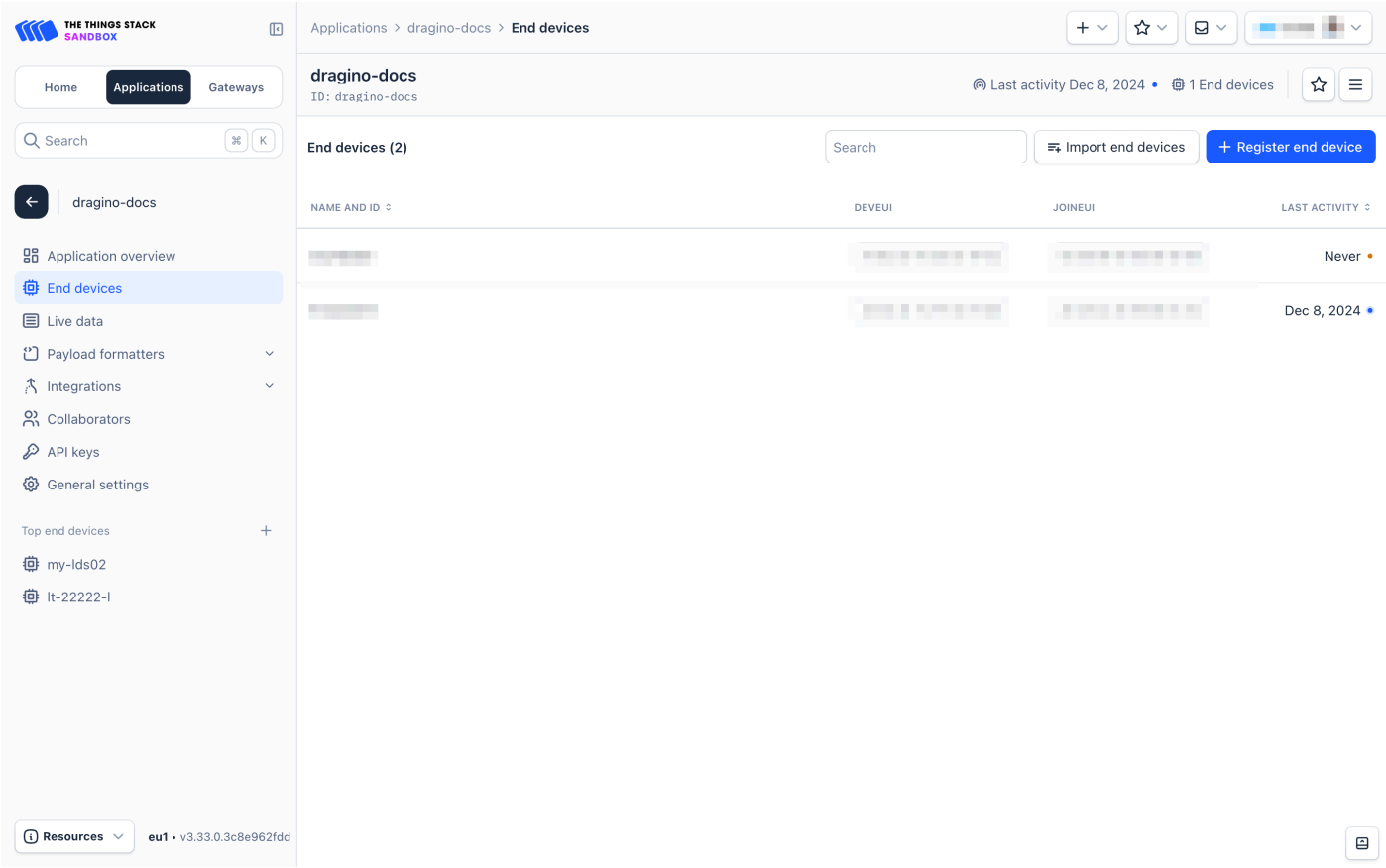


- On the **Create Application** page, configure the following:
  - **Application ID**: Provide a unique identification for your application within The Things Stack.
  - **Application name**: (optional) Provide a descriptive name.
  - **Description**: (optional) Provide a description.
- Click on **Create application** button.



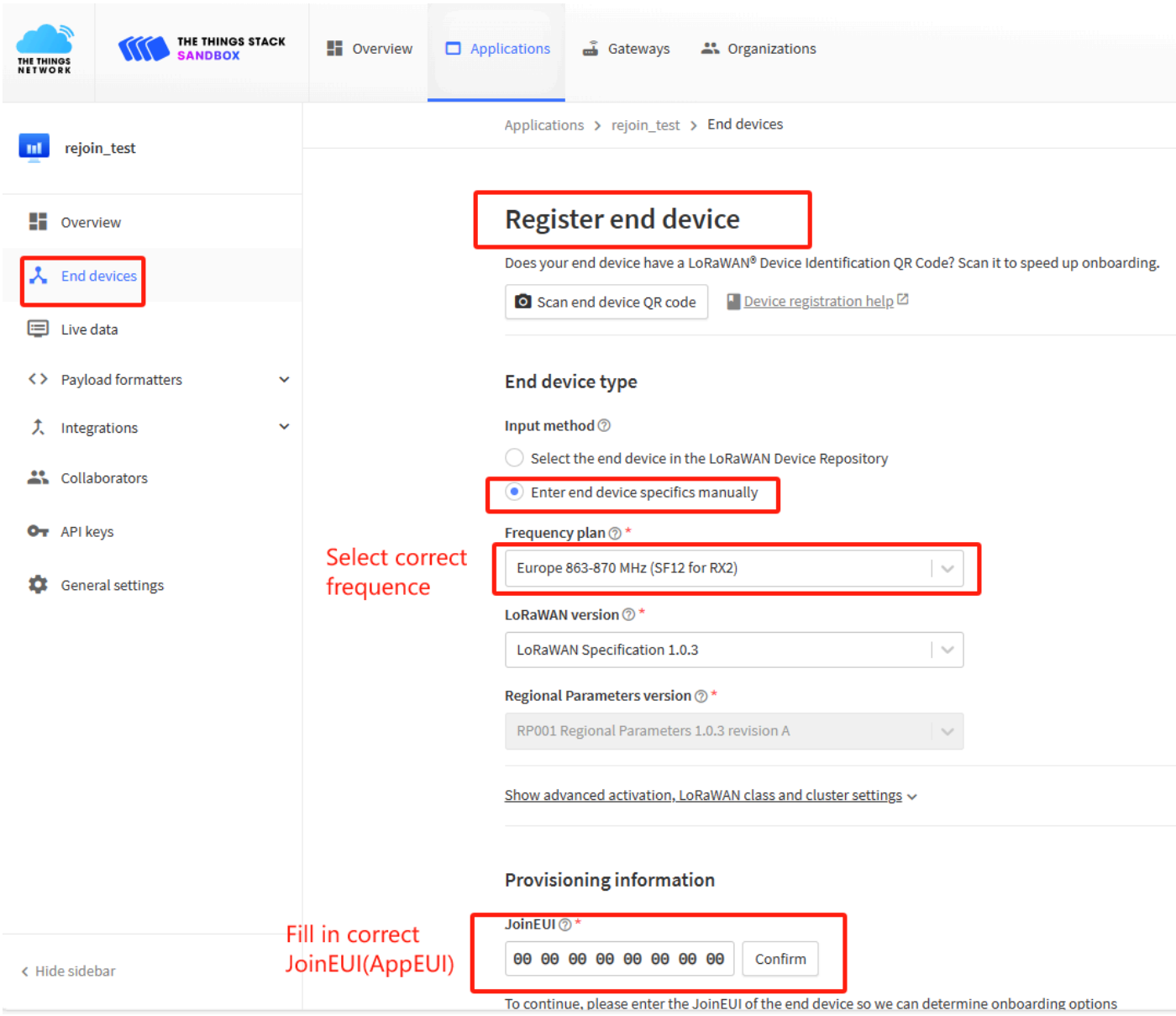
2.4.2 Register CS01-LB

- Go to your application's page and click on the **End devices** in the left menu.
- On the End devices page, click on **+ Register end device**

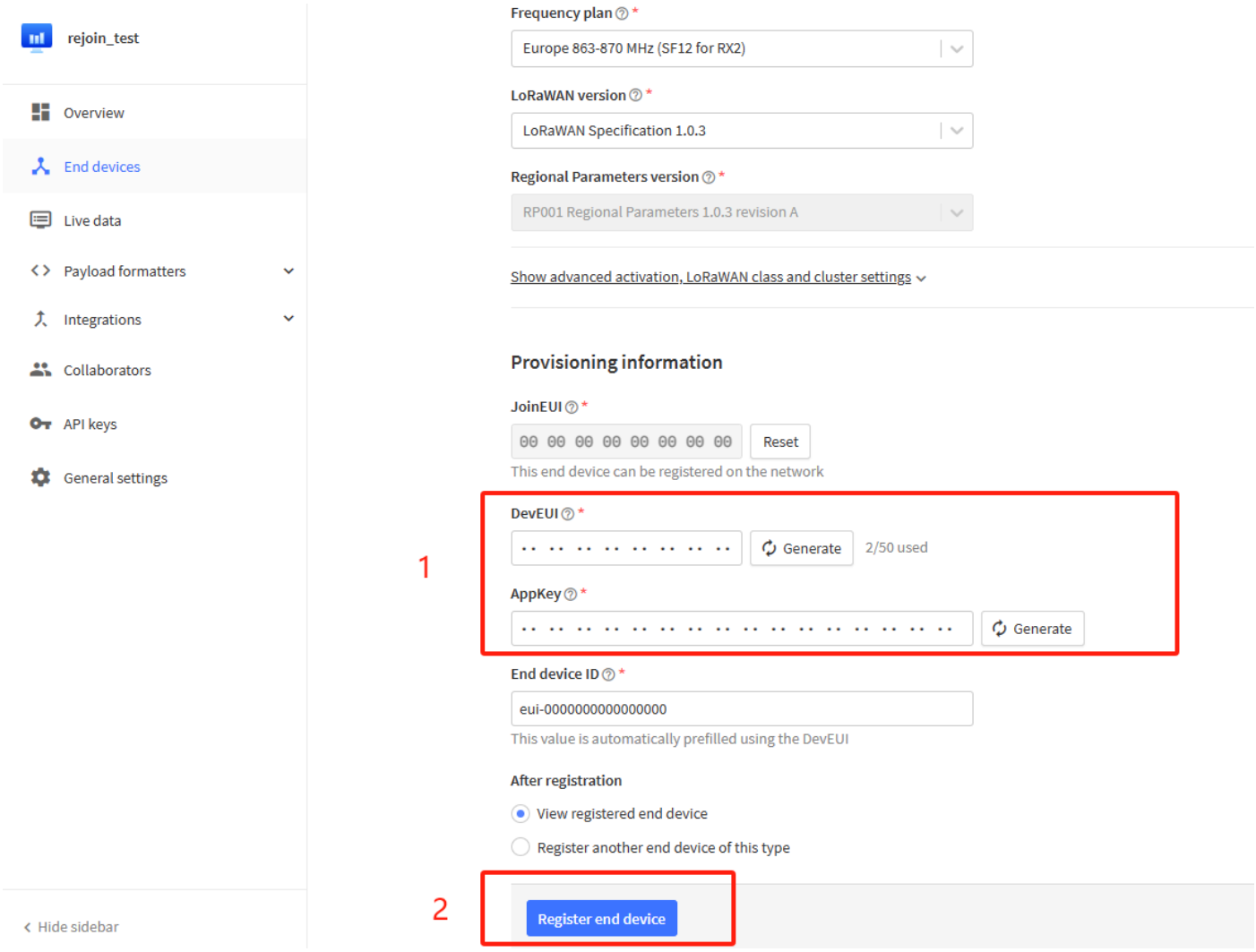


On the **Register end device** page:

- Select the option **Enter end device specifies manually** under **Input method**.
- **Frequency plan** : Select the **Frequency plan** that matches your device.
- **LoRaWAN version**: LoRaWAN Specification 1.0.3
- **JoinEUI** : Enter the AppEUI here (see the registration information sticker). Then click **Confirm** button.



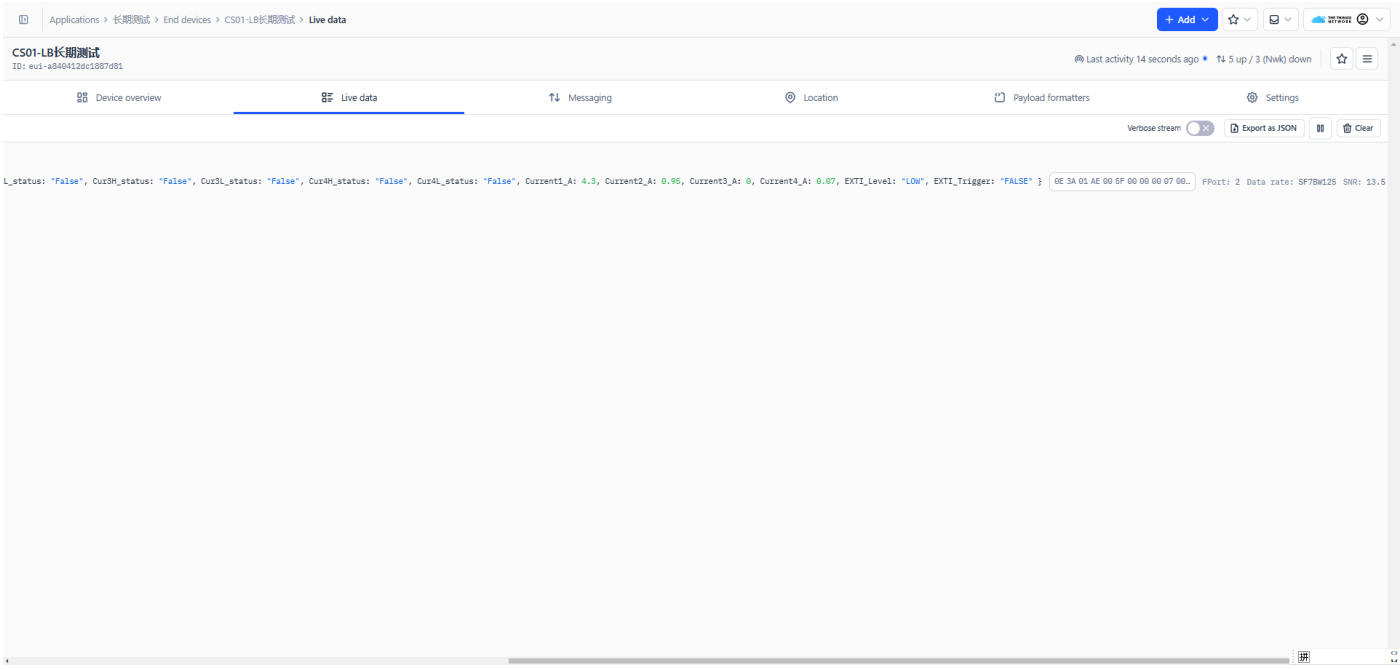
- **DevEUI** : Enter the **DevEUI** here (see the registration information sticker).
- **AppKey** : Enter the **AppKey** here (see the registration information sticker).
- **End device ID** : Enter a unique name for your CS01-LB within this application.
- Under **After registration**, select the **View registered end device** option.
- Click **Register end device** button.



