



RG-03H_Ai-LoRaWS-1001

User Manual

Version V1.0.3

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1. Product Overview

1.1. RG-03H Gateway

The RG-03H is a smart wireless data communication gateway developed by Shenzhen Ai-Thinker Technology Co., Ltd. (hereinafter referred to as Ai-Thinker). This product uses the company's self-developed ESP32-SU module as the main controller. The ESP32 integrates 2.4 GHz Wi-Fi and Bluetooth dual-mode capabilities in a single chip solution. The RG-03H gateway also integrates the company's self-developed Ra-01SH or Ra-01SH-P modules to enable LoRaWAN protocol transmission; it features a built-in 4G Cat1 cellular module for wireless transmission between the gateway and the backend server.

The RG-03H gateway integrates multiple data transmission methods including Ethernet, 4G cellular, and Wi-Fi, allowing users to choose freely and flexibly.

The Ra-01SH or Ra-01SH-P module is used for ultra-long-range spread spectrum communication. Its RF chip SX1262 primarily uses the LoRa™ long-range modem for ultra-long-range spread spectrum communication, offering strong anti-interference capability and minimizing current consumption. With SEMTECH's patented LoRa™ modulation technology, the SX1262 achieves high sensitivity exceeding -148 dBm, enabling long transmission distances and high reliability. Meanwhile, compared to traditional modulation technologies, LoRa™ modulation technology also has significant advantages in blocking resistance and selectivity, solving the problem of conventional designs being unable to simultaneously balance distance, anti-interference, and power consumption.

■ Product Image



Figure 1 RG-03H Gateway Assembly Diagram

■ Brief Description

The RG-03H gateway is a single-channel compact gateway that supports three networking methods: Ethernet, 4G, and Wi-Fi. It supports power adapter supply and is suitable for small coverage scenarios such as warehouses, factories, and agriculture.

1.2. Ai-LoRaWS-1001 Temperature and Humidity Sensor

The Ai-LoRaWS-1001 temperature and humidity sensor is an intelligent sensor independently developed by Ai-Thinker, serving as a node in LoRaWAN networking. This product uses the company's self-developed Ra-08H module as the main controller to implement LoRaWAN protocol transmission. It is equipped with a built-in ER34615 lithium thionyl chloride battery, making node deployment convenient. An external SHT40 temperature and humidity sensor is provided for temperature and humidity collection, with a measurement accuracy of $\pm 0.2\text{ }^{\circ}\text{C}$ ($0\text{-}60\text{ }^{\circ}\text{C}$) and $\pm 1.8\%$ RH ($30\text{-}70\%$ RH, @ $25\text{ }^{\circ}\text{C}$).

The Ra-08H module is used for ultra-long-range spread spectrum communication. Its chip, the ASR6601, is a general-purpose LPWAN wireless communication SoC that integrates an RF transceiver, a modem, and a 32-bit RISC MCU. This MCU uses an ARM core with an operating frequency of up to 48 MHz.

The Ra-08H module supports LoRa modulation and conventional (G)FSK modulation for LPWAN use cases; additionally, the transmitter supports BPSK modulation and (G)MSK modulation, while the receiver supports (G)MSK modulation.

■ Product Image



Figure 2 Ai-LoRaWS-1001 Temperature and Humidity Sensor Assembly Diagram

■ Brief Description

The Ai-LoRaWS-1001 temperature and humidity sensor is a single-channel compact gateway node, powered by a built-in ER34615 lithium thionyl chloride battery with a nominal capacity of 19000 mAh, suitable for small coverage scenarios such as warehouses, factories, and agriculture.

2. Product Features

2.1. RG-03H Gateway

- Supports 802.11b/g/n
- Supports LoRa frequency range: 803–930 MHz
- Supports spreading factors: SF5/SF6/SF7/SF8/SF9/SF10/SF11/SF12
- Supports FSK, GFSK, MSK, GMSK, LoRa™, and OOK modulation
- Supports three Internet access methods: Ethernet, Wi-Fi, and 4G, with automatic priority switching
- Supports remote configuration and remote firmware upgrade (FOTA)
- Supports heartbeat detection and automatic reconnection upon disconnection.
- Supports local and cloud logging

2.2. Ai-LoRaWS-1001 Temperature and Humidity Sensor

- Supports LoRa frequency range: 803–930 MHz
- Supports spreading factors: SF5/SF6/SF7/SF8/SF9/SF10/SF11/SF12
- Supports LoRa, (G)FSK, BPSK, (G)MSK modulation
- Built-in ER34615 lithium thionyl chloride battery, rated capacity 19000 mAh
- External SHT40 temperature and humidity sensor

3. Product Specifications

3.1. RG-03H Gateway

3.1.1. LoRa Wireless Parameters

Ra-01SH:

- Supports LoRa frequency range: 803–930 MHz
- Theoretical maximum LoRa transmit power: +22 dBm
- High Sensitivity: -140 dBm
- Supports spreading factors: SF5/SF6/SF7/SF8/SF9/SF10/SF11/SF12
- Supports FSK, GFSK, MSK, GMSK, LoRa™, and OOK modulation

Ra-01SH-P:

- Supports LoRa frequency range: 803–930 MHz
- Theoretical maximum LoRa transmit power: +29 dBm
- High sensitivity: -137 dBm @ 125 kHz, SF10
- Supports spreading factors: SF5/SF6/SF7/SF8/SF9/SF10/SF11/SF12
- Supports FSK, GFSK, MSK, GMSK, LoRa™, and OOK modulation

3.1.2. 4G Communication Parameters

EG810M-EU:

- LTE-FDD: B1/B3/B5/B7/B8/B20/B28
- Maximum downlink rate: 10 Mbps; maximum uplink rate: 5 Mbps
- Supports TCP/UDP/PPP/NTP/NITZ/FTP/HTTP/PING/HTTPS/FTPS/SSL/FILE/MQTT protocols

EG800Q-NA:

- LTE-FDD: B2/B4/B5/B12/B13/B66
- Maximum downlink rate: 10 Mbps; maximum uplink rate: 5 Mbps
- Supports
TCP/UDP/NTP/NITZ/FTP/HTTP/PING/HTTPS/FTPS/SSL/MQTT/CMUX/PPP/FILE/S
MTP/SMTSPS protocols

3.1.3. Wi-Fi Communication Parameters

- Supports 2.4 GHz frequency band
- Supports 802.11b/g/n
- Supports 802.11n, 2.4 GHz, with data rates up to 150 Mbps
- Supports full Bluetooth V4.2 standard, including Classic Bluetooth (BR/EDR), and Bluetooth Low Energy (BLE)

3.1.4. Ethernet Parameters

- RJ45 interface
- High-performance 10/100 Mbps Ethernet transceiver
- Compliant with IEEE802.3/802.3u (Fast Ethernet)
- Compliant with ISO 802-3/IEEE 802.3 (10BASE-T)

3.1.5. Hardware Peripheral Features

Power supply: DC connector, 12 V/1 A

Antenna interface: SMA interface for LoRa antenna; SMA interface for 4G antenna; SMA interface for Wi-Fi antenna

Indicators: 1 × red indicator: PWR; 3 × green indicators: NET, 4G, LoRa

Button: 1 × button: RST/BSP button

SIM card slot: Nano SIM card slot

Average operating current: 64.7 mA (Test conditions: center frequency EU868 868.1 MHz, spreading factor SF7, Class A mode, data frame length 15 bytes, network access via Ethernet, power analyzer sampling interval 1 ms, test duration 10 min)