Press the **ACT** button for **5 seconds** to activate the CS01-LB.

The **Green LED** will blink rapidly 5 times, and the device will enter OTAA mode for 3 seconds. Then, it will start joining the LoRaWAN network. The **Green LED** will remain solid for **5 seconds** after successfully joining the network.

Once the device has joined successfully, it will start uploading messages to The Things Stack, and you can see the messages in the **Live data** panel.



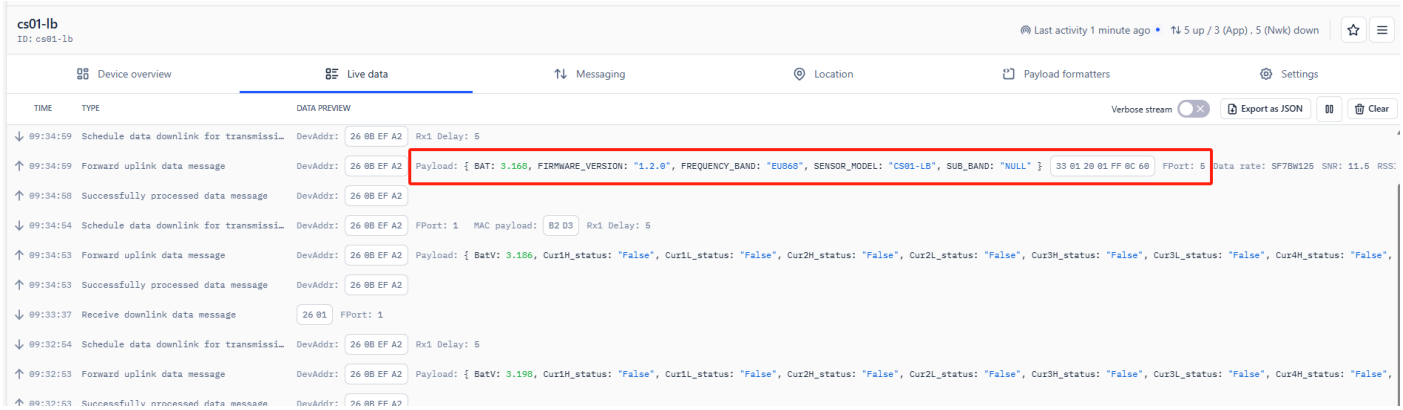
2.3 Device Status, FPort=5

You can use the downlink command, **0x26 01**, to request the CS01-LB to send device configuration details, including the device configuration status. The CS01-LB will uplink a payload via **FPort=5** to the LoRaWAN Network Server.

The payload format is as follows:

Device Status (FPort=5)					
Size (bytes)	**1**	**2**	**1**	**1**	**2**
Value	Sensor Model	Firmware Version	Frequency Band	Sub-band	BAT

Example: Consider the uplink payload **33 01 00 01 FF 0C 60**.



The following values can be extracted from the above payload.

Sensor Model (1 byte): For CS01-LB, this value is 0x33

Firmware Version (2 bytes): 0x0100, Means: v1.0.0 version

Frequency Band (1 byte):

- 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 (1 byte):

AU915 and US915:value 0x00 ~ 0x08

CN470: value 0x0B ~ 0x0C

Other Bands: Always 0x00

Battery Info (2 bytes):

Check the battery voltage.

0x0C 60 = 3168 mV

2.4 Working Mode & Uplink Payload

2.4.1 MOD=1(General Acquisition Mode), FPort=2

Note: The AT+CCAL=0,0,0,0 command must be set when the v1.0 version firmware for the first time, otherwise inaccurate current readings may occur.

MOD=1 is the default mode. The end node will uplink the real-time current sensor value in two case:

- At each TDC interval.
- When an alarm is triggered based on the **AT+CALARM** configure.

Uplink packets use FPort=2.

Size(bytes)	2	2	2	2	2	1

Value	Battery Info&Interrupt flag & Interrupt Level	Current channel 1	Current channel 2	Current channel 3	Current channel 4	Alarm_status*

Alarm_status is a combination of Cur1L_status, Cur1H_status, Cur2L_status, Cur2H_status, Cur3L_status, Cur3H_status, Cur4L_status and Cur4H_status.

It consists of a total of 1 byte, as shown below:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Cur1L	Cur1H	Cur2L	Cur2H	Cur3L	Cur3H	Cur4L	Cur4H

Example: Consider the payload, **0C 7E 05 86 05 7E 05 8D 00 00 00**.

0C 7E 05 86 05 7E 05 8D 00 00 00

Battery Info

Check the battery voltage for CS01-LB/LS.

In this example:

0x0C7E&0x3FFF = **3198mV**

Some other examples:

Ex1: 0x0B45&0x3FFF = 2885mV

Ex2: 0x0B49&0x3FFF = 2889mV

Interrupt Flag & Interrupt Level

This data field indicates whether this packet was generated by an interrupt or not. Click here for the hardware and software setup.

Note: The interrupt pin refers to the **GPIO_EXTI** pin on the screw terminal. See the pin mapping.

In this example:

0x0C&0x80>>15 =0x00 : Normal uplink packet

0x0C&0x40>>14 =0x00 : Interrupt pin low level

Some other examples:

If byte[0]&0x80>>15=0x00 : Normal uplink packet.

If byte[0]&0x80>>15=0x01 : Interrupt uplink Packet.

If byte[0]&0x40>>14=0x00 : Interrupt pin low level.

If byte[0]&0x40>>14=0x01 : Interrupt pin high level.

Current channel 1:

Channel 1 for measuring AC current with a resolution of 0.01A.

Example: 0x0586 = 1414/100 = 14.14A

Current channel 2:

Channel 2 for measuring AC current with a resolution of 0.01A.

Example: 0x057E = 1406/100 =14.06A

Current channel 3:

Channel 3 for measuring AC current with a resolution of 0.01A.

Example: 0x058D = 1421/100 = 14.21A

Current channel 4:

Channel 4 for measuring AC current with a resolution of 0.01A.

Example: 0x0000 = 000/100 = 0A

Cur1L_status:

When setting the current threshold alarm for channel 1, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur1L_status** is **false** because the **bit 7** is **0.**

Cur1H_status:

When setting the current threshold alarm for channel 1, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 6** is **0.**

Cur2L_status:

When setting the current threshold alarm for channel 2, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur2L_status** is **false** because the **bit 5** is **0.**

Cur2H_status:

When setting the current threshold alarm for channel 2, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 4** is **0.**

Cur3L_status:

When setting the current threshold alarm for channel 3, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur1L_status** is **false** because the **bit 3** is **0.**

Cur3H_status:

When setting the current threshold alarm for channel 3, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 2** is **0.**

Cur4L_status:

When setting the current threshold alarm for channel 4, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur1L_status** is **false** because the **bit 1** is **0.**

Cur4H_status:

When setting the current threshold alarm for channel 4, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 0** is **0.**

2.4.2 MOD=2 (Continuous Sampling Mode), FPort=7

In Continuous Sampling Mode **(AT+MOD=2, aa, bb)**, the CS01 will record the current sensor data at fixed intervals and later report multiple groups of data together to the IoT server.

Note: This mode has high power consumption. An external power supply might be needed. For more details, please check the power consumption section.

AT+MOD=2,aa,bb format**:**

- **First Parameter set to 2:** Sets the CS01-LB to work in Continuous Sampling Mode.
- **aa** : Sets the sampling interval (unit: seconds)
- **bb** : Defines how many groups of data will be uplinked together.

When CS01-LB is in Continuous Sampling Mode, the TDC time setting is disabled, and CS01-LB will send uplink once it finished the number of sampling define in "bb".

Example Command:AT+MOD=2,60,5

The CS01-LB will read data from 4 channels every 1 minute. After reading 5 groups, the CS01-LB will send an uplink. Therefore, the uplink interval is 5 minutes. Each uplink will include 5 groups of sensor values. Each group contains data from 4 channels. The payload for each uplink will include:

- **Battery (2 bytes)**
- **Group 1 Sensor Value (8 bytes):** The 4th most recent reading for Channel 1, Channel 2, Channel 3, and Channel 4
- **Group 2 Sensor Value (8 bytes):** The 3rd most recent reading for Channel 1, Channel 2, Channel 3, and Channel 4
- **Group 3 Sensor Value (8 bytes):** The 2nd most recent reading for Channel 1, Channel 2, Channel 3, and Channel 4
- **Group 4 Sensor Value (8 bytes):** The most recent reading for Channel 1, Channel 2, Channel 3, and Channel 4
- **Group 5 Sensor Value (8 bytes):** The current reading for Channel 1, Channel 2, Channel 3, and Channel 4

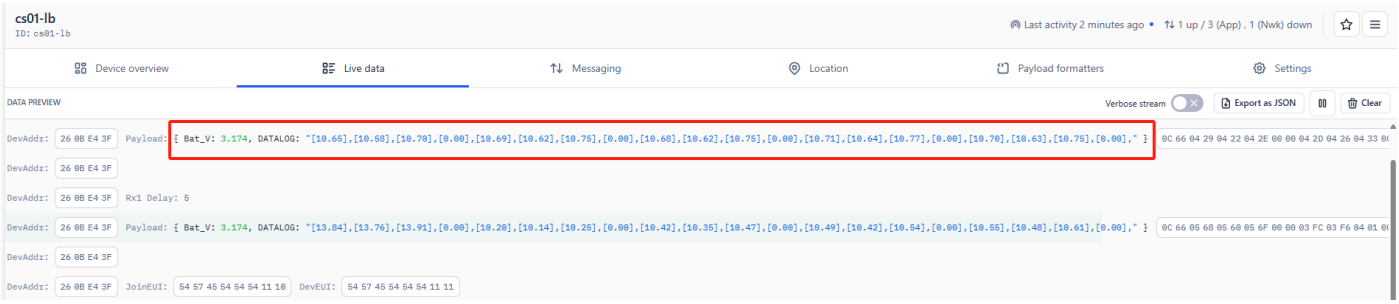
In total, the payload in this example is 42 bytes.

Note: Continuous Sampling Mode may generate a large payload, and the CS01-LB will select the appropriate DR to uplink the data. This might reduce the transmission distance.

Uplink packets use FPort=7.

Size(bytes)	2	Dynamic Length , Depending on how many groups
Value	BAT	Sensor value: Each 8 bytes represent a set of sensor values (the maximum is 30 groups).

Example: Consider the payload, 0C6604290422042E0000042D042604330000042C042604330000042F042804350000042E042704330000.



Battery voltage: 0x0C66&0x3FFFF = **3174 mV**

2.4.3 Current Accumulation Calculation Function(since v1.3.1)

After turning on the current accumulation function (setting AT+TOTALCURRENT command), CS01-LB will accumulate the current consumption and send the accumulated current consumption at each TDC. The unit is mA/min.

Note:

1. This mode is only available for AT+MOD=1.

2. This mode has high power consumption. An external power supply might be needed.

Uplink packets use FPort=2.

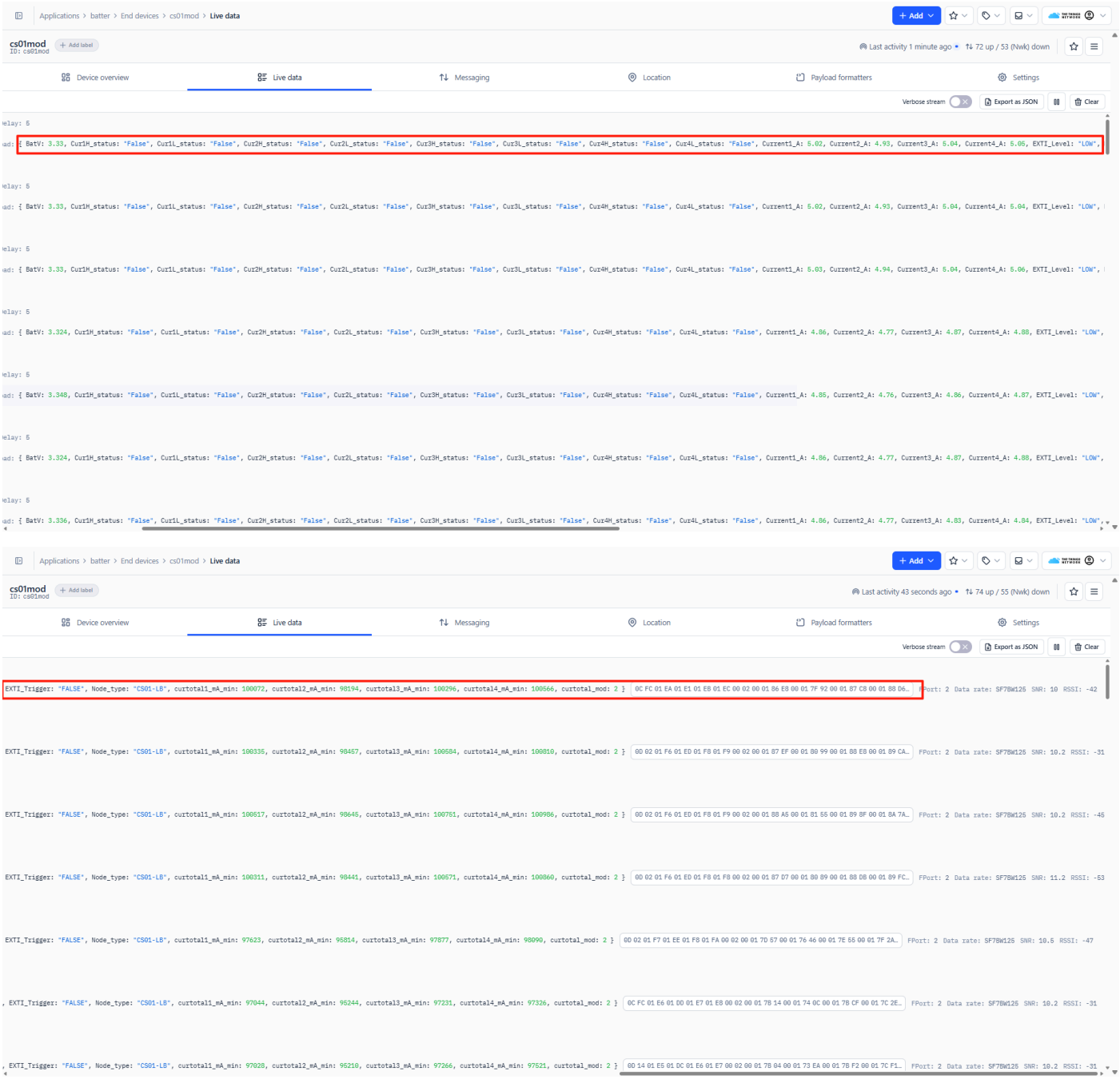
Size(bytes)	2	2	2	2	2	1	1	4	4	4	4
value	Battery Info & Interrupt flag & Interrupt Level	Current channel 1	Current channel 2	Current channel 3	Current channel 4	Alarm_status	Curtotal_mod	Curtotal1_mA_min	Curtotal2_mA_min	Curtotal3_mA_min	Curtotal4_mA_min

Alarm_status is a combination of Cur1L_status, Cur1H_status, Cur2L_status, Cur2H_status, Cur3L_status, Cur3H_status, Cur4L_status and Cur4H_status.

It consists of a total of 1 byte, as shown below:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Cur1L	Cur1H	Cur2L	Cur2H	Cur3L	Cur3H	Cur4L	Cur4H

Example in TTNv3:



Consider the payload, **0C FC 01 EA 01 E1 01 EB 01 EC 00 02 00 01 86 E8 00 01 7F 92 00 01 87 C8 00 01 88 D6**.

Battery Info

Check the battery voltage for CS01-LB/LS.

In this example:

0x0CFC&0x3FFF = **3324mV**

Some other examples:

Ex1: 0x0B45&0x3FFF = 2885mV

Ex2: 0x0B49&0x3FFF = 2889mV

Interrupt Flag & Interrupt Level

This data field indicates whether this packet was generated by an interrupt or not. Click here for the hardware and software setup.

Note: The interrupt pin refers to the **GPIO_EXTI** pin on the screw terminal. See the pin mapping.

In this example:

0x0C&0x80>>15 =0x00 : Normal uplink packet

0x0C&0x40>>14 =0x00 : Interrupt pin low level

Some other examples:

If byte[0]&0x80>>15=0x00 : Normal uplink packet.

If byte[0]&0x80>>15=0x01 : Interrupt uplink Packet.

If byte[0]&0x40>>14=0x00 : Interrupt pin low level.

If byte[0]&0x40>>14=0x01 : Interrupt pin high level.

Current channel 1:

Channel 1 for measuring AC current with a resolution of 0.01A.

Example: 0x01EA = 490/100 = 4.90A

Current channel 2:

Channel 2 for measuring AC current with a resolution of 0.01A.

Example: 0x01E1 = 481/100 =4.81A

Current channel 3:

Channel 3 for measuring AC current with a resolution of 0.01A.

Example: 0x01EB = 491/100 = 4.91A

Current channel 4:

Channel 4 for measuring AC current with a resolution of 0.01A.

Example: 0x01EC = 492/100 = 4.92A

Cur1L_status:

When setting the current threshold alarm for channel 1, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur1L_status** is **false** because the **bit 7** is **0.**

Cur1H_status:

When setting the current threshold alarm for channel 1, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 6** is **0.**

Cur2L_status:

When setting the current threshold alarm for channel 2, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur2L_status** is **false** because the **bit 5** is **0.**

Cur2H_status:

When setting the current threshold alarm for channel 2, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 4** is **0.**

Cur3L_status:

When setting the current threshold alarm for channel 3, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur1L_status** is **false** because the **bit 3** is **0.**

Cur3H_status:

When setting the current threshold alarm for channel 3, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 2** is **0.**

Cur4L_status:

When setting the current threshold alarm for channel 4, this flag is **True** if the current is lower than the set threshold; otherwise, it is **False**.

In this example, **Cur1L_status** is **false** because the **bit 1** is **0.**

Cur4H_status:

When setting the current threshold alarm for channel 4, this flag is **True** if the current is higher than the set threshold; otherwise, it is **False**.

In this example, **Cur1H_status** is **false** because the **bit 0** is **0.**

Curtotal_mod:

This byte indicates the current working mode of the cumulative calculation function.

If bytes[11] =0x00 //Disable the current integration function.

If bytes[11] =0x01 //Enable the current accumulation function.

If bytes[11] =0x02 //Enable the current accumulation function, clear the accumulated value after TDC sends the packet, and recalculate the accumulated value.

Curtotal1_mA_min:

Indicates the current accumulation value of Curtotal1, Unit: mA/min.

If (bytes[12]<<24 | bytes[13]<<16 | bytes[14]<<8 | bytes[15])>>>0 = 0x000186E8 = 100072(Unit: mA/min)

Curtotal2_mA_min:

Indicates the current accumulation value of Curtotal2, Unit: mA/min.

If (bytes[16]<<24 | bytes[17]<<16 | bytes[18]<<8 | bytes[19])>>>0= 0x00017F92 = 98194(Unit: mA/min)

Curtotal3_mA_min:

Indicates the current accumulation value of Curtotal3, Unit: mA/min.

If (bytes[20]<<24 | bytes[21]<<16 | bytes[22]<<8 | bytes[23])>>>0= 0x000187C8 = 100296(Unit: mA/min)

Curtotal4_mA_min:

Indicates the current accumulation value of Curtotal4, Unit: mA/min.

If (bytes[24]<<24 | bytes[25]<<16 | bytes[26]<<8 | bytes[27])>>>0= 0x000188D6 = 100566(Unit: mA/min)

Related AT Command:

AT+TOTALCURRENT

AT+SETCURRENT

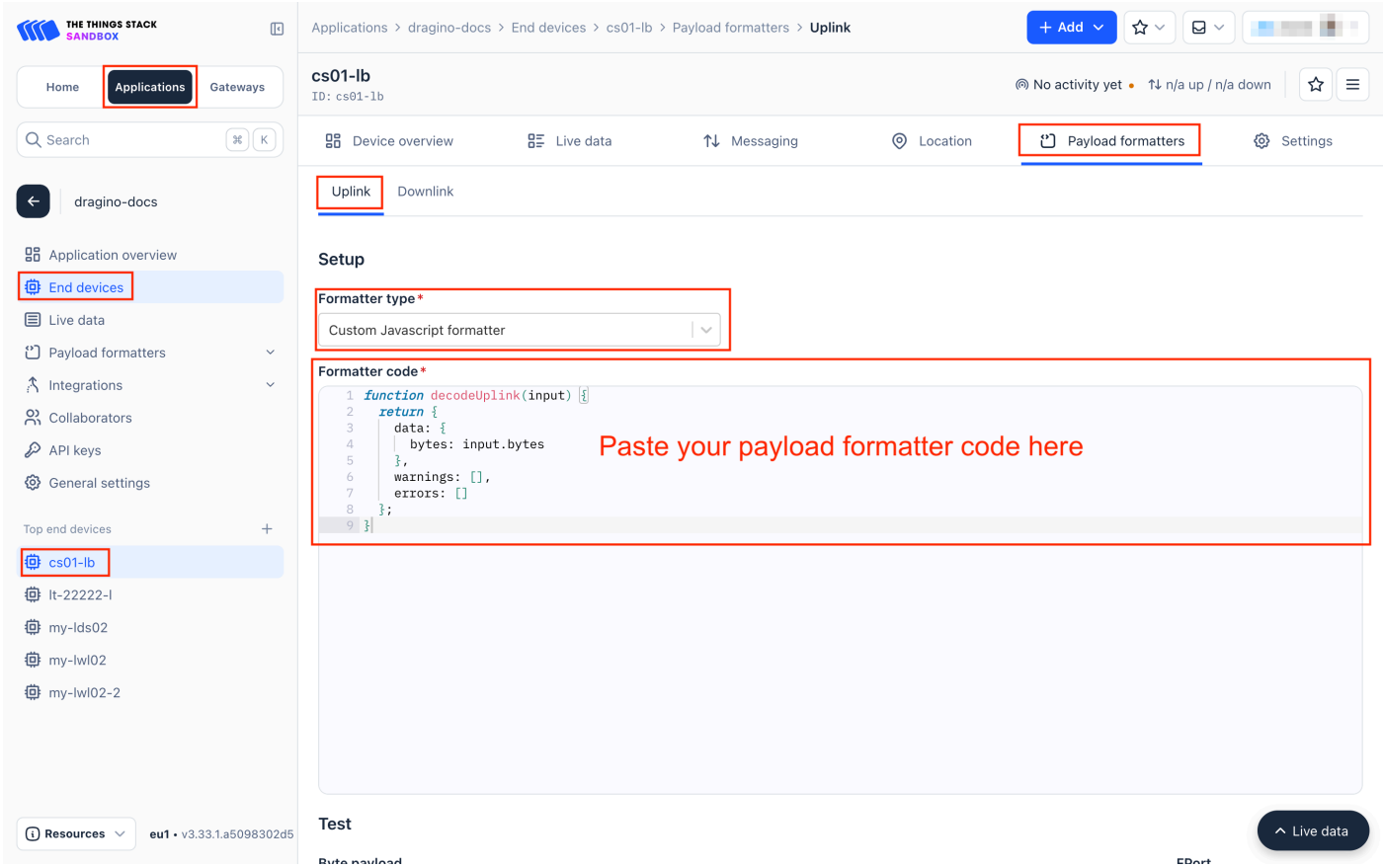
2.5 Payload Formatter

Payload formatters convert hexadecimal payloads into human-readable data fields. The Things Stack supports payload formatters for decoding uplink and downlink payloads.

Dragino has written a payload formatter to decode uplink payloads, which is compatible with The Things Stack. The uplink payload formatter can be downloaded from this link (CS01-LB_v1.0_TTN_Decoder.txt):

https://github.com/dragino/dragino-end-node-decoder/tree/main/CS01-LB

- Select the **CS01-LB** from your **application**.
- Click on the **Payload formatters** tab.
- Click on the **Uplink** tab if it is not selected by default.
- Select **Custom Javascript formatter** from the **Formatter type** dropdown list.
- In the **Formatter code** text box, paste the uplink formatter code you copied from the **above GitHub link**.
- Click on the **Save changes** button.



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, CS01-LB/LS will store the reading for future retrieving purposes.

2.6.1 How datalog works

CS01-LB/LSwill wait for ACK for every uplink, when there is no LoRaWAN network,CS01-LB/LS 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) CS01-LB/LS will do an ACK check for data records sending to make sure every data arrive server.
- b) CS01-LB/LS will send data in **CONFIRMED Mode**, but CS01-LB/LS won't re-transmit the packet if it doesn't get ACK, it will just mark it as a NONE-ACK message. In a future uplink if CS01-LB/LS gets a ACK, CS01-LB/LS will consider there is a network connection and resend all NONE-ACK messages.

2.6.2 Enable Datalog

User need to make sure below two settings are enable to use datalog;

- **SYNCMOD=1(Default)** to enable sync time via LoRaWAN MAC command, click here (AT+SYNCMOD) for detailed instructions.

- **PNACKMD=1** to enable datalog feature, click here (AT+PNACKMD) for detailed instructions.

Once CS01-LB/LS Joined LoRaWAN network, it will send the MAC command (DeviceTimeReq) and the server will reply with (DeviceTimeAns) to send the current time to CS01-LB/LS. If CS01-LB/LS fails to get the time from the server, CS01-LB/LS 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.

2.6.3 Unix Timestamp

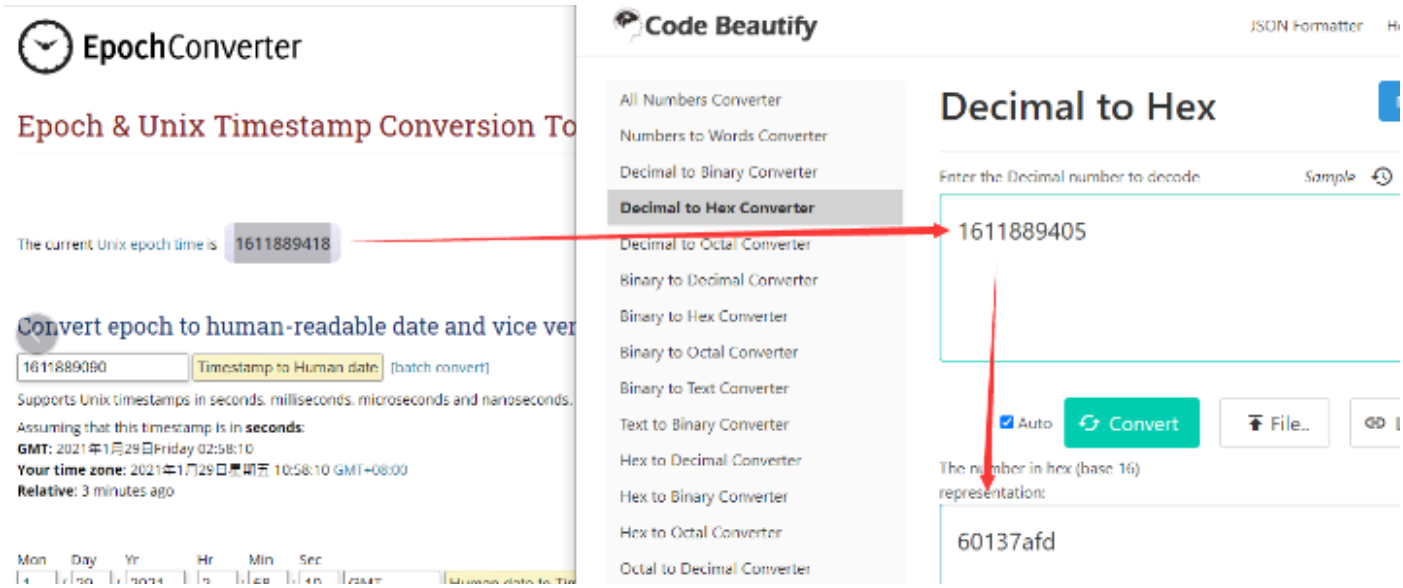
The CS01-LB uses the following Unix Timestamp:

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

You can get the Unix Timestamp from this link: https://www.epochconverter.com/ :

The following example shows how to convert the Unix Timestamp into hex number.



So, you can use **AT+TIMESTAMP=1611889405** or downlink 30**60137afd**00 to set the current time as **2021 – Jan -- 29 Friday 03:03:25**

2.6.4 Datalog Uplink Payload (FPort=3)

The Datalog uplinks will use the following payload format.

Retrieval data payload:

Size(bytes)	1	2	2	2	4
Value	Interrupt flag & Interrupt_level	Current1	Current2	Current3	Unix TimeStamp

Interrupt flag & Interrupt level :

Size(bit)	bit 7	bit 6	[bit 5:bit 2]	bit1	bit0
Value	NO ACK message	Poll Message Flag	Reserve	interrupt level	interrupt flag

No ACK Message: 1: This indicates that the payload is from an uplink message that did not receive an ACK from the server (for the **PNACKMD=1** feature)

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

- Poll Message Flag is set to 1.
- The **Poll Message Flag** is set to 1. Each data entry is 11 bytes. To save airtime and battery, devices will send the maximum bytes allowed based on the current DR and frequency bands.

For example, in the US915 band, the maximum payload for different DR values is as follows:

a) **DR0:** Maximum is 11 bytes, so one data entry
b) **DR1:** Maximum is 53 bytes, so the device will upload 4 data entries (total 44 bytes)
c) **DR2:** Total payload includes 11 data entries
d) **DR3:** Total payload includes 22 data entries

If the device doesn't have any data at the polling time, it will uplink 11 bytes of zeros.