3.2. Ai-LoRaWS-1001 Temperature and Humidity Sensor

3.2.1. LoRa Wireless Parameters

- Supports LoRa frequency range: 803–930 MHz
- Theoretical maximum LoRa transmit power: +22 dBm
- High sensitivity: -138 dBm @ 125 kHz, SF12
- Supports spreading factors: SF5/SF6/SF7/SF8/SF9/SF10/SF11/SF12
- Supports LoRa, (G)FSK, BPSK, (G)MSK modulation
- Supports NFC

3.2.2. Hardware Peripheral Features

- SHT40 temperature and humidity sensor
- Supports RF parameter configuration via NFC, including channel switching and bandwidth modification
- External LoRa magnetic-mount antenna with SMA connector
- Built-in ER34615 lithium thionyl chloride battery, rated capacity 19000 mAh
- Average operating current: 122.67 μ A (Test conditions: center frequency EU868 868.1 MHz, spreading factor SF7, Class A mode, data frame length 15 bytes, network access via Ethernet, power analyzer sampling interval 1 ms, test duration 10 min)
- Sleep base current: 3.2 μ A (Test conditions: center frequency: EU868 868.1 MHz, spreading factor: SF7, Class A mode, data frame length: 15 bytes, network access via Ethernet, power analyzer sampling interval 1 ms, test duration 10 min)

4. Software Function Overview and Instructions

4.1. Function Overview

Both the RG-03H gateway and Ai-LoRaWS-1001 temperature and humidity sensor support the standard LoRaWAN protocol with only OTAA activation and default support for the TTN server.

The RG-03H gateway and the Ai-LoRaWS-1001 temperature and humidity sensor both operate on a single channel.

By default, the non-PA version of the RG-03H gateway operates in the EU868 band, with the default channel frequency of 868.1 MHz. The PA version operates on the US915 frequency band, with the default channel of 902.3 MHz.

The firmware of the Ai-LoRaWS-1001 temperature and humidity sensor can be selected as either EU868 or US915. The operating channel must be aligned with that of the gateway.

The non-PA version of the RG-03H gateway supports the following frequency bands: EU868, AS923, RU864, KR920. The PA version of the RG-03H gateway supports the following frequency bands: IN865, AU915, US915.

The Ai-LoRaWS-1001 temperature and humidity sensor supports frequency bands such as AS923, RU864, KR920, IN865, and AU915.

The Ai-LoRaWS-1001 temperature and humidity sensor supports obtaining the required DEVEUI and APPKEY for network joining by scanning the QR code, effectively simplifying the registration process and enabling quick installation.

For requirements involving other frequency bands, please contact Ai-Thinker staff.

4.2. LoRaWAN Network Joining Instructions for Supported Devices

- ① Register a personal or enterprise account on [TTN platform](#).
- ② After logging in, click to enter the console. Since the gateway is configured for the Europe region by default, select the Europe region in the console.

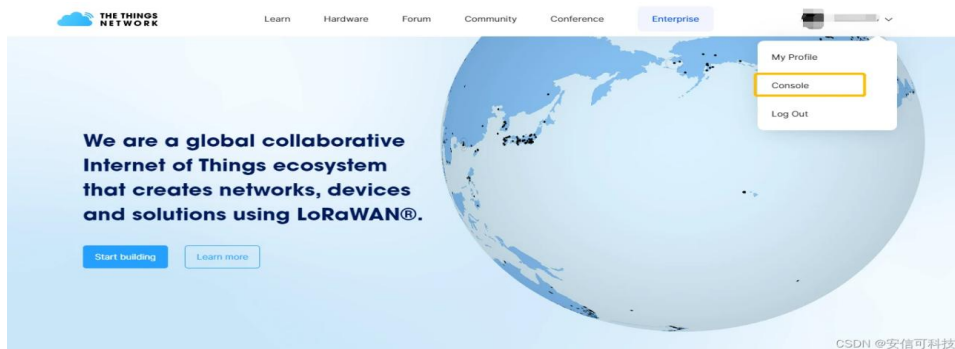


Figure 3 Click to Enter the Console

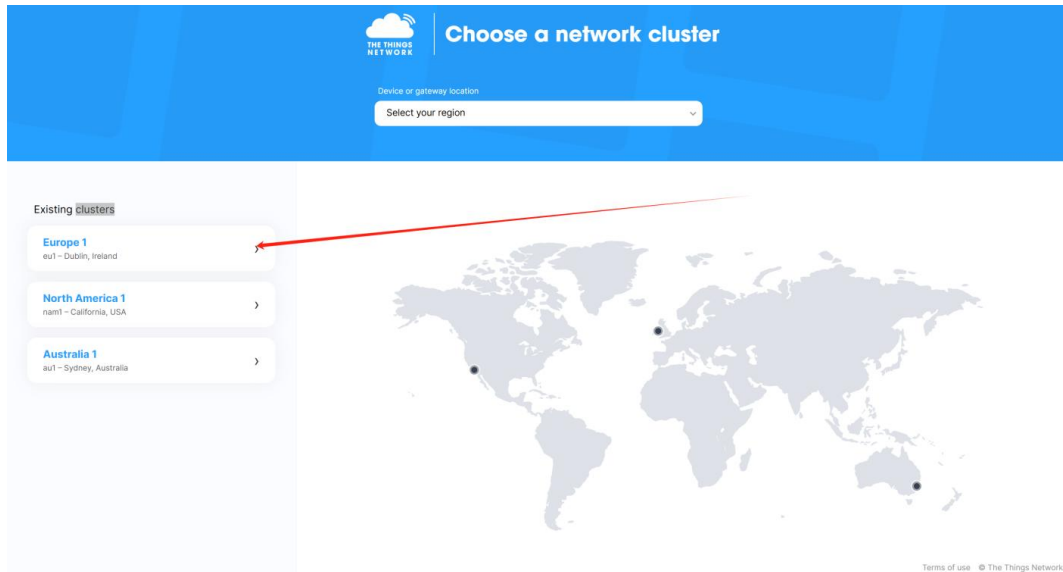


Figure 4 Click to Enter the Europe Region Console

- ③ Scan the QR code on the RG-03H enclosure to obtain the Gateway EUI. The QR code data format is shown below.

```
{
  "name": "RG-03H_XXXXXX",
  "transport": "ble",
  "GWEUI": "A1A1XXXXXXXXXXXXXXXXXXXX"
}
```

Figure 5 Obtain Gateway EUI

- ④ Register the gateway on the TTN platform and select “Europe 868.1 MHz” as the gateway operating frequency band.