Example:

If the CS01-LB has the following data stored inside flash:

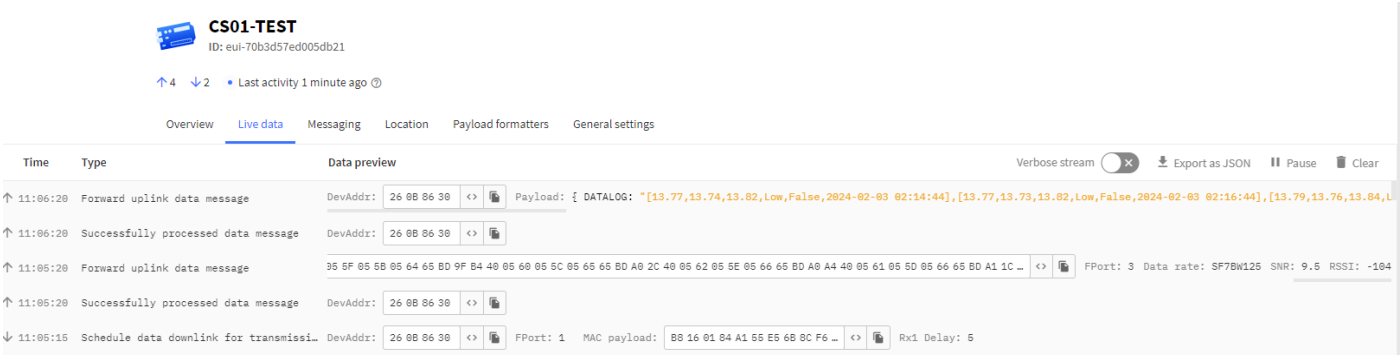
```
8031490 2024/1/30 04:36:58 bat:3648 current1:0.29 current2:0.00 current3:0.00 current4:0.07 level:low status:false
80314A0 2024/1/30 04:56:58 bat:3648 current1:0.29 current2:0.00 current3:0.00 current4:0.07 level:low status:false

80314B0 2024/1/30 05:16:58 bat:3648 current1:0.29 current2:0.00 current3:0.00 current4:0.07 level:low status:false
80314C0 2024/1/30 05:36:58 bat:3648 current1:1.53 current2:0.00 current3:0.00 current4:0.07 level:low status:false
80314D0 2024/1/30 05:56:58 bat:3648 current1:1.43 current2:0.00 current3:0.00 current4:0.07 level:low status:false
80314E0 2024/1/30 06:16:58 bat:3648 current1:1.39 current2:0.00 current3:0.00 current4:0.07 level:low status:false
80314F0 2024/1/30 06:36:58 bat:3648 current1:1.21 current2:0.00 current3:0.00 current4:0.07 level:low status:false

OK
```

If you send the downlink command, 3165BD971865BDA5283C

Where:

- **Start time:** 65BD9718 = 23/05/24 03:30:41
- **Stop time:** 65BDA528 = 23/05/24 03:33:00

The CS01-LB will uplink this payload:



4005650562056A65BD974440055D0559056265BD97BC400562055E056765BD983440056405600569 65BD98AC4005

Where the first 11 bytes is for the first entry:

40 05 65 05 62 05 6A 65 BD 97 44

Current1=0x0565/100=13.81

Current2=0x0562/100=13.78

Current3=0x056A/100=13.86

Interrupt flag & Interrupt_level=0x40 : This indicates a reply data sampling uplink message, with the interrupt level set to low and the interrupt flag set to false.

Unix time is 0x65BD9744=1706923844s=24/2/3 01:30:44

2.7 Frequency Plans

The CS01-LB uses OTAA mode and the frequency plans below by default. Each frequency band uses different firmware, and the user must update the firmware to the corresponding band for their country: See End Device Frequency Band for more information.

2.8 Firmware Change Log

The firmware can be download from this link: https://www.dropbox.com/scl/fo/cnnyz4ynebs3am96jvtv0/h?rlkey=4no594ssi0nzt2lc3irbkid9b&dl=0

2.9 Integrate with IoT Platforms

The Things Stack can be integrated with many IoT platforms, including ThingsEye and Datacake, for visualizing and analyzing data coming from the CS01-LB. Most of these IoT platforms also support sending downlinks to the CS01-LB.

2.9.1 Integrate with ThingsEye

The Things Stack application supports integration with ThingsEye.io. Once integrated, ThingsEye.io acts as an MQTT client for The Things Stack MQTT broker, allowing it to subscribe to upstream traffic and publish downlink traffic.

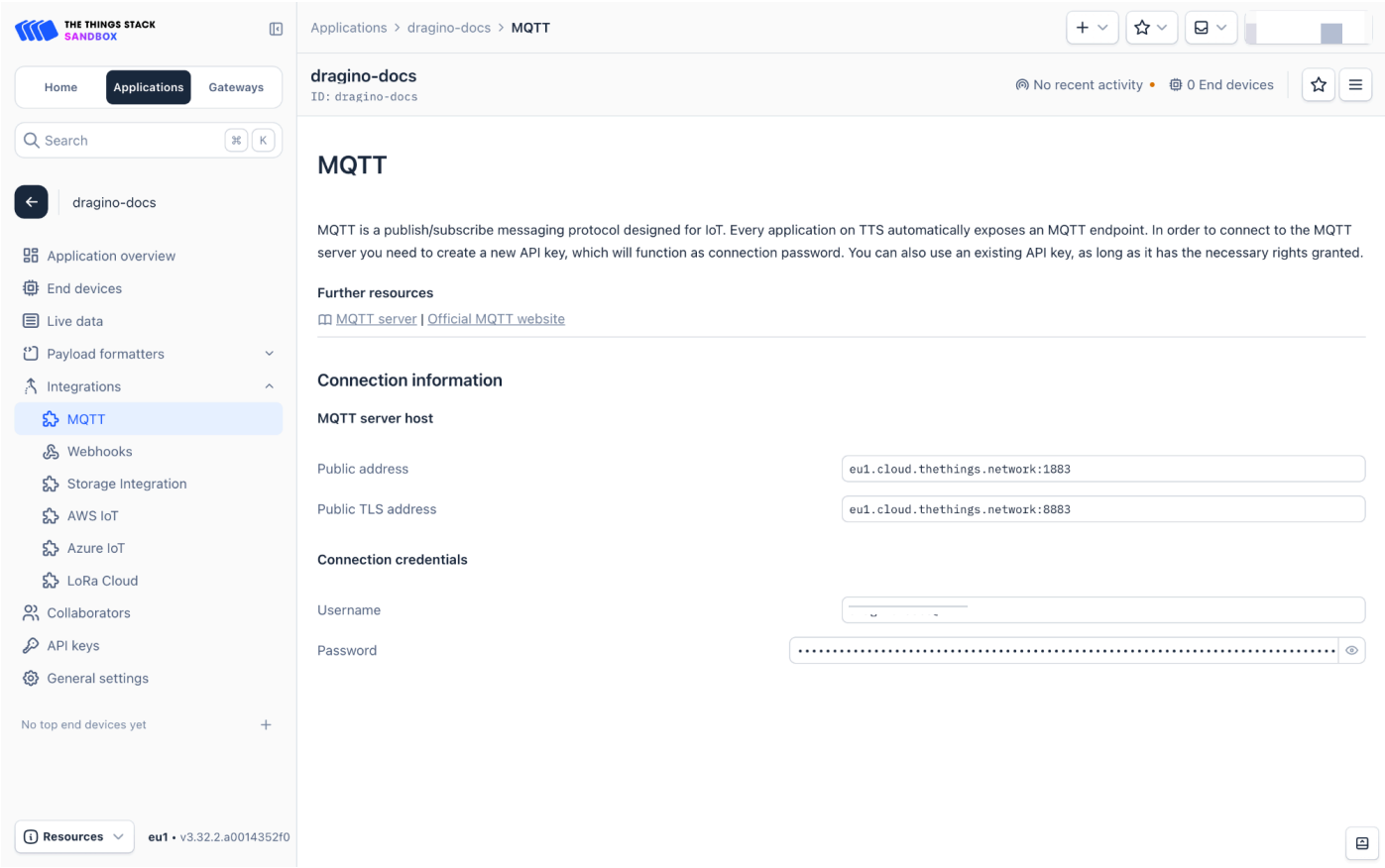
2.9.1.1 Configuring The Things Stack

We use The Things Stack Sandbox in this example. Of course, you can apply this example to any The Things Stack plan.

- In **The Things Stack Sandbox**, go to the **Application** for the LDS02 you added.
- Select **MQTT** under **Integrations** in the left menu.
- In the **Connection information** section, under **Connection credentials**, The Things Stack displays an auto-generated **username**. You can use it or provide a new one.
- Click the **Generate new API key** button to generate a password. You can view it by clicking on the **visibility toggle/eye** icon. The **API key** works as the **password**.

" class="xwiki-metadata-container">The username and password (API key) you created here are required in the next section.

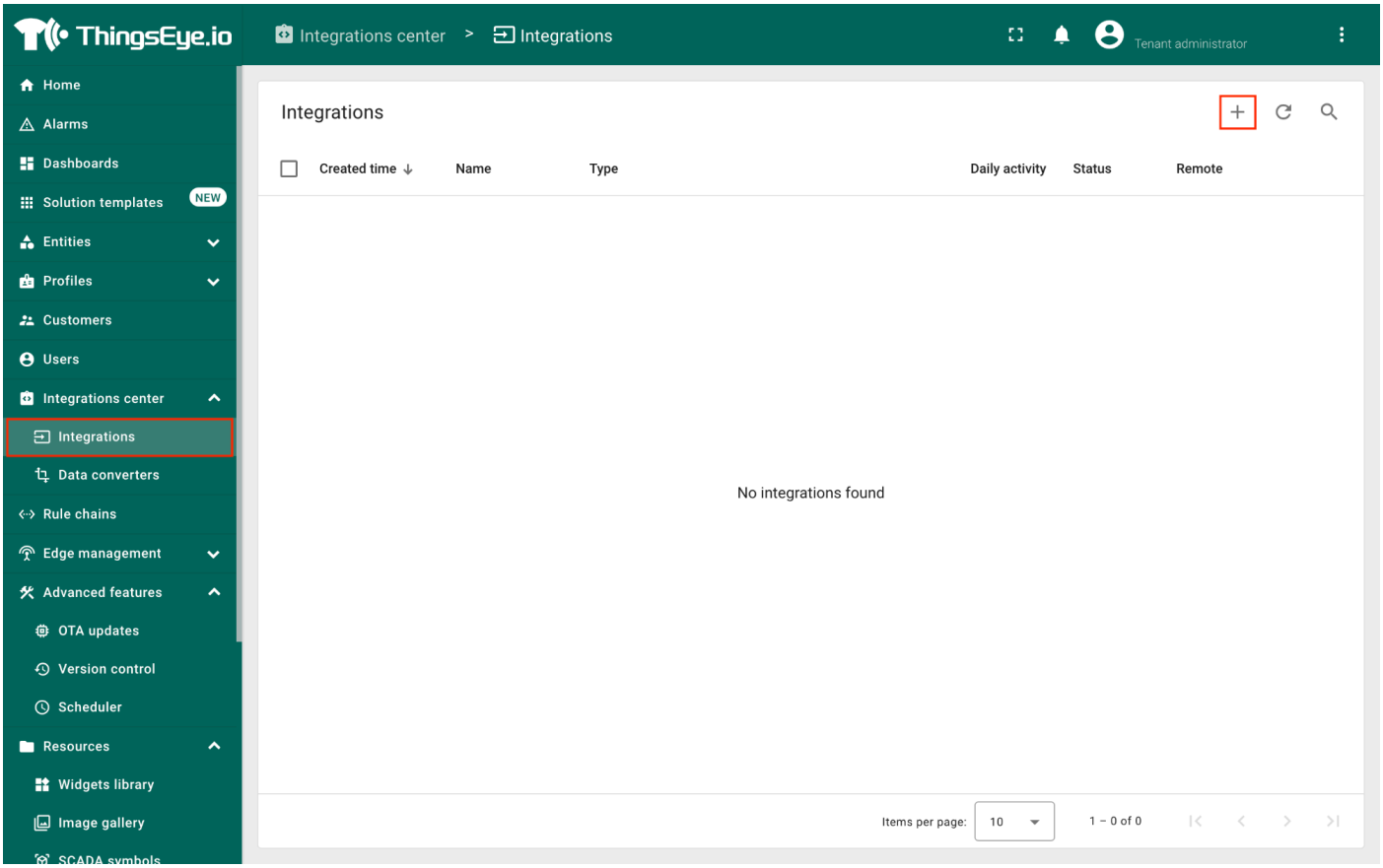
The username and password (API key) you created here are required in the next section.



2.9.1.2 Configuring ThingsEye.io

The ThingsEye.io IoT platform is not open for self-registration at the moment. If you are interested in testing the platform, please send your project information to admin@thingseye.io, and we will create an account for you.

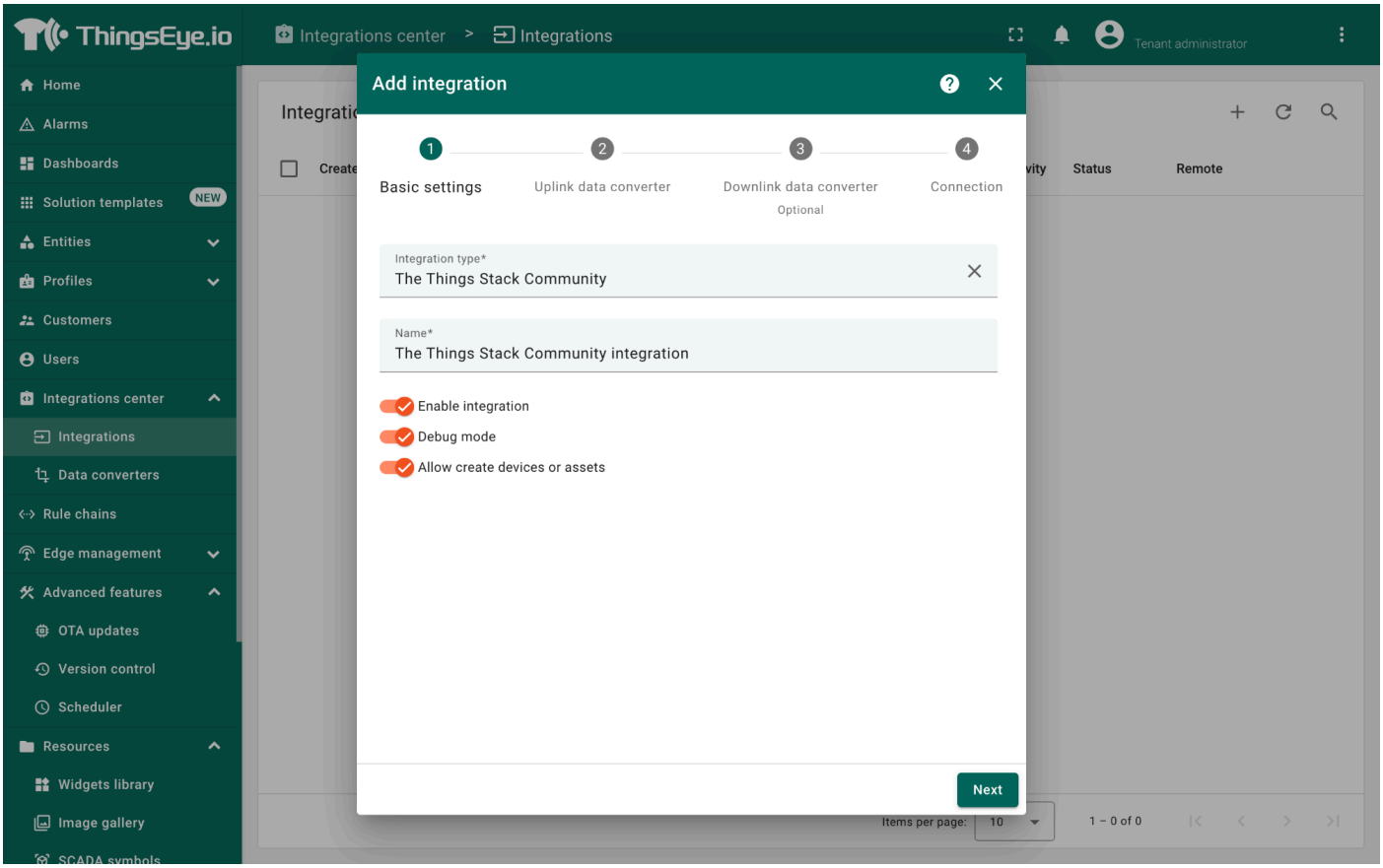
- Login to your ThingsEye.io account.
- Under the **Integrations center**, click **Integrations**.
- Click the **Add integration** button (the button with the **+** symbol).