Figure 6 Register Gateway

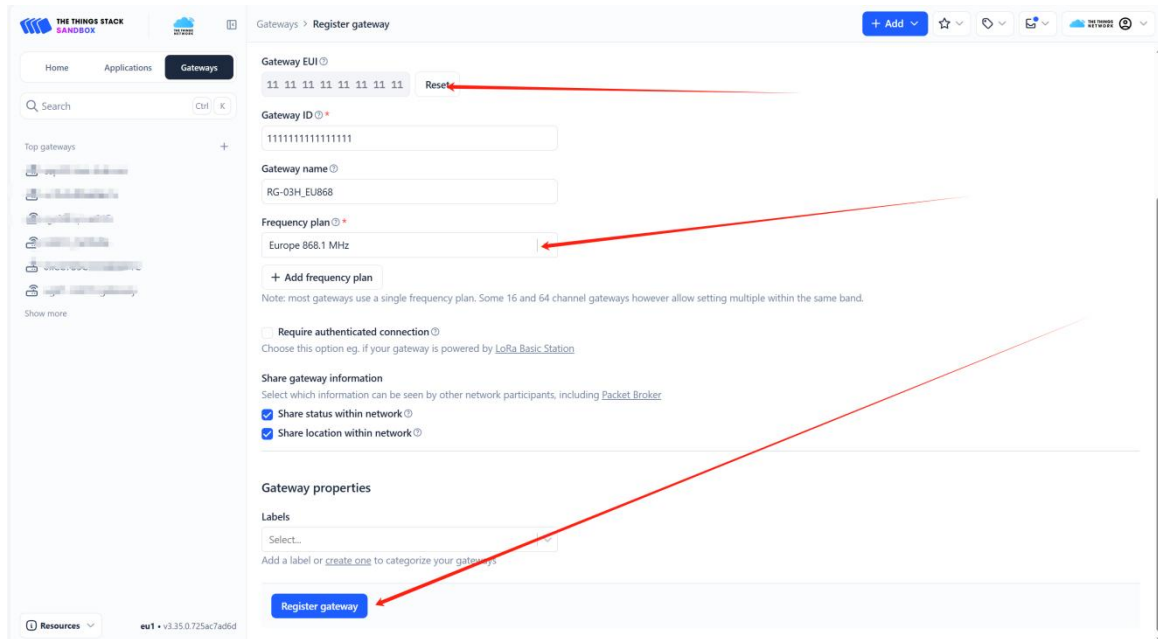


Figure 7 Configure Gateway Frequency Band

⑤ Create an application

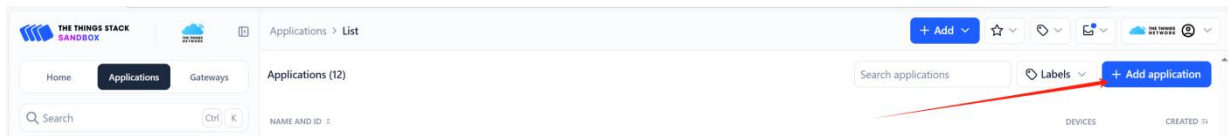


Figure 8 Create Application

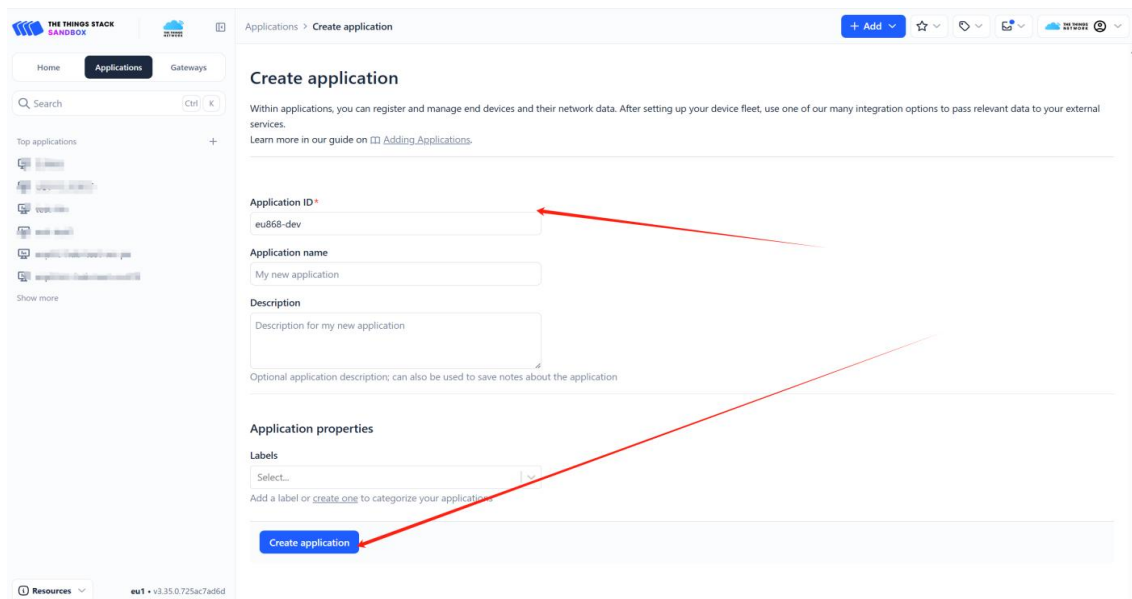


Figure 9 Create Application

- ⑥ Scan the QR code on the Ai-LoRaWS-1001 sensor enclosure to obtain the node DEVEUI and APPKEY. The parameter format is shown below.

It should be noted that the APPEUI of the sensor is fixed to 0000000000000000.

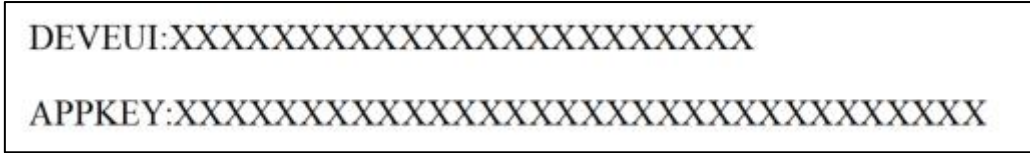


Figure 10 Obtain Network Joining Parameters

- ⑦ Register the node on the TTN platform and select “Europe 868.1 MHz” as the node operating frequency band.

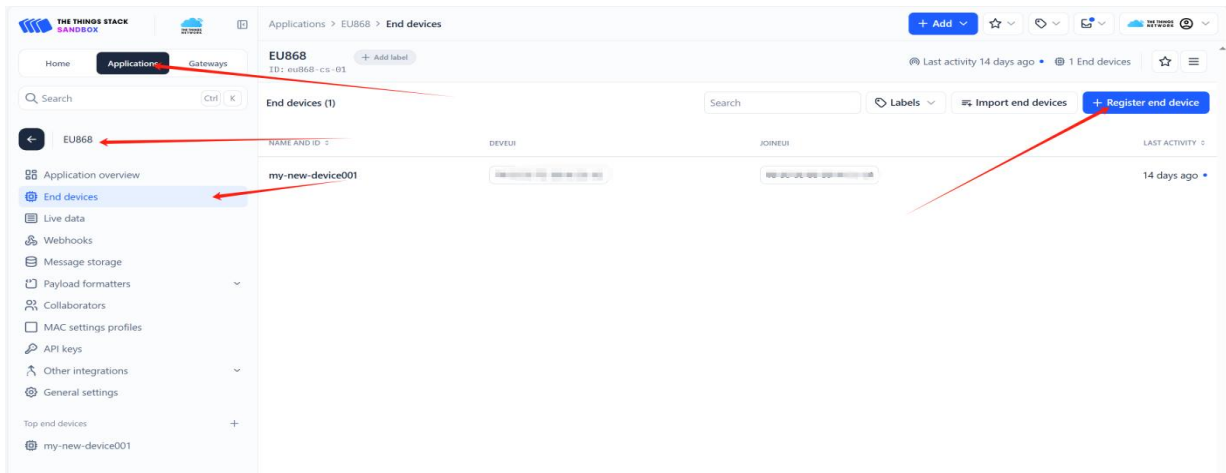


Figure 11 Create Node

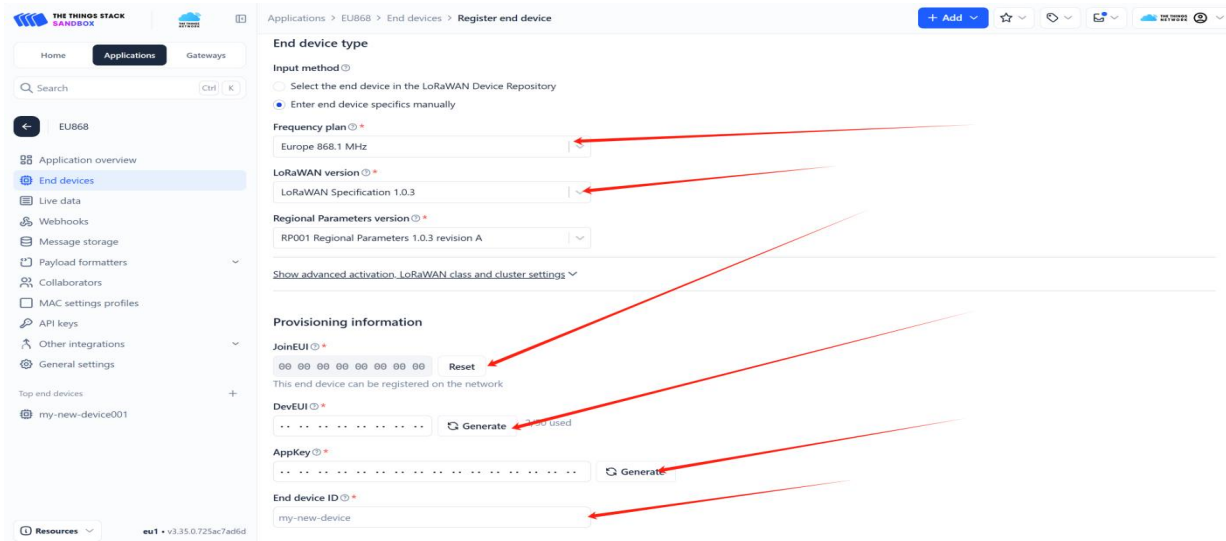


Figure 12 Create Node

- ⑧ Configure the gateway network connection and check on the platform whether the gateway is successfully online.

The gateway supports the following network connection methods: Wi-Fi provisioning, wired Ethernet access, and 4G SIM card access.

◆ Wi-Fi Provisioning Procedure

1. Connect the antenna to the device, then connect the power supply.
2. When powering on the device, press and hold the provisioning button. When the Wi-Fi indicator blinks slowly, the device has entered provisioning mode.
3. Install the “ESP BLE Prov” Wi-Fi Provisioning app on your mobile phone. App download [Link](#). Open the app and click the three-dot icon in the upper-right corner. Click “Settings” and disable the default selected option “Encrypted Communication”. Return to the main screen of the app and click “Provision New Device” to complete permission authorization. Location permission is optional. (If the location permission prompt appears, select “CANCEL”). Then click “I don’t have a QR code”, and then click “CHANGE”, and modify the scan name filter to “RG-03”. Select the scanned device name to connect, choose the Wi-Fi to be connected and enter the password, then click “OK” once the network connection is completed. When the Wi-Fi indicator stays on, provisioning is successful and the device has successfully connected to the server.