On the **Add integration** window, configure the following:

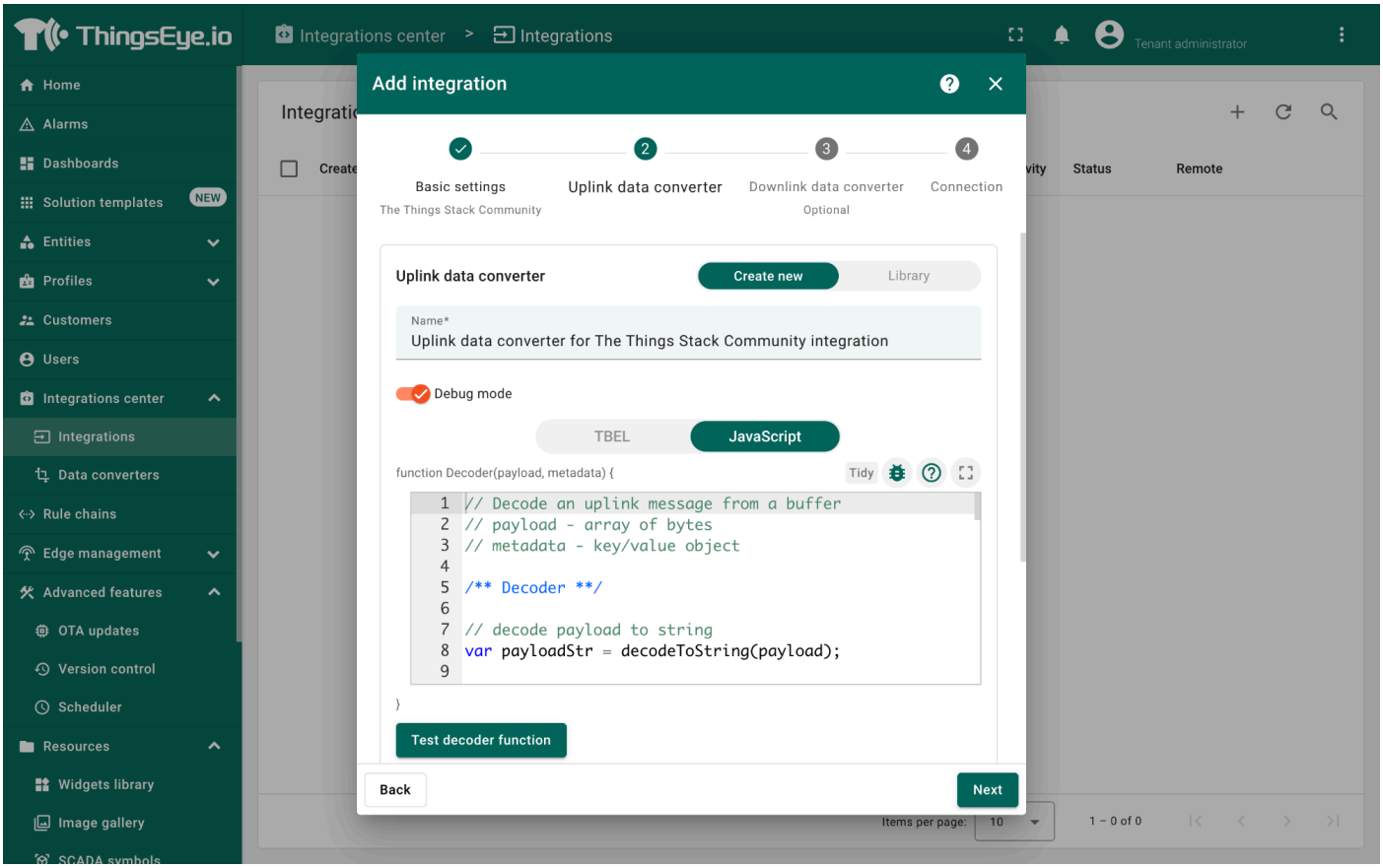
Basic settings:

- Select **The Things Stack Community** from the **Integration type** list.
- Enter a suitable name for your integration in the **Name** text box or keep the default name.
- Ensure the following options are turned on.
    - Enable integration
    - Debug mode
    - Allow creating devices or assets
- Click the **Next** button. you will be navigated to the **Uplink data converter** tab.



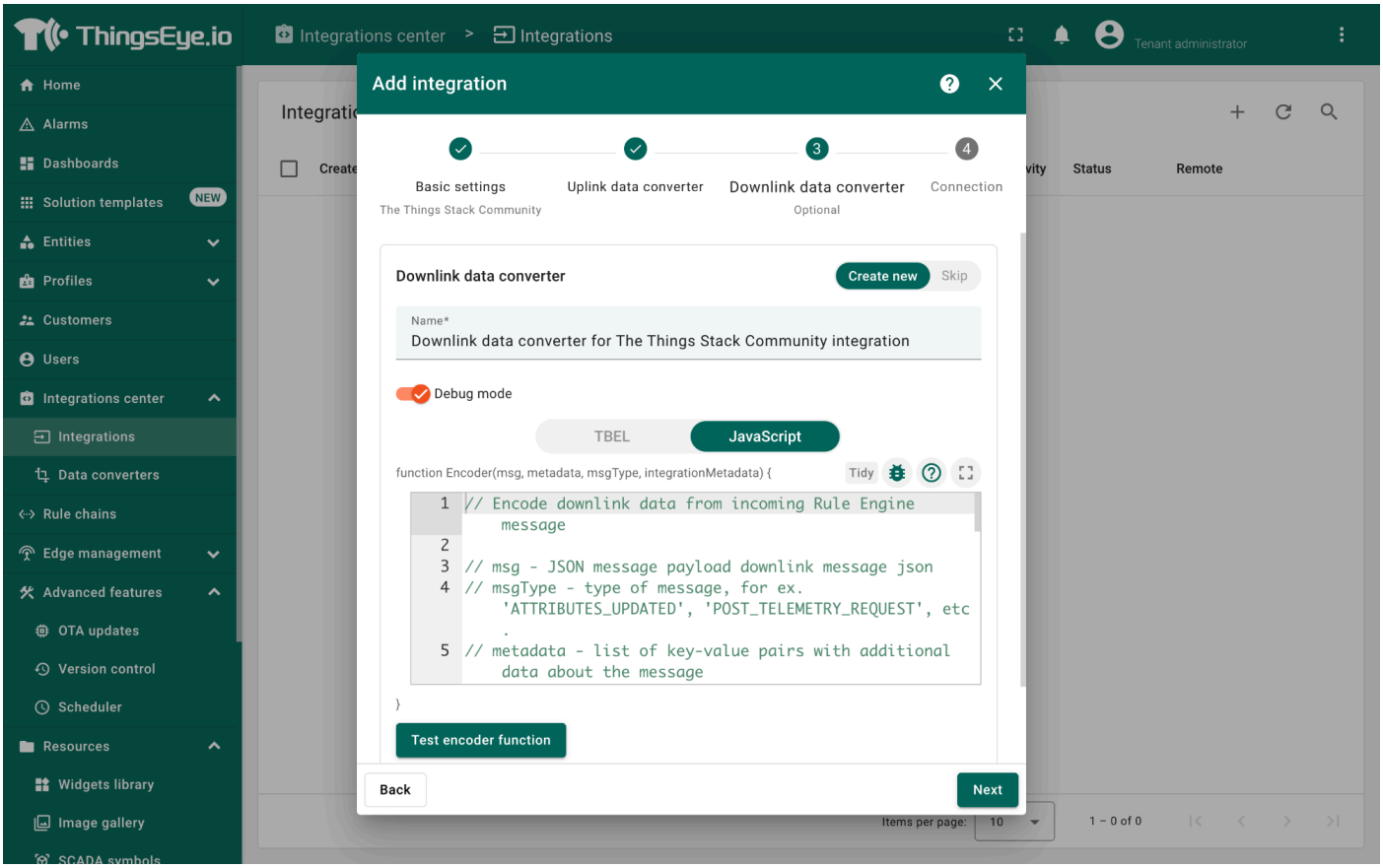
Uplink data converter:

- Click the **Create new** button if it is not selected by default.
- Enter a suitable name for the uplink data converter in the **Name** text box or keep the default name.
- Click the **JavaScript** button.
- Paste the uplink decoder function into the text area (first, delete the default code). The demo uplink decoder function can be found here.
- Click the **Next** button. You will be navigated to the **Downlink data converter** tab.



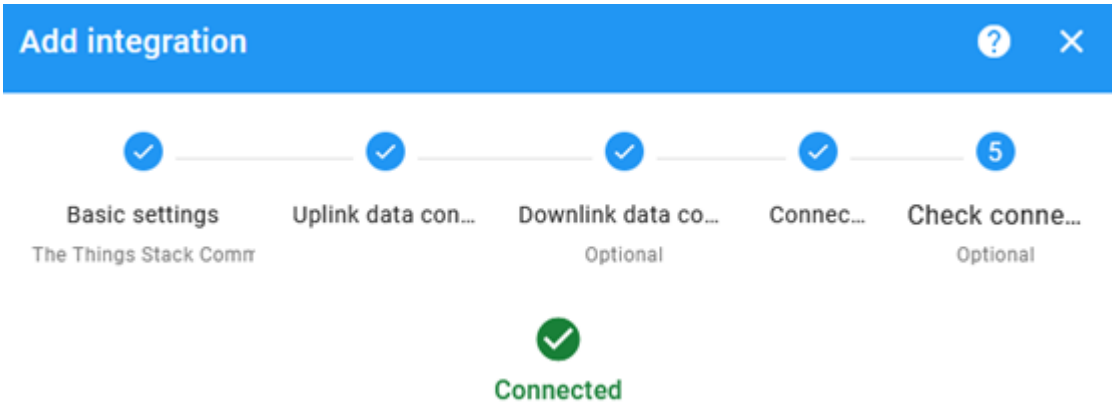
Downlink data converter (this is an optional step):

- Click the **Create new** button if it is not selected by default.
- Enter a suitable name for the downlink data converter in the **Name** text box or keep the default name.
- Click the **JavaScript** button.
- Paste the downlink decoder function into the text area (first, delete the default code). The demo downlink decoder function can be found here.
- Click the **Next** button. You will be navigated to the **Connection** tab.

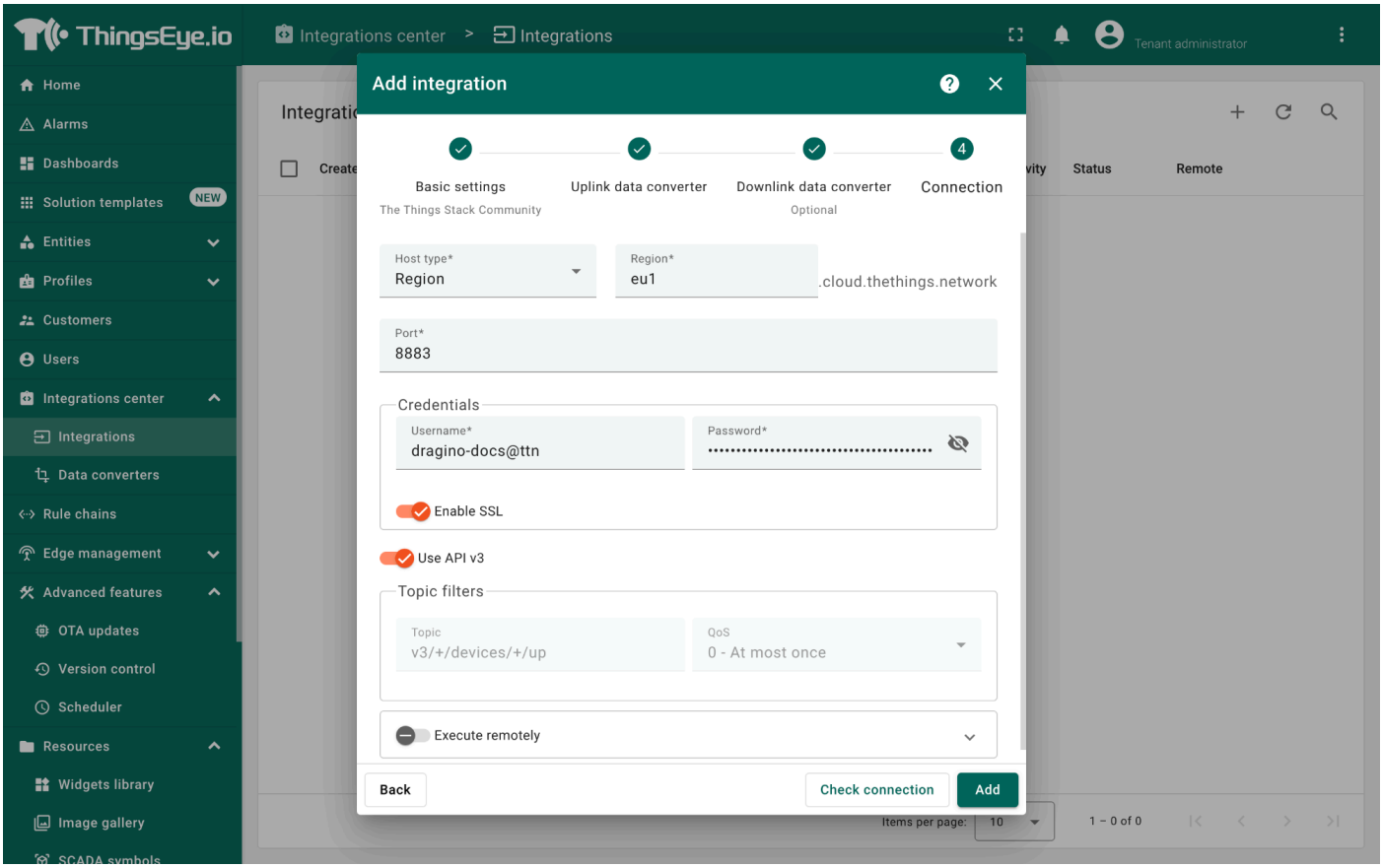


Connection:

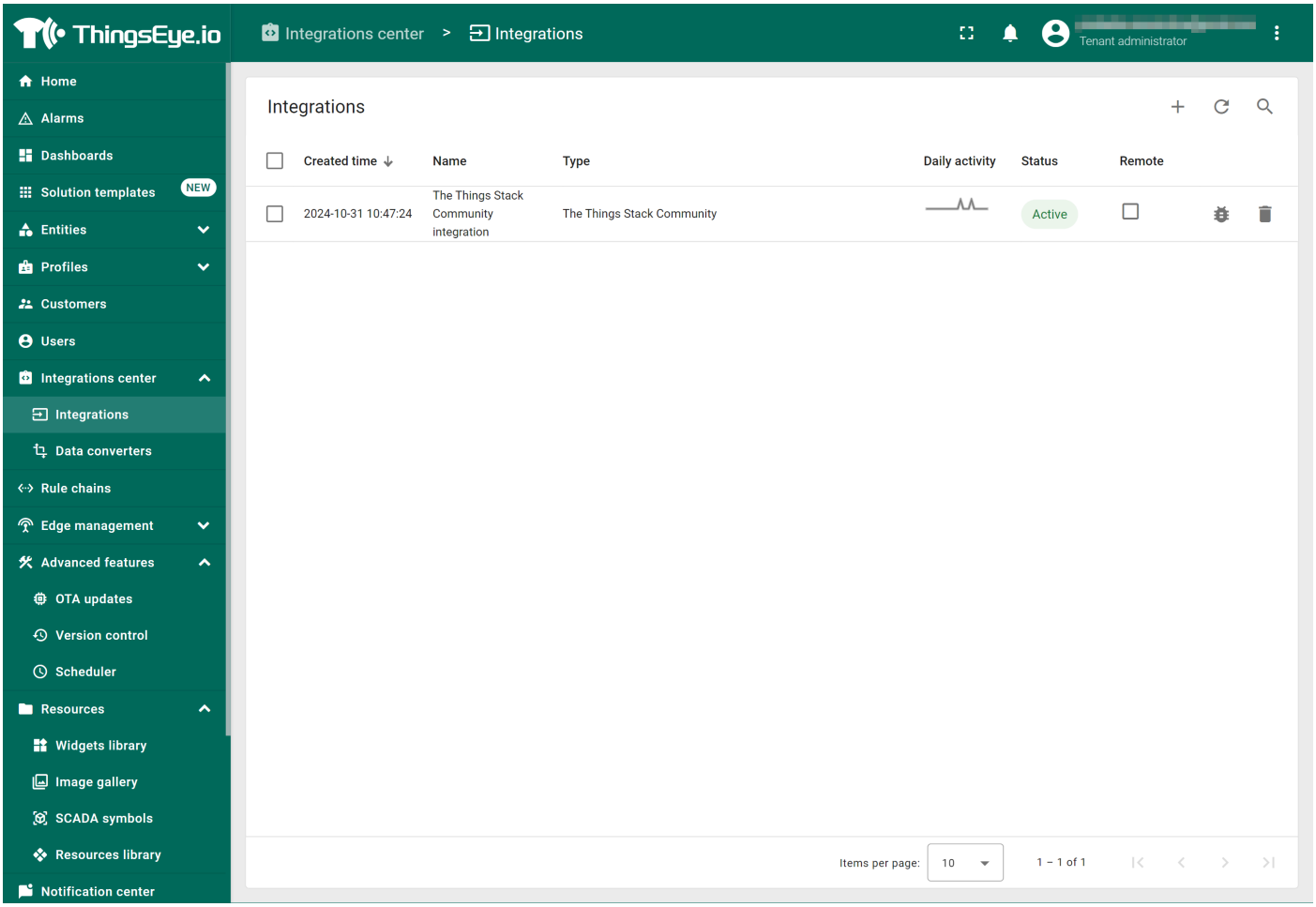
- Choose **Region** from the **Host type**.
- Enter the **cluster** of your **The Things Stack** in the **Region** textbox. You can find the cluster in the url (e.g., https://**eu1**.cloud.thethings.network/...).
- Enter the **Username** and **Password** of the MQTT integration in the **Credentials** section.
  The **username** and **password** can be found on the MQTT integration page of your The Things Stack account (see **2.9.1.1 Configuring The Things Stack**).
- Click the **Check connection** button to test the connection. If the connection is successful, you will see the message saying **Connected**.



- Click the **Add** button.

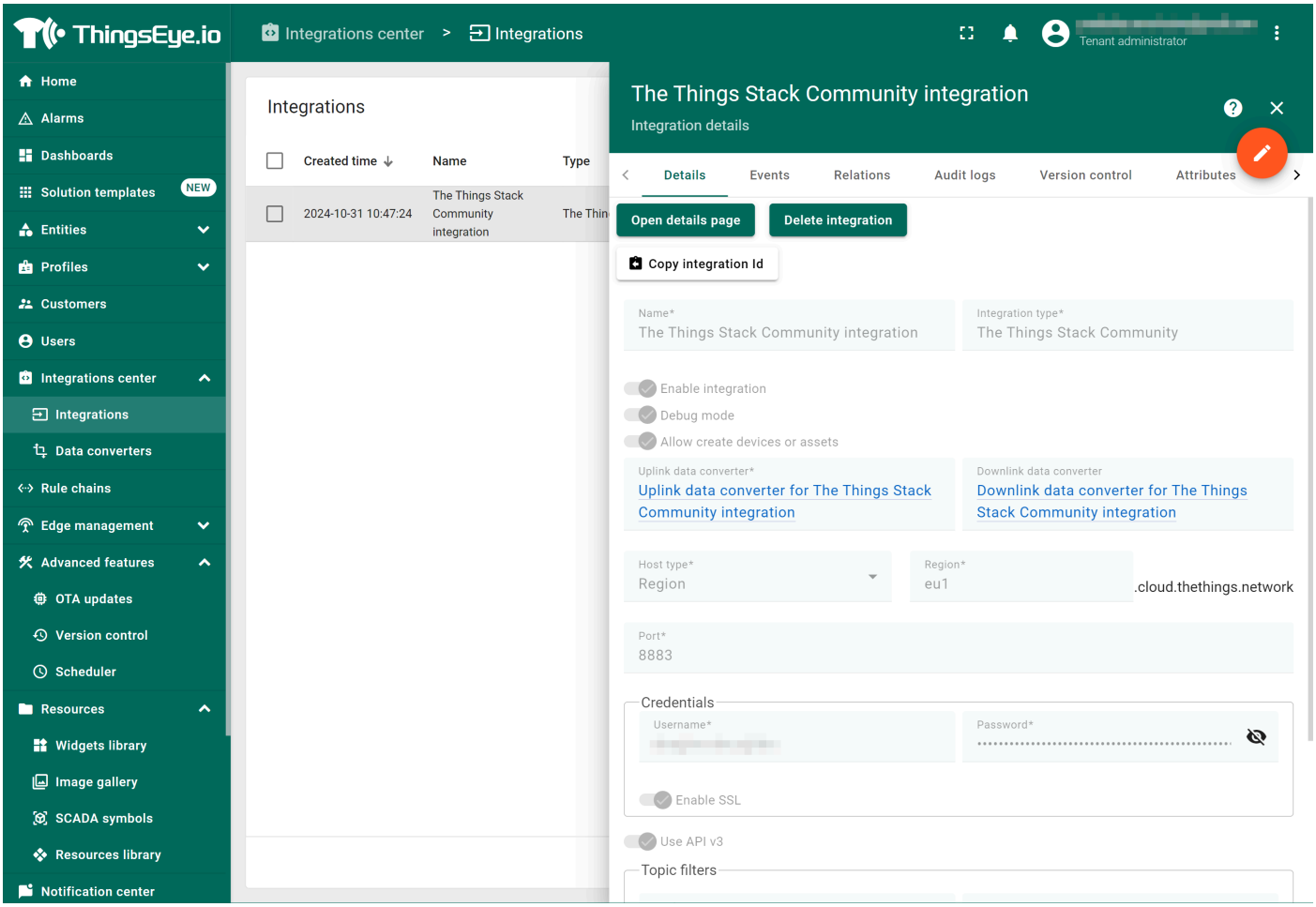


Your integration has been added to the **Integrations** list and will be displayed on the **Integrations** page. Check whether the status is shown as **Active**. If not, review your configuration settings and correct any errors.



2.9.1.3 Viewing integration details

Click on your integration from the list. The **Integration details** window will appear with the **Details** tab selected. The **Details** tab shows all the settings you have provided for this integration.



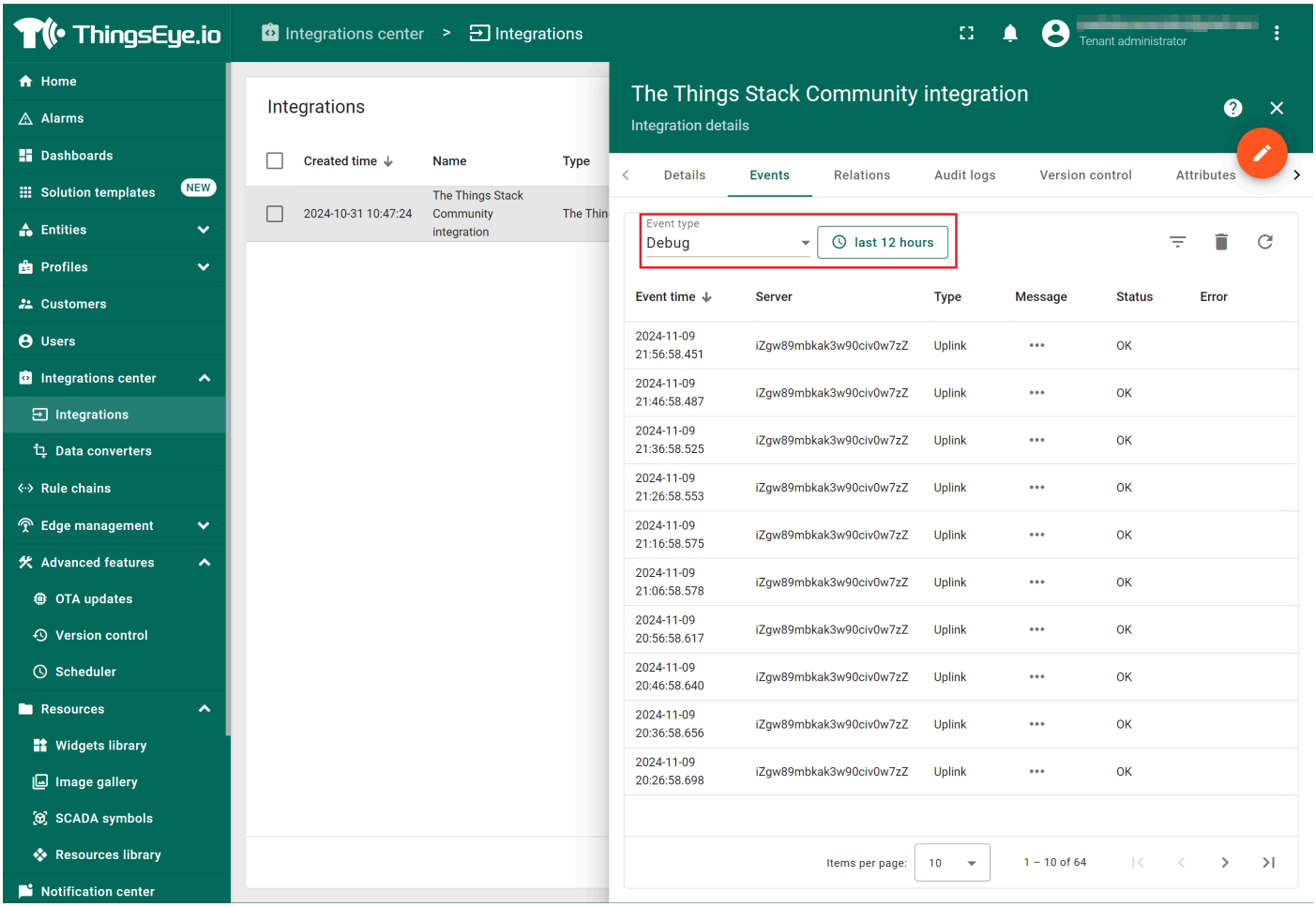
If you want to edit the settings you have provided, click on the **Toggle edit mode** button. Once you have done click on the **Apply changes** button.

See also ThingsEye documentation.

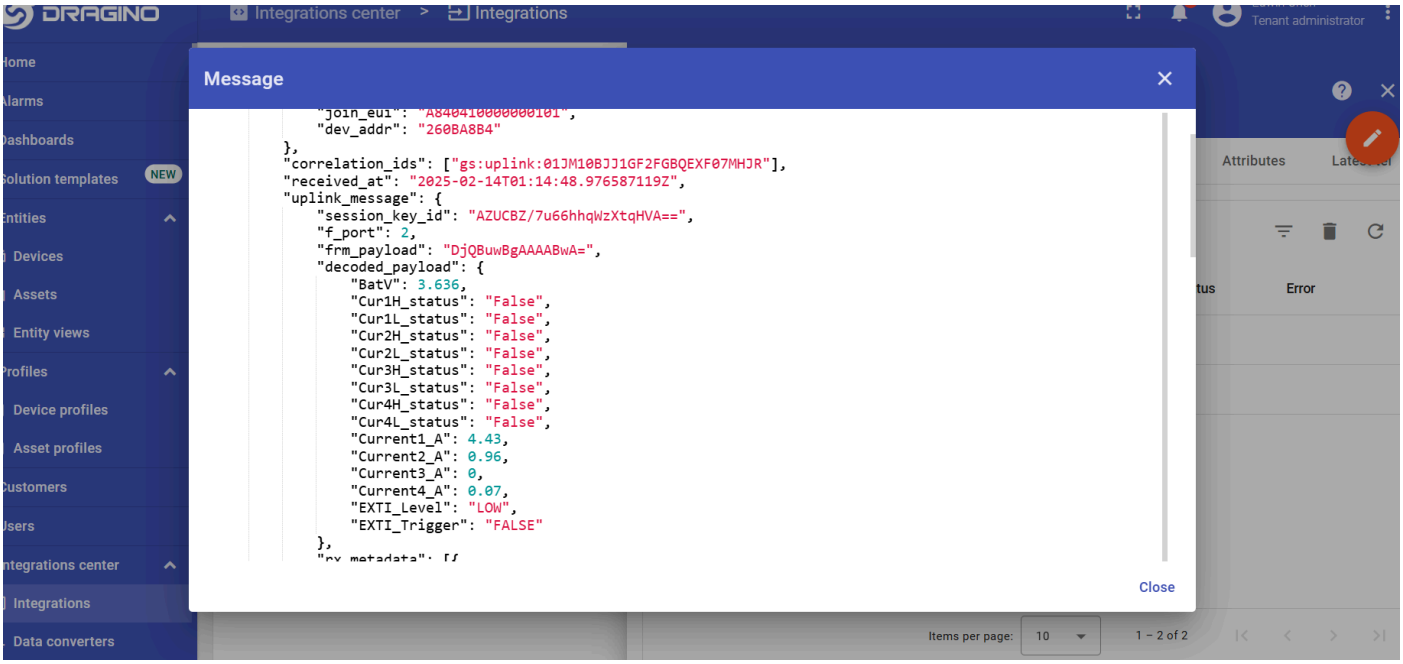
2.9.1.4 Viewing events

The **Events** tab displays all the uplink messages from the CS01-LB.

- Select **Debug** from the **Event type** dropdown.
- Select the **time frame** from the **time window**.