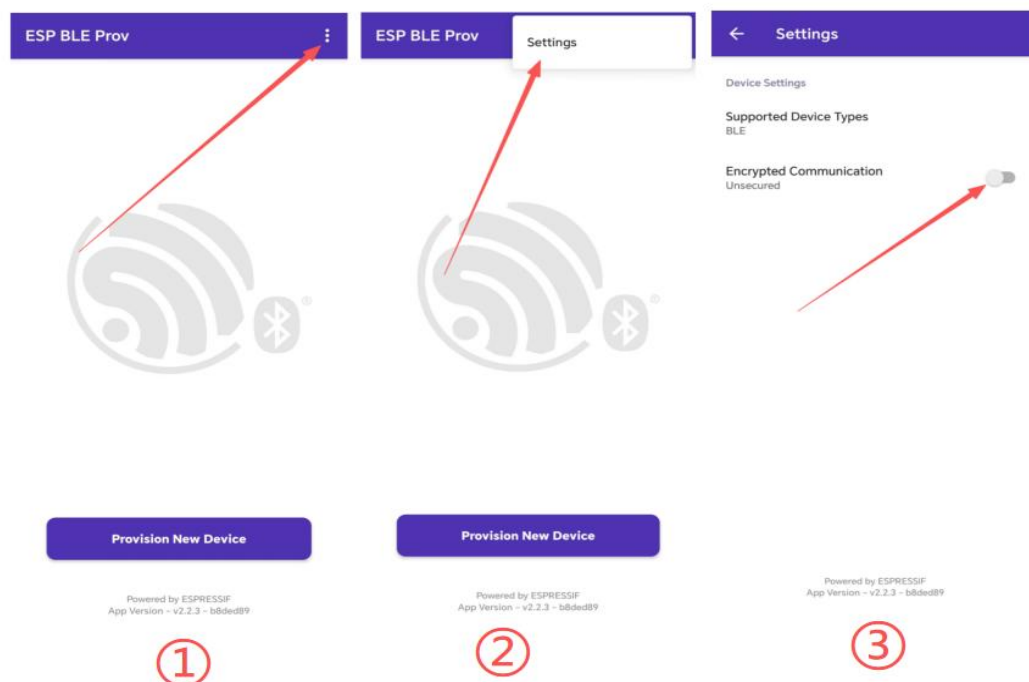


Figure 13 Encryption Disabling Procedure

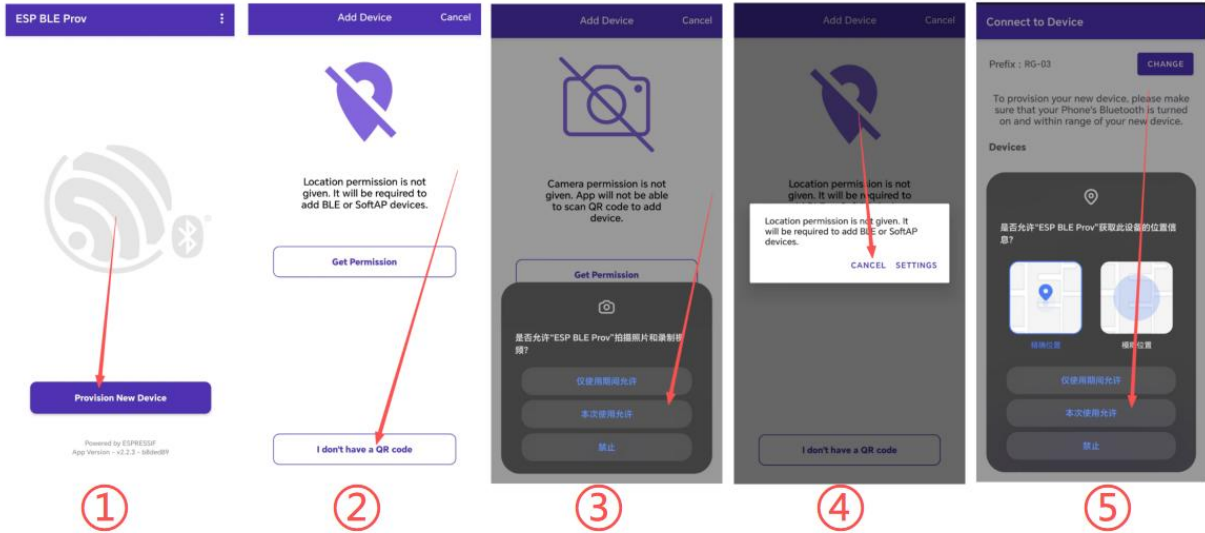


Figure 14 App Authorization Procedure

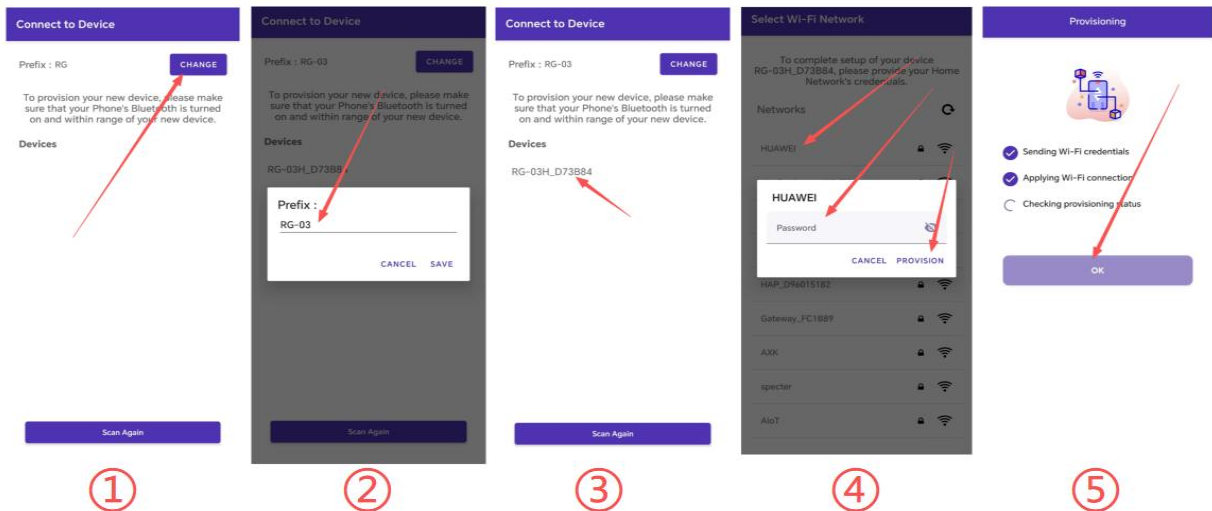


Figure 15 Wi-Fi Provisioning Procedure

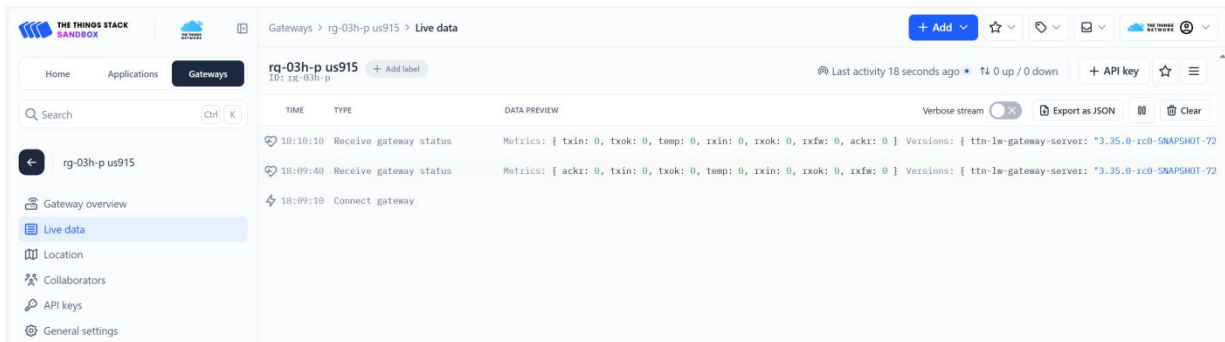


Figure 16 Check Gateway Network Joining Status

⑨ After confirming that the gateway has successfully joined the platform, **send a restart command (Z00000000001) to the sensor via NFC. Upon completing the configuration and waiting for five minutes**, check the Live Data of the node on the platform to confirm whether the node has successfully joined the network. **Refer to Section 4.3 for NFC data writing operations and data definitions.**

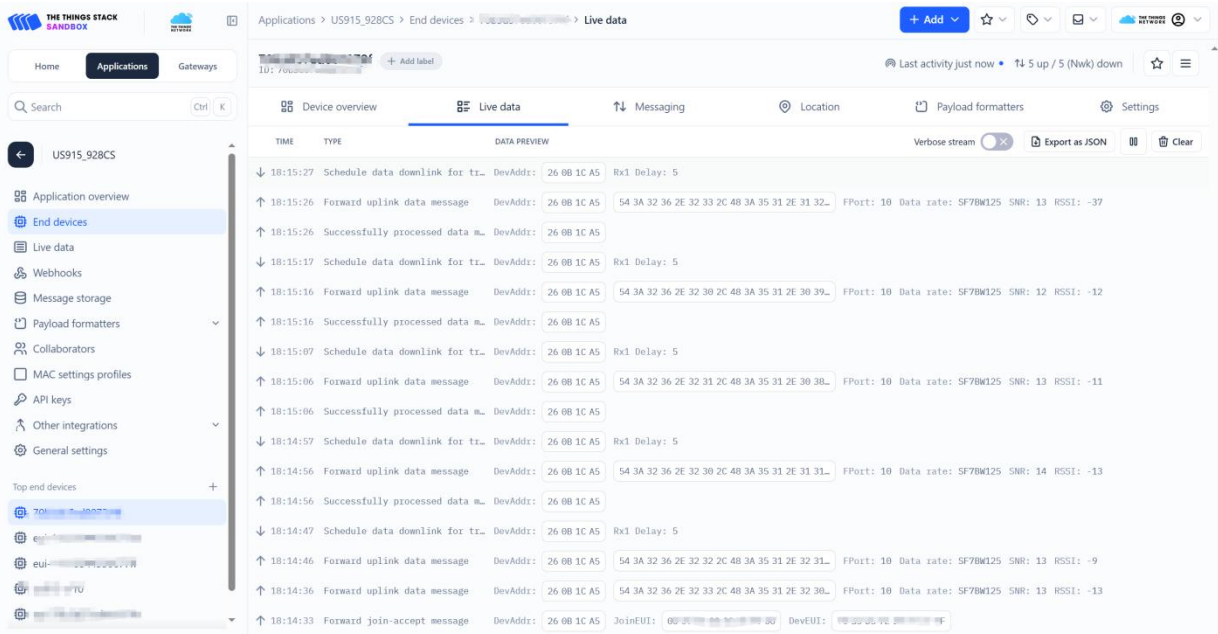


Figure 17 Check Node Network Joining Status

⑩ Explanation of Node Data Reporting Format

Reported Data (HEX): 543A32382E34302C483A35332E3039

(Corresponding string): T: 28.40, H: 53.09

Where: T represents temperature, and H represents humidity.

4.3. NFC Function Instructions for the Sensor

- ① Install the “NFC 标签助手” (NFC Tag Assistant) app on your mobile phone to enable NFC read and write functions; app download [Link](#);



Figure 18 NFC Tag Assistant

- ② Open the app and place the phone close to the NFC antenna to read chip information.



Figure 19 NFC Read Information

③ The format for read information is described as follows:

- a. 5A represents the data header
- b. 0D represents the length
- c. 01 represents the status is “Executed”
- d. 38 36 38 31 00 represents the frequency 868.1 MHz
- e. 30 37 00 represents spreading factor SF7
- f. 31 32 35 00 represents bandwidth BW125K

④ Select the “写入” (Write) tab and click “文本” (Text), enter the configuration information in the text box, press “确定” (OK), and wait for the write operation to complete.