- To view the **JSON payload** of a message, click on the **three dots (...)** in the **Message** column of the desired message.

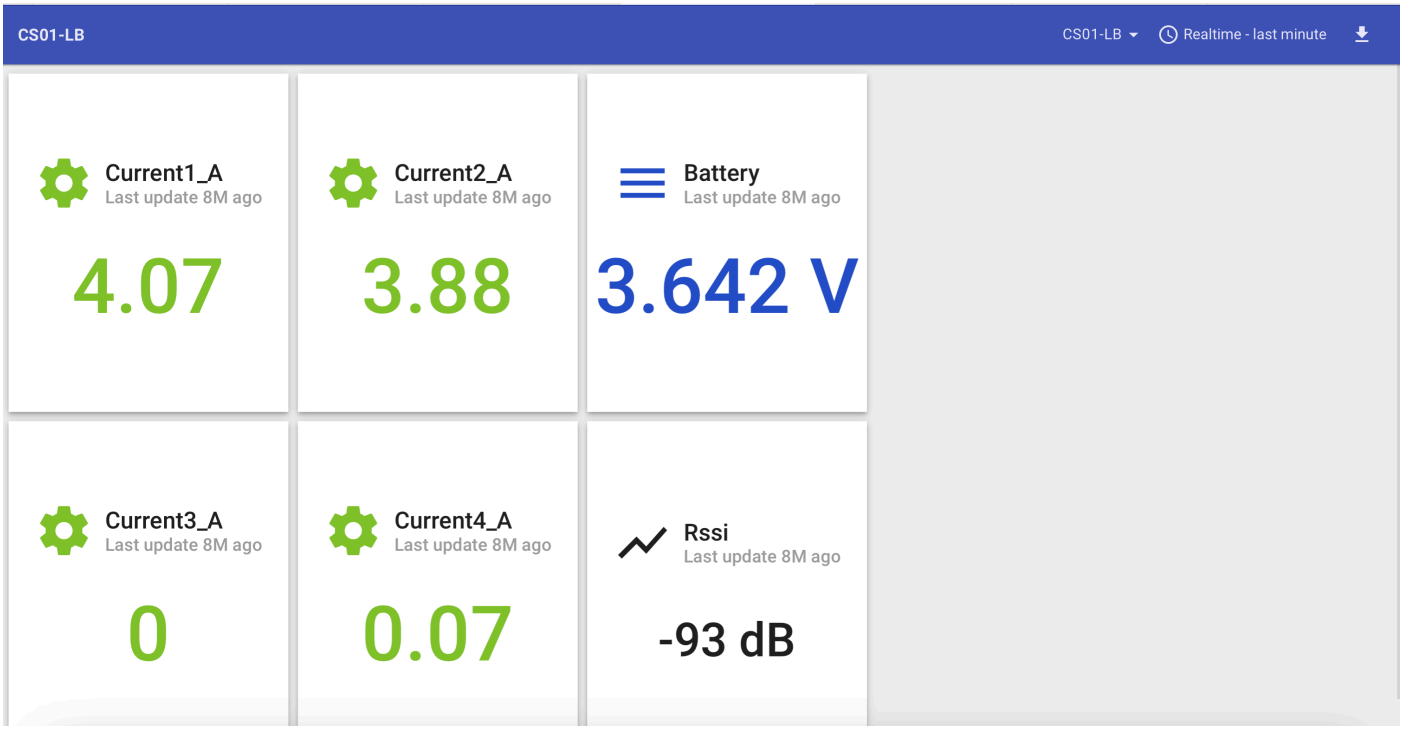


2.9.1.5 Deleting an integration

If you want to delete an integration, click the **Delete integration** button on the Integrations page.

2.9.1.6 Viewing sensor data on a dashboard

You can create a dashboard with ThingsEye to visualize the sensor data coming from the CS01-LB. The following image shows a dashboard created for the CS01-LB. See **Creating a dashboard** in ThingsEye documentation for more information.



3. Configure CS01-LB

3.1 Configure Methods

CS01-LB supports the following configuration methods:

- **AT Command via Bluetooth Connection** (Recommended): See BLE Configure Instructions.
- **AT Command via UART Connection**: See UART Connection.
- **LoRaWAN Downlink**: Instructions for different platforms can be found in the IoT LoRaWAN Serve section.

3.2 General Commands

These commands are used to configure:

- General system settings, such as the uplink interval.
- LoRaWAN protocol and radio-related commands.

They are the same for all Dragino devices that support the 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/

3.3 Commands Specially Designed for CS01-LB

These commands are only valid for CS01-LB, as listed below:

3.3.1 Set Uplink Transmit Interval

Feature: Change CS01-LB Uplink Transmit Interval.

AT Command: AT+TDC

Command Example	Function	Response
AT+TDC=?	Get current uplink transmit interval	30000 OK the uplink interval is 30000ms = 30s
AT+TDC=60000	Set uplink 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 CS01-LB'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 Get Device Status

Send a LoRaWAN downlink to get the device status.

Downlink Payload: 0x26 01

Sensor will upload device status via FPort=5. See payload section for details.

3.3.3 Get Data

Feature: Get the current sensor data.

AT Command:

- **AT+GETSENSORVALUE=0** // The serial port gets the reading of the current sensor

- **AT+GETSENSORVALUE=1** // The serial port gets the current sensor reading and uploads it.

3.3.4 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 the current interrupt mode	0 OK the mode is 0 =Disable Interrupt
AT+INTMOD=2	Set interrupt mode: 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

3.3.5 Set Power Output Duration

Control the output duration of 3.3V. Before each sampling, the device will:

1. First, enable the power output to the external sensor.
2. Keep it on for the specified duration, read the sensor value, and construct the uplink payload.
3. Finally, turn off the power output.

AT Command: AT+3V3T

Command Example	Function	Response
AT+3V3T=?	Show 3.3V open time.	0 (default) OK
AT+3V3T=1000	Close after a delay of 1000 milliseconds.	OK

Downlink Command: 0x07

Format: Command Code (0x07) followed by 3 bytes.

The first byte indicates the voltage, the second and third bytes indicate the power output duration for the sensor.

- Example 1: Downlink Payload: 07 01 01 F4 **--->** AT+3V3T=500
- Example 2: Downlink Payload: 07 01 FF FF **--->** AT+3V3T=65535

3.3.6 Set Working Mode

Feature: Get or Set the working mode.

AT Command: AT+MOD

Command Example	Function	Response
AT+MOD=?	Get the current Working Mode	1 (default) OK
AT+MOD=2,60,5,0	Set Working Mode 2	OK

Description of the AT instruction for setting Working Mode 2:

Command Example	Function	Parameter
AT+MOD=1	Set General acquisition mode.	1: General acquisition mode.
AT+MOD=2,60,5	The first parameter sets the continuous detection mode 2.	2: Continuous acquisition mode.
	The second parameter sets the detection sampling interval.	60: Data were collected every 60 seconds.
	The third bit parameter sets the number of groups to record data.	After 5 groups of data are collected, the uplink is performed.
AT+MOD=2,60,5,0	The first parameter sets the continuous detection mode 2.	2: Continuous acquisition mode.
	The second parameter sets the detection sampling interval.	60: Data were collected every 60 seconds.
	The third bit parameter sets the number of groups to record data.	After 5 groups of data are collected, the uplink is performed.
	The fourth parameter (**This parameter is valid only for CS01-LS.**) setting 5V normally open. **Keep 5V on, standby current 16mA.**	0: Not set 5V normally open 1: Setting 5V normally open

Downlink Command: 0x0A

Format: Command Code (0x0A) followed by 1 byte or 4bytes,5 bytes.

- Example 1: Downlink Payload: 0A 01 **--->** AT+MOD=1
- Example 2: Downlink Payload: 0A 02 00 3C 05 **--->** AT+MOD=2,60,5
- Example 3: Downlink Payload: 0A 02 00 3C 05 00 **--->** AT+MOD=2,60,5,0

3.3.7 Set the Alarm Threshold

Feature: Get or set the current alarm threshold. **(Takes effect only when AT+MOD=1)**

Note: The third, fifth, seventh and ninth parameter units of the v1.0 version are A, and the units of the third, fifth, seventh, and ninth parameters of versions after v1.1 are mA.

AT Command: AT+CALARM

Command Example	Function	Response
AT+CALARM=?	Get current alarm threshold.	0,0,0,0,0,0,0,0,0(default) OK
AT+CALARM=1,1,20,1,20,0,0,0,0 (v1.0 version)	When the current of channel 1 and channel 2 exceeds 20A, it will alarm and send a data packet.	OK

Command Example	Function	Parameter

AT+CALARM=1,1,10000,0,20000,0,0,0,0 (Versions after v1.1)	The first parameter enables or disables the threshold alarm.	0: Not Alarm 1: Alarm
	The second and third parameters set "current 1" below threshold alarm or above threshold alarm.	0,xx: Means if value <xx, Then Alarm 1,xx: Means if value >xx, Then Alarm **eg:**1,10000: if value >10000mA(10A), Then Alarm
	The fourth and fifth parameters set "current 2" below the threshold alarm or above the threshold alarm.	0,xx: Means if value <xx, Then Alarm 1,xx: Means if value >xx, Then Alarm **eg:**0,20000: if value <20000mA(20A), Then Alarm
	The sixth and seventh parameters set "current 3" below the threshold alarm or above the threshold alarm.	0,0: Means if value <xx, Then Alarm 0,0: Means if value >xx, Then Alarm **eg:**0,0: Disable this channel alarm
	The eighth and ninth parameters set "current 4" below the threshold alarm or above the threshold alarm.	0,0: Means if value <xx, Then Alarm 0,0: Means if value >xx, Then Alarm **eg:**0,0: Disable this channel alarm

Downlink Command: 0x0B

Format: Command Code (0x0B) followed by 17 bytes.

- Example 1: Downlink Payload: 0B 01 01 00 27 10 00 00 4E 20 00 00 00 00 00 00 00 00 **--->** AT+CALARM=1,1,10000,0,20000,0,0,0,0 => 1(01),1(01),10000(00 27 10),0(00),20000(00 4E 20),0(00),0(00 00 00),0(00),0(00 00 00)
- Example 2: Downlink Payload: 0B 01 00 00 00 00 00 00 00 00 00 00 03 E8 01 00 07 D0 **--->** AT+CALARM=1,0,0,0,0,0,1000,1,2000 => 1(01),0(00),0(00 00 00),0(00),0(00 00 00),0(00),1000(00 03 E8),1(01),2000(00 07 D0)

- Example 3: Downlink Payload: 0B 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 **--->** AT+CALARM=0,0,0,0,0,0,0,0,0 => 0(00),0(00),0(00 00 00),0(00),0(00 00 00),0(00),0(00 00 00),0(00),0(00 00 00)

Format: The first byte(Command Code) is 0x0B, the last byte is 0x01 or 0x02, and the middle 9 bytes.

When the last byte is 0x01, you can set the first, second, third, fourth and fifth parameters of the AT command.

- Example 1: Downlink Payload: 0B 01 01 00 27 10 00 00 4E 20 01**--->** AT+CALARM=1,1,10000,0,20000,0,0,0,0 => 1(01),1(01),10000(00 27 10),0(00),20000(00 4E 20)

When the last byte is 0x02, you can set the first, sixth, seventh, eighth and ninth parameters of the AT command.

- Example 2: Downlink Payload: 0B 01 00 00 03 E8 01 00 07 D0 02**--->** AT+CALARM=1,0,0,0,0,0,1000,1,2000 => 1(01),0(00),1000(00 03 E8),1(01),2000(00 07 D0)

Format: Command Code (0x0B) followed by 9 bytes.

- Example 1: Downlink Payload: 0B 01 01 14 01 14 00 00 00 00 **--->** AT+CALARM=1,1,20,1,20,0,0,0,0 (v1.0 version) =>1(01),1(01),20(14),1(01),20(14),0(00),0(00),0(00),0(00)
- Example 2: Downlink Payload: 0B 01 01 14 01 14 00 00 00 00 **--->** AT+CALARM=1,1,20000,1,20000,0,0,0,0 (Versions after v1.1) =>1(01),1(01),20(14),1(01),20(14),0(00),0(00),0(00),0(00)
- Example 3: Downlink Payload: 0B 00 00 00 00 00 00 00 00 00 **--->** AT+CALARM=0,0,0,0,0,0,0,0,0 =>0(00),0(00),0(00),0(00),0(00),0(00),0(00),0(00),0(00)

3.3.8 Set Alarm Interval

The shortest time of two Alarm packet(unit: min). The default is 20 minutes.

- **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(0C 1E) **--->** Set AT+ATDC=0x 1E = 30 minutes

3.3.9 Set enable or disable of the measurement channel

This command can be used when user connects **less than four current sensors**. This command can turn off unused measurement channels to **save battery life**.

AT Command: AT+ENCHANNEL

Command Example	Function	Response
AT+ENCHANNEL=?	Get enabled channels.	1,1,1,1 (Default) OK

AT+ENCHANNEL=1,1,1,0	Channel 4 disabled.	OK
AT+ENCHANNEL=1,1,0,0	Channel 3 and 4 disabled.	OK

Downlink Command: 0x08

Format: Command Code (0x08) followed by 4 bytes.

The first byte means the first channel, the second byte means the second channel, the third byte means the third channel, and the fourth byte means the fourth channel.And 1 means enable channel, 0 means disable channel.

- Example 1: Downlink Payload: 08 01 01 01 01 **--->** AT+ENCHANNEL=1,1,1,1 // All channels are enabled
- Example 2: Downlink Payload: 08 01 01 01 00 **--->** AT+ENCHANNEL=1,1,1,0 // Channel 4 disabled
- Example 3: Downlink Payload: 08 01 01 00 00 **--->** AT+ENCHANNEL=1,1,0,0 // Channel 3 and 4 disabled

3.3.10 Set the current proportion parameter (Since V1.2)

This command sets the processing multiplier of the actual value to get the displayed value.

The default current ratio parameter is 100, meaning the displayed value equals the actual value multiplied by 1, which is suitable for a standard 100A current transformer.

The valid range is 0 to 65535 (cannot be set to 0). If this value is set to 1000, the displayed value will be 10 times the actual value.

AT Command: AT+PROPORTION

Command Example	Function	Response
AT+PROPORTION=?	Get the current proportion parameter	100 (Default) OK
AT+PROPORTION=1	Set the displayed value to 1/100 of the actual value	OK
AT+PROPORTION=300	Setting the display value to 3 times the actual value	OK

Downlink Command: 0x0D

Format: Command Code (0x0D) followed by 2 bytes.

- Example 1: Downlink Payload: 0D 00 64 **--->** AT+PROPORTION=100 // Set the displayed value to the actual value multiplied by 1, which is suitable for standard 100A current transformers.
- Example 2: Downlink Payload: 0D 01 2C **--->** AT+PROPORTION=300 // Set the displayed value to the actual value multiplied by 3,which is suitable for standard 300A current transformers.
- Example 3: Downlink Payload: 0D 02 58 **--->** AT+PROPORTION=600 // Set the displayed value to the actual value multiplied by 6,which is suitable for standard 600A current transformers.

Note: When using this command to set the current ratio parameter, it will simultaneously apply to all four channels. For example, setting AT+PROPORTION=300 means all four channels will use 300A CTs. If you need to use CTs with different measurement ranges across the four channels, please refer to FAQ 7.2.