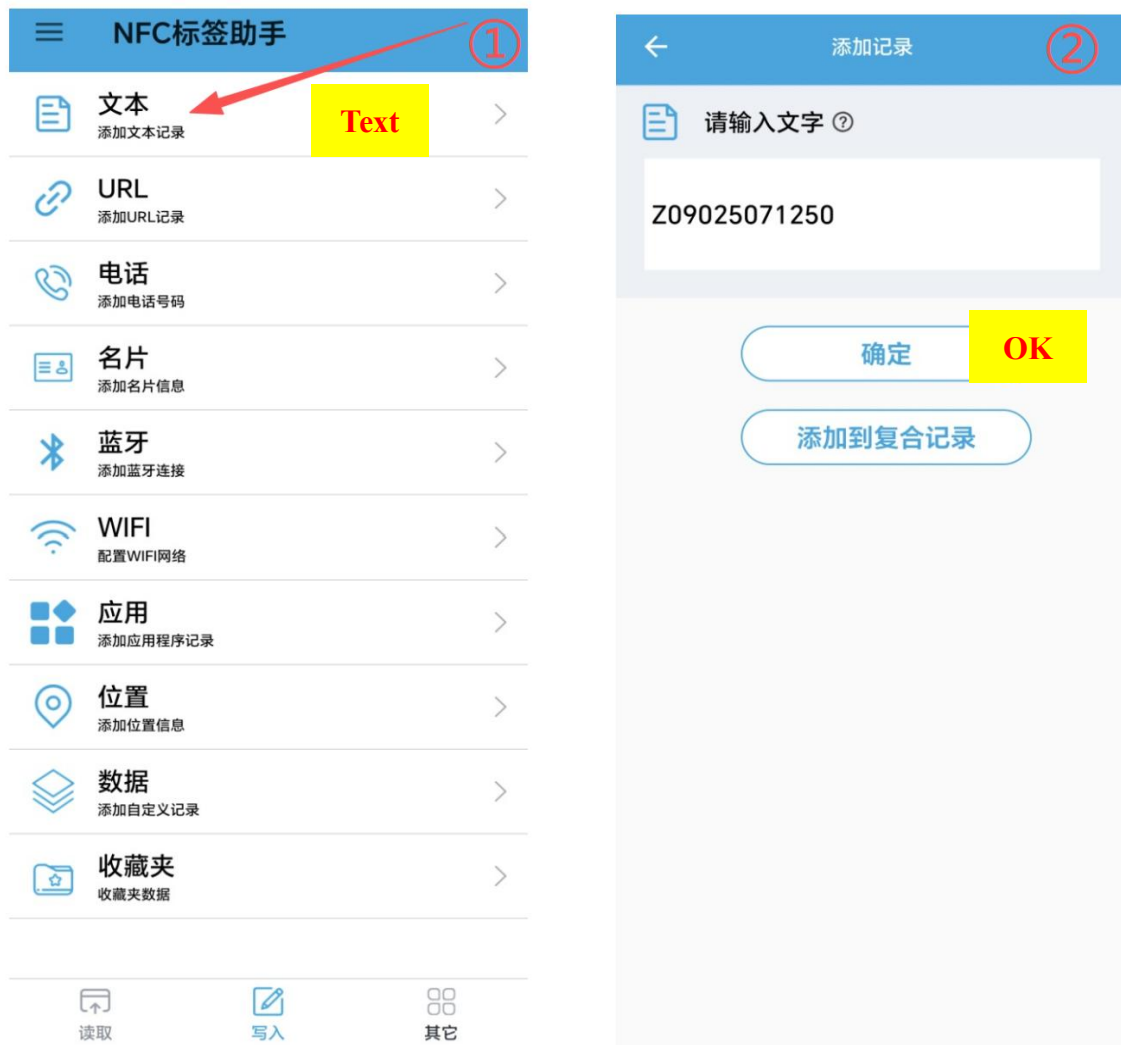


Figure 20 Write Configuration Information via NFC

⑤ Configuration Information Format Description

Table 1 Sensor Parameter Configuration Protocol

Field No.	Code Seg.	Field Desc.	Parsing Description	Example Value
1	Z	Protocol header	ASCII character “Z”, corresponding to HEX format “0x5A”	0x5A
2	0	Execution status	“0” = not executed “1” = executed successfully “2” = execution failed (When issuing a command, it must be configured as 0 for the command to be executed; after execution, it will change to 1 or 2 to prevent repeated execution)	0 indicates not executed.
3	9025	Frequency	The value divided by 10, in MHz	9025 indicates 902.5 MHz
4	7	Spreading factor	Usually ranges from SF7 to SF12	07 indicates SF7
5	125	Bandwidth	Common: 125kHz, 250kHz, 500kHz	125 indicates 125 kHz bandwidth
6	0	Restart flag	“0”= no restart “1” = restart	0 indicates no restart

4.4. Web Interface Instructions for RG-03H Gateway

- ① Connect to the gateway hotspot (name: “LoRaHub-AP_XXXXXX”, password: “12345678”). After connecting, access the web interface (IP: “192.168.4.1:8000”).



Figure 21 RG-03H Hotspot Connection

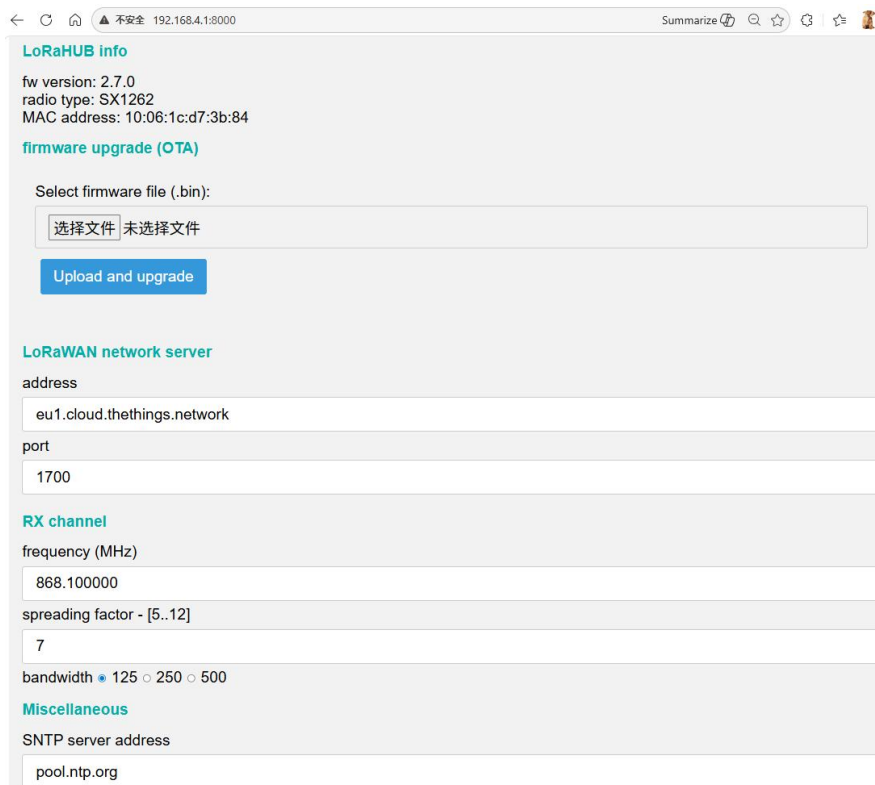


Figure 22 RG-03H Web Interface

- ② The web interface supports configuration of receive channel frequency and bandwidth, SNTP server settings, hotspot account and password configuration, and OTA upgrade.

4.5. OTA Upgrade Instructions for RG-03H Gateway

- ① Open the RG-03H gateway web interface. In the “firmware upgrade (OTA)” section, select the OTA firmware file to be upgraded.

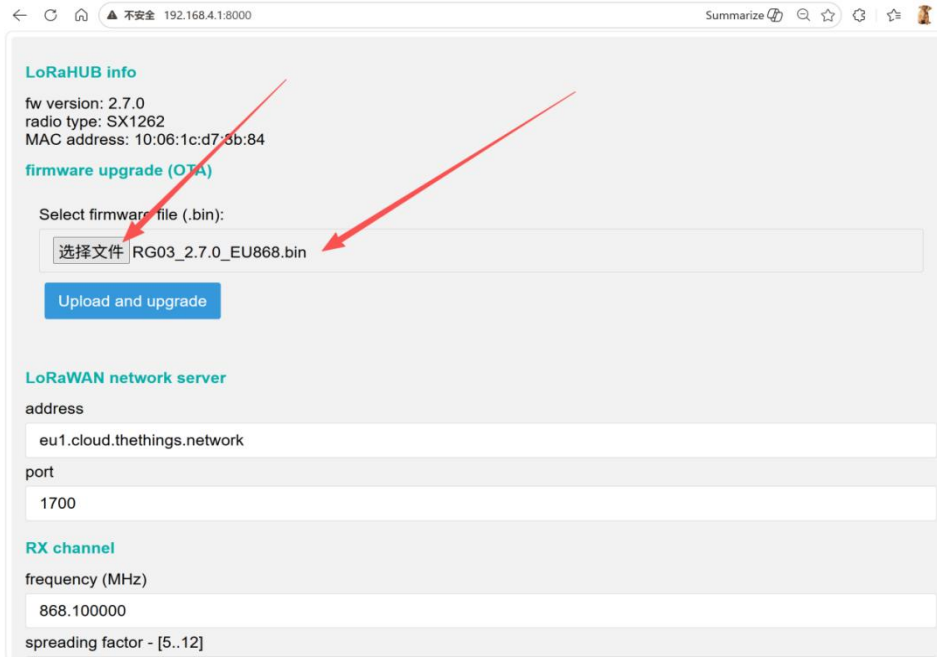


Figure 23 Upload OTA Upgrade File for RG-03H Gateway

- ② After the OTA file is successfully uploaded, click the “Upload and upgrade” and wait for the OTA upgrade prompt to complete the firmware upgrade.