3.3.11 Set current resolution (Since V1.2)

AT Command: AT+RESOLUTION

Command Example	Function	Response
AT+RESOLUTION=?	Get the current resolution	0 (Default) OK
AT+RESOLUTION=0	Set the resolution to 0.01A, two decimal places	OK
AT+RESOLUTION=1	Set the resolution to 0.001A, three decimal places**(At this resolution, the current value of each channel changes from two bytes to three bytes)**	OK

Downlink Command: 0x0E

Format: Command Code (0x0E) followed by 1 byte.

- Example 1: Downlink Payload: 0E 00 **--->** AT+RESOLUTION=0
- Example 2: Downlink Payload: 0E 01 **--->** AT+RESOLUTION=1

3.3.12 Set total current(Since v1.3.1)

Only takes effect when AT+MOD=1.

Feature: Set or get the total current.

AT Command: AT+TOTALCURRENT=a,b

Parameter	Value	Description

a	0-2	**Operation Mode:** • 0: Disable accumulation • 1: Enable accumulation • 2: Enable + auto-clear after TDC transmission
b	0-60 (must divide 60)	Sampling Interval (seconds): • Example: 20 = 3 samples/minute (60/20) **Note: When all four current channels are open, the total acquisition time for the four channels exceeds 1 second, so it cannot be set to 1.**

Example:

- AT+TOTALCURRENT=0,0 // Disable accumulation.
- AT+TOTALCURRENT=1,20 // Enable accumulation and sample once every 20 seconds.
- AT+TOTALCURRENT=2,20 // Enable accumulation, sample once every 20 seconds, and automatically clear the accumulated value after each TDC packet is sent and recalculate.

Downlink Command: 0x09 aa bb

- **Example 1:** Downlink Payload: 09 00 00 // Same as AT+TOTALCURRENT=0,0
- **Example 2:** Downlink Payload: 09 01 14 // Same as AT+TOTALCURRENT=1,20
- **Example 3**: Downlink Payload: 09 02 14 // Same as AT+TOTALCURRENT=2,20

3.3.13 Set the Current accumulation(Since v1.3.1)

Feature: Get or set the Current accumulation.

AT Command: AT+SETCURRENT=a,b

Parameter	Value	Meaning
a	0-4	0: Represents 4 channels controlled simultaneously 1: Control channel 1 2: Control channel 2 3: Control channel 3 4: Control channel 4
b	Manually set the channel to start accumulating from this value.	0: Clear the cumulative number Range: 0~4294967295(Unit: mA/min)

Example:

- AT+TOTALCURRENT=0,0 // Clear the current accumulated values of 4 channels simultaneously.
- AT+TOTALCURRENT=1,100 // Set the first channel to start accumulating from 100(Unit: mA/min)
- AT+TOTALCURRENT=2,200 // Set the second channel to start accumulating from 200(Unit: mA/min)
- AT+TOTALCURRENT=3,300 // Set the third channel to start accumulating from 300(Unit: mA/min)
- AT+TOTALCURRENT=4,400 // Set the fourth channel to start accumulating from 400(Unit: mA/min)

Downlink Command: 0x10

Format: 10 + 5 bytes (channel + 4-byte value)

- **Example 1:** Downlink Payload: 10 00 00 00 00 00 // Same as AT+TOTALCURRENT=0,0
- **Example 2**: Downlink Payload: 10 01 00 00 00 64 // Same as AT+TOTALCURRENT=1,100
- **Example 3**: Downlink Payload: 10 02 00 00 00 C8 // Same as AT+TOTALCURRENT=2,200
- **Example 4**: Downlink Payload: 10 03 00 00 01 2C // Same as AT+TOTALCURRENT=3,300
- **Example 5**: Downlink Payload: 10 04 00 00 01 90 // Same as AT+TOTALCURRENT=4,400

4. Use Cases

4.1 Monitor the power status of an office

This is a case study for the CS01-LB current sensor. It shows how to use the CS01-LB to monitor an office's power usage status.

Click here for more: **Case 1: Monitor the power status of an office**

4.2 Function Setting: Power Consumption Calculation Case

- Set the alarm: When the current reaches 0.1, send data.
- Set the alarm interval to 5 minutes.
- Set the regular data interval to approximately 6 hours. The power outage alarm takes priority.
- Switch off the connected device.
- Look for the alarm message, as the current will drop to a minimum.
- Repeat the device switch-off after 8 minutes (since the alarm interval is set to 5 minutes) and check for the alarm message.

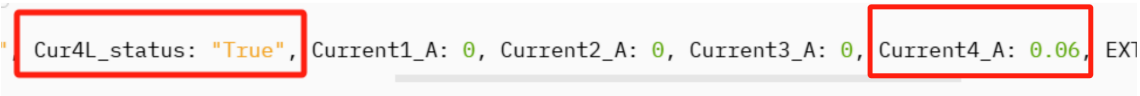
- In a scenario with 4 outages per day, we should receive 4 alarm messages and 4 regular current messages (with a data frequency set to 6 hours).

Question: How long will the battery last under these conditions?

The third, fifth, seventh, and ninth parameter units of version v1.0 are in A (Ampere), while the units of the same parameters in versions after v1.1 are in mA (Milliampere).

Below are my settings:

- **AT+CALARM=1,0,0,0,0,0,0,0,100**
- **AT+ENCHANNEL=0,0,0,1**



According to the settings, three aspects need to be calculated, as follows:

- **Alarm Interval:** The alarm occurs once every five minutes, 12 times per hour, for a total of 288 times per day. Each alarm is equivalent to one detection, and the consumption per detection is approximately 0.0172mAh. Therefore, the daily consumption is calculated as follows:

0.0172 * 288 = 4.9536mAh

- **Sleep Current Consumption**: The sleep current consumption per day is approximately 0.0053268 * 24 = 0.1278432mAh.
- **Uplink Messages**: There are 4 alarms + 4 regular current messages, which is equivalent to sending 8 uplink messages per day. Each upload consumes:
  - Single sensor: 0.076761064mAh
  - Four sensors: 0.109365489mAh
- So:
  - Single sensor consumption per day: 0.076761064 * 8 = 0.614088512mAh
  - Four sensors consumption per day: 0.109365489 * 8 = 0.874923912mAh

The CS01-LB battery capacity is 8500mAh. Based on the above data, the battery life is calculated as follows:

- Single sensor: 8500 / (4.9536 + 0.1278432 + 0.614088512) = 1492 days
- Four sensors: 8500 / (4.9536 + 0.1278432 + 0.874923912) = 1427 days

This is an approximate calculation of battery life. The actual battery life also depends on the frequency band and DR (Data Rate) you use. See the figure below for details

		Alarm detection power(mAh)	Sleep power(mAh)	Single channel Average power（mAh)	Four channel Average power(mAh)	Single channel Total power consumption per day(mA)	Four channel Total power consumption per day(mA)	single channel battery life(day)	four channel battery life(day)
EU868	DR5_SF7_125K_14dB	0.0172	0.0053268	0.076761064	0.109365489	5.695531712	5.956367112	1492	1427
	DR4_SF8_125K_14dB	0.0172	0.0053268	0.077205381	0.109809617	5.699086248	5.959920136	1491	1426
	DR3_SF9_125K_14dB	0.0172	0.0053268	0.078026909	0.110630771	5.705658472	5.966489368	1489	1424
	DR2_SF10_125K_14dB	0.0172	0.0053268	0.079877971	0.112480979	5.720466968	5.981291032	1485	1421
	DR1_SF11_125K_14dB	0.0172	0.0053268	0.083577501	0.116178808	5.750063208	6.010873664	1478	1414
	DR0_SF12_125K_14dB	0.0172	0.0053268	0.089495198	0.122093701	5.797404784	6.058192808	1466	1403
US915/AS923/AU915/KR920	DR3_SF7_125K_20dB	0.0172	0.0053268	0.076568554	0.1091734	5.693991632	5.9548304	1492	1427
	DR2_SF8_125K_20dB	0.0172	0.0053268	0.077007688	0.109612377	5.697504704	5.958342216	1491	1426
	DR1_SF9_125K_20dB	0.0172	0.0053268	0.077826711	0.110431054	5.704056888	5.964891632	1490	1425
	DR0_SF10_125K_20dB	0.0172	0.0053268	0.079309344	0.111913047	5.715917952	5.976747576	1487	1422

5. Battery & Power Consumption

The CS01-LB uses an ER26500 + SPC1520 battery pack. See the link below for detailed information about the battery and how to replace it:
Battery Info & Power Consumption Analysis.

Note: Continuous sampling mode will significantly increase power consumption.
For example, if all four channels are used for sampling data:

- Sample every minute and uplink data every 5 minutes: The battery life is about 10 months.
- Sample every minute and uplink data every 20 minutes: The battery life is about 12 months.

If you want to use an external DC adapter to power the CS01-LB in this case, please refer to Power Device using a 3.3v Power Adapter.

6. OTA Firmware update

User can update the CS01-LB firmware to:

- Change the frequency band/region.
- Update with new features.
- Fix bugs.

Firmware and changelog can be downloaded from : **Firmware download link**

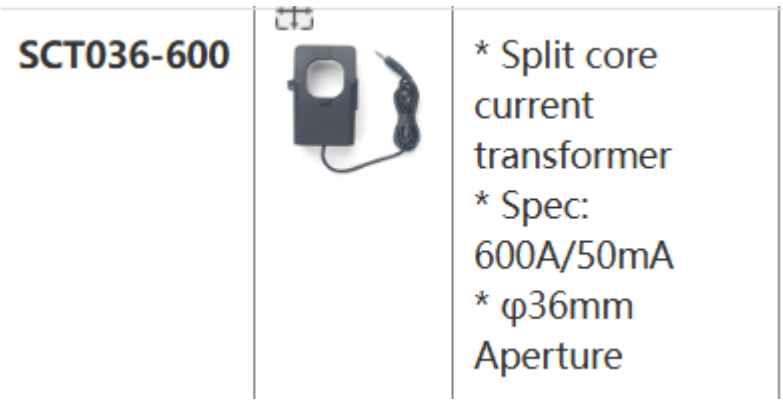
Methods to Update Firmware:

- Recommended method: OTA firmware update via wireless
  : **http://wiki.dragino.com/xwiki/bin/view/Main/Firmware%20OTA%20Update%20for%20Sensors/**
- Update through the UART TTL interface : **Instruction**.

7. FAQ

7.1 Why can't current clamps measure current over range?

First, we take the SCT036-600 as an example to explain the specifications of the current clamp.



Meaning of *Spec: 600A/50mA :

- 600A: Indicates the rated primary current of the current transformer. This means the clamp is designed to measure up to 600A on the primary side under normal operating conditions.
- 50mA: Indicates the rated secondary output current. When 600A flows through the primary, the secondary will output 50mA.

Why can't you measure current over range:

Reduced accuracy: Exceeding the range will lead to increased measurement errors and inaccurate results.

Equipment damage: Excessive current may damage the sensor or circuit inside the current clamp.

Safety risks: Over-range measurement may cause overheating, short circuit and other problems, resulting in safety risks.

7.2 How to modify Payload to match 100A/300A/600A sensors respectively?

When using 300A or 600A current transformers, discrepancies may occur between the measured current values and actual readings due to parameter ratio inconsistencies

Users need to amplify the current readings in equal proportions:

When users use 300A transformers, they need to amplify the current readings by 3 times.

When users use 600A transformers, they need to amplify the current readings by 6 times.

There are two ways:

1. You can use the **AT+PROPORTION** command to simultaneously control the amplification of 4 channels to the same multiple. For specific usage, please refer to: AT+PROPORTION

2. If the 4 channels use sensors with different ranges, you need to change the output ratio in decoding. The operation is as follows:

Uplink Downlink

Setup

Formatter type*

Custom Javascript formatter

Formatter code*

```
function Decoder(bytes, port) {
  //CS01-LB Decode
  if(port==0x02)
  {
    var decode = {};
    var value=(bytes[0]<<8 | bytes[1]) & 0x3FFF;
    decode.BatV= value/1000;
    decode.EXTI_Trigger=(bytes[0] & 0x40)? "TRUE":"FALSE";
    decode.EXTI_Level=(bytes[0] & 0x80)? "HIGH":"LOW";
    decode.Current1_A=(bytes[2]<<8 | bytes[3])/100;
    decode.Current2_A=(bytes[4]<<8 | bytes[5])/100;
    decode.Current3_A=(bytes[6]<<8 | bytes[7])/100;
    decode.Current4_A=(bytes[8]<<8 | bytes[9])/100;
    decode.Cur1L_status= (bytes[10] &0x80)? "True":"False";
    decode.Cur1H_status= (bytes[10] &0x40)? "True":"False";
    decode.Cur2L_status= (bytes[10] &0x20)? "True":"False";
    decode.Cur2H_status= (bytes[10] &0x10)? "True":"False";
    decode.Cur3L_status= (bytes[10] &0x08)? "True":"False";
    decode.Cur3H_status= (bytes[10] &0x04)? "True":"False";
    decode.Cur4L_status= (bytes[10] &0x02)? "True":"False";
    decode.Cur4H_status= (bytes[10] &0x01)? "True":"False";

    if(bytes.length==11)
    {
```

Final output current

Paste application formatter

The final current output is multiplied by the ratio. For example:

When the mutual inductor used by channel 1 and channel 2 is 300A, modify it as follows:

- decode.Current1_A=((bytes[2]<<8 | bytes[3])/100)*3;
- decode.Current2_A=((bytes[4]<<8 | bytes[5])/100)*3;

When the transformer used by channel 3 and channel 4 is 600A, modify as follows:

- decode.Current3_A=((bytes[6]<<8 | bytes[7])/100)*6;
- decode.Current4_A=((bytes[8]<<8 | bytes[9])/100)*6;

7.3 Why are the collected current values inaccurate?

When the current value collected by the node is inaccurate, please check whether the calibration value is set using the AT+CCAL command in the node. If so, change the calibration value to 0, as follows:

AT+CCAL=0,0,0,0.

Configuration method, please refer to: Use case

7.4 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)

8. Ordering Information

Part Number: **CS01-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

Note: CS01-LB doesn't include a current sensor. You need to purchase it separately.

Reference Models for current sensors:

- **SCT013G-D-100**: **100A/50mA**
- **SCT024-300**: **300A/50mA**
- **SCT036-600**: **600A/50mA**

9. Packaging Information

Package Includes:

- CS01-LB LoRaWAN 4 Channels Current Sensor Converter

Dimension and weight:

Package Size / pcs :

- For CS01-LB: 145*105*55 mm
- For CS01-LS: mm

Weight / pcs :

- For CS01-LB: 310 g
- For CS01-LS: g

Transformer size and weight:

Package Size / pcs :

- For SCT013G-D-100: 100*80*30 mm
- For SCT024-300: 69*50*107 mm
- For SCT036-600: 74*74*100 mm

Weight / pcs :

- For SCT013G-D-100: 80g
- For SCT024-300: 209 g
- For SCT036-600: 330 g

10. Support

- Support is available Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different time zones, we cannot offer live support. However, your questions will be answered as soon as possible within the aforementioned schedule.
- Please provide as much information as possible regarding your inquiry, including product models, a detailed description of the problem, and steps to replicate it. Send your email to support@dragino.cc