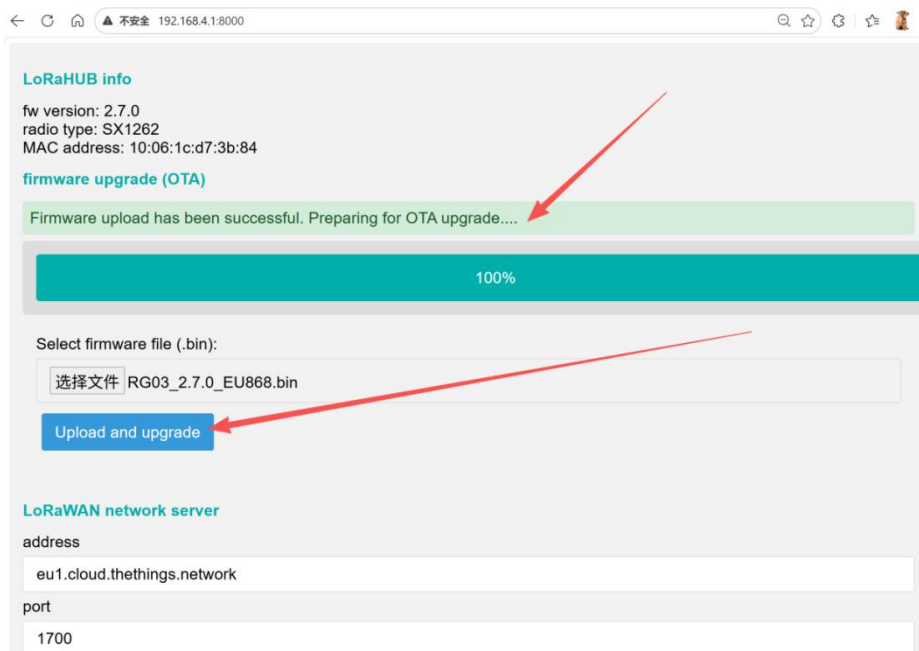


Figure 24 OTA Upgrade Completed Interface for RG-03H Gateway

5. Interface Definition

5.1. RG-03H Gateway Appearance and Dimensions

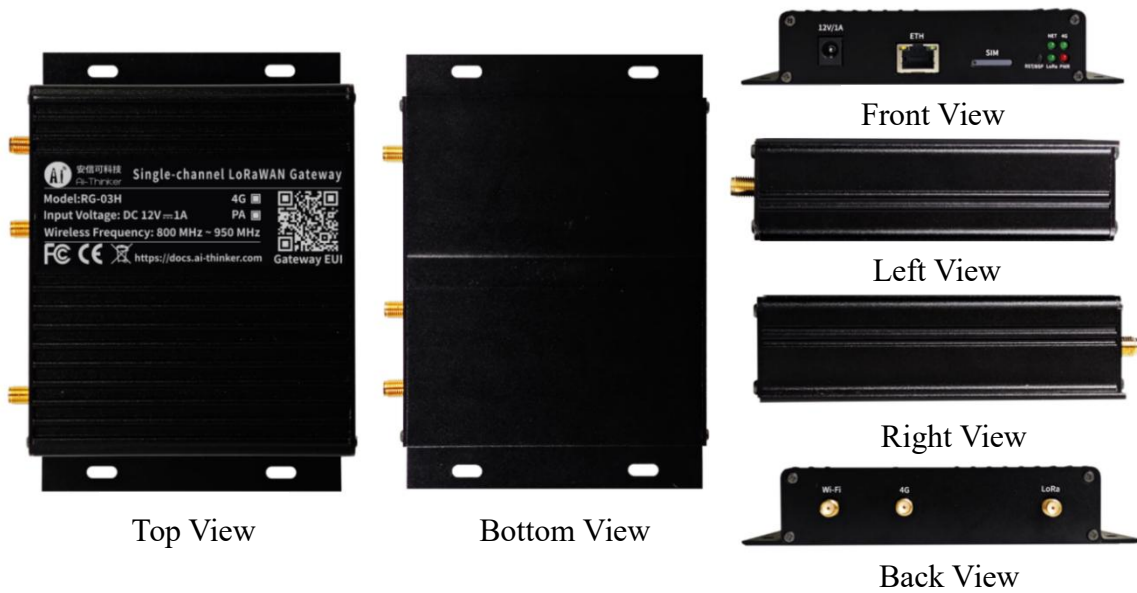


Figure 25 RG-03H Gateway Appearance



Figure 26 Silkscreen Diagram of Different RG-03H Configuration Versions

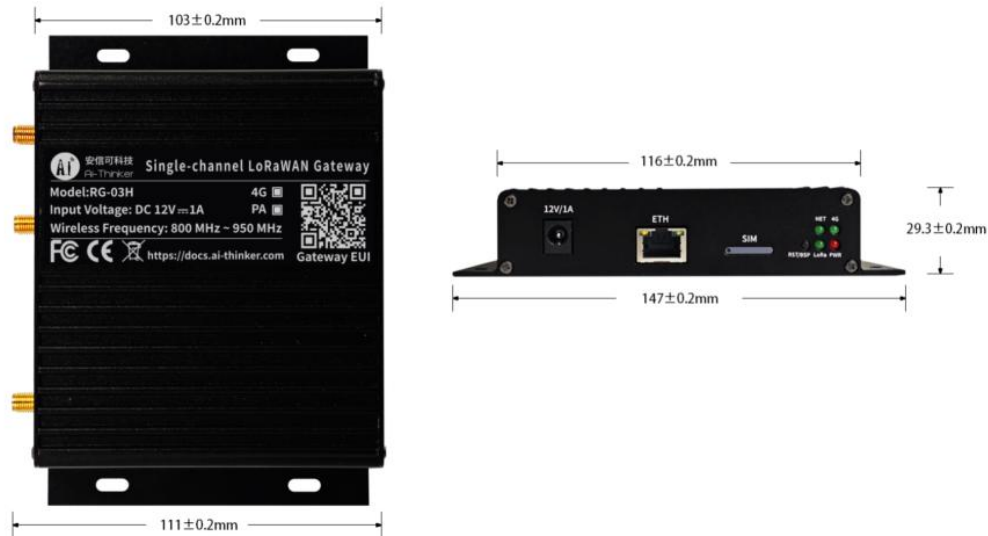


Figure 27 RG-03H Gateway Dimensions

5.2. RG-03H Gateway Hardware Interface Description

Table 2 RG-03H Indicator Status and Button Functions

Indicator or Button	Network Status	LED Status or Button Function	Note
Power indicator (red LED)	Powered on	LED stays on	/
NET indicator (green LED diagonally opposite red LED)	Wi-Fi not connected	LED off	/
	Entered Wi-Fi provisioning mode	LED blinks slowly	
	Wi-Fi connected successfully	LED blinks quickly	
	Connected to LoRaWAN server	LED stays on	
4G indicator (green LED above red LED)	No SIM card inserted	LED blinks slowly	/
	4G SIM card registering to network	LED blinks quickly	
	4G SIM card successfully registered	LED blinks when data is present	
LoRa indicator (green LED to the left of the red LED)	No data interaction	LED off	/
	Data interaction in progress	LED blinks	
Factory reset	/	Reset button	Long press to reset

Table 3 RG-03H External Interface Function Description

External Interface	Function	Note
RJ45	Ethernet interface	/
SMA interface (leftmost)	Wi-Fi antenna interface	/
SMA interface (middle)	4G antenna interface	/
SMA interface (rightmost)	LoRa antenna interface	/
DC interface	12 V @ 1 A power input	/

5.3. Ai-LoRaWS-1001 Temperature and Humidity Sensor Appearance and Dimensions



Figure 28 Ai-LoRaWS-1001 Temperature and Humidity Sensor Appearance



Figure 29 Ai-LoRaWS-1001 Temperature and Humidity Sensor Dimensions

5.4. Ai-LoRaWS-1001 Temperature and Humidity Sensor Hardware

External Interface Description

Table 4 Ai-LoRaWS-1001 External Interface Function Description

External Interface	Function	Note
Temperature and humidity sensor	Collects indoor temperature and humidity	/
NFC module	Supports NFC read/write functions	/

6. Installation Instructions

RG-03H Gateway Installation Precautions

1. Ensure that the antenna screws are fully tightened.
2. Keep the antenna away from strong interference sources whenever possible.
3. Ensure that the antenna are positioned upward.
4. The exposed cable of the LoRa magnetic-mount antenna should be fully extended.
5. Ensure that the SIM card is inserted in the correct orientation, if used.
6. Ensure that the power adapter is properly connected.
7. The main unit must be securely fixed.

Ai-LoRaWS-1001 Temperature and Humidity Sensor Installation Precautions

1. Ensure that the antenna screws are fully tightened.
2. Keep the antenna away from strong interference sources whenever possible.
3. The exposed cable of the LoRa magnetic-mount antenna should be fully extended.
4. After opening the enclosure and installing the battery, ensure that the waterproof sealing strip is properly installed and the screws are tightened.
5. The main unit must be securely fixed.

7. Application Scenarios

The LoRa wireless monitoring system composed of the RG-03H gateway and Ai-LoRaWS-1001 temperature and humidity sensor is suitable for a wide range of long-distance, low-power data collection and environmental monitoring scenarios. With high sensitivity and multi-mode communication capabilities, including LoRaWAN, Wi-Fi, Ethernet, and 4G, the system can flexibly meet the requirements of different deployment environments.

■ Smart Agriculture

The Ai-LoRaWS-1001 collects temperature and humidity data from farmland or greenhouses and uploads it to the cloud platform through the RG-03H gateway, enabling environmental parameter monitoring and automated irrigation control.

■ Warehousing and Cold Chain Management

Suitable for warehouses, cold storage facilities, logistics warehouses, and similar scenarios. The system monitors temperature and humidity changes in real time to ensure the safety of stored and transported goods. It also supports remote data visualization and historical record queries.

■ Industrial Monitoring

Sensor nodes can be deployed in factory workshops, equipment rooms, and other areas to collect environmental parameters, supporting equipment operation safety and energy consumption management.

■ Smart Buildings and Public Facilities

Applicable to environmental monitoring systems in office buildings, schools, hospitals, and other facilities, helping improve comfort and energy efficiency.

■ Tunnels and Underground Utility Corridors

With LoRa's ultra-long-range transmission capability, the system enables environmental monitoring and alarm data transmission in enclosed or weak-signal environments.

The system offers flexible deployment, low power consumption, and easy maintenance. It allows for the expansion of node numbers or integration with cloud platforms based on actual needs, enabling data collection and intelligent monitoring across multiple scenarios.

8. Ordering Information

Table 5 Gateway Ordering Information

Product Model	Product Name	Key Features	Note
RG-03H	LoRaWAN single-channel smart gateway	Supports Ethernet/Wi-Fi/4G network access; supports EU868, AS923, RU864, KR920, US915 and other frequency bands; supports remote configuration and FOTA upgrade	Non-PA version and PA enhanced version available
Antenna	LoRa antenna (magnetic-mount) Wi-Fi antenna (rod type) 4G antenna (rod type)	SMA interface, easy installation	Standard or optional
Power adapter	12 V/1 A DC power supply	Suitable for RG-03H gateway	Standard or optional accessory

Table 6 Sensor Ordering Information

Product Model	Product Name	Key Features	Note
Ai-LoRaWS-1001	LoRaWAN temperature and humidity sensor node	Built-in ER34615 lithium thionyl chloride battery (19000 mAh); external SHT40 temperature and humidity sensor; supports multi-band LoRa communication; low-power design	Optional EU868 or US915 firmware
Antenna	LoRa antenna (magnetic-mount)	SMA interface, easy installation	Standard or optional

9. Contact Information

[Official Website](#)

[Official Forum](#)

[Development DOCS](#)

[LinkedIn](#)

[Tmall Store](#)

[Taobao Store](#)

[Alibaba Store](#)

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Company Address: Room 403, 408–410, Building C, Huafeng Smart Innovation Port, Gushu, Xixiang, Bao'an District, Shenzhen, Guangdong, China

Contact Hotline: 0755-29162996



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