SENSECAP

Sensor Hub - 4G Data Logger

User Manual

Version: V3.0

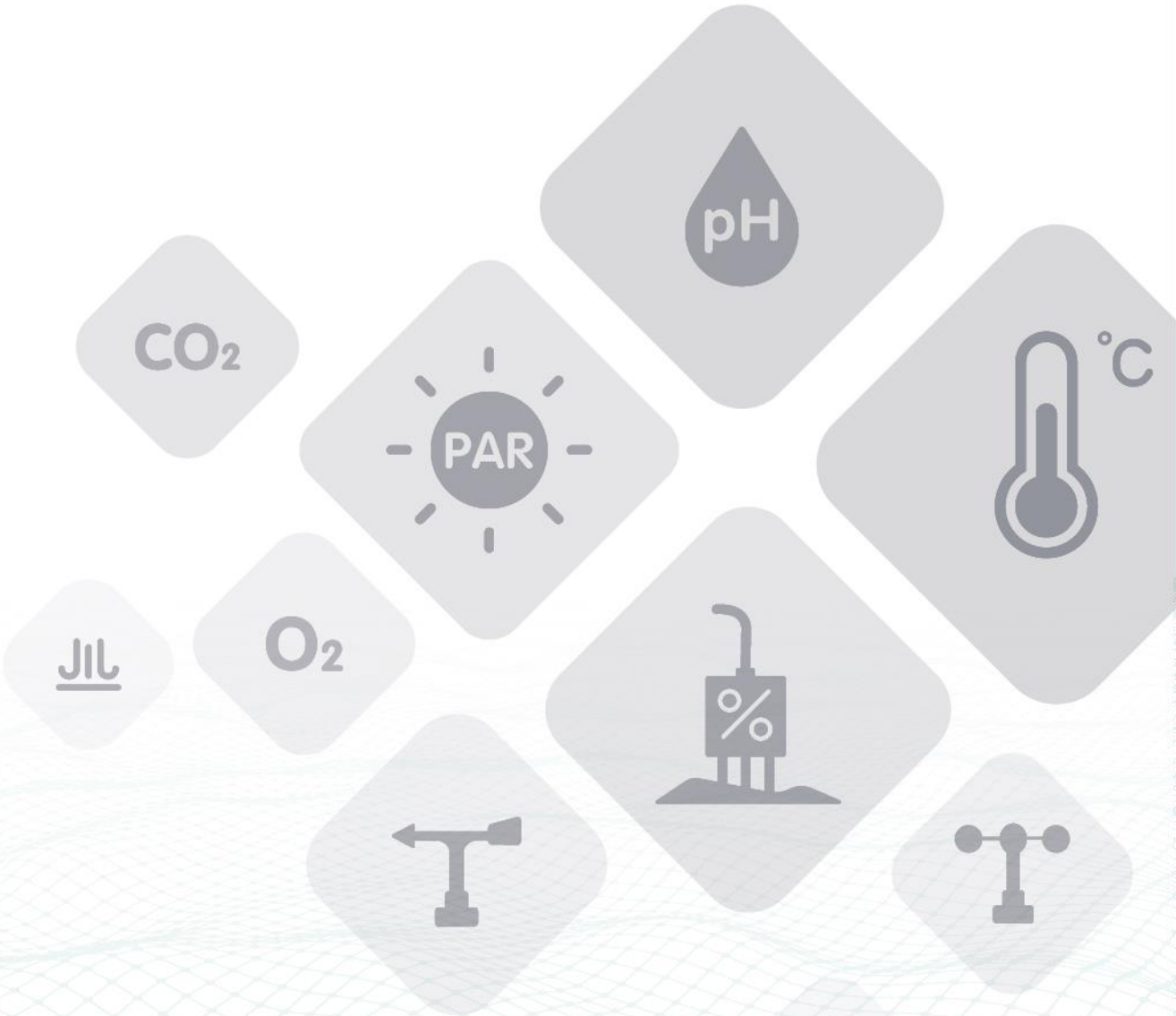


Table of Contents

1. Product Introduction

SenseCAP is an industrial-grade sensing network system that enables low-power environmental data acquisition. The system consists of reliable and easy-to-use hardware products, software and cloud services. SenseCAP currently includes a product family of Sensor Hub 4G Data Logger & Sensors; and SenseCAP LoRaWAN Gateways & Sensors, etc.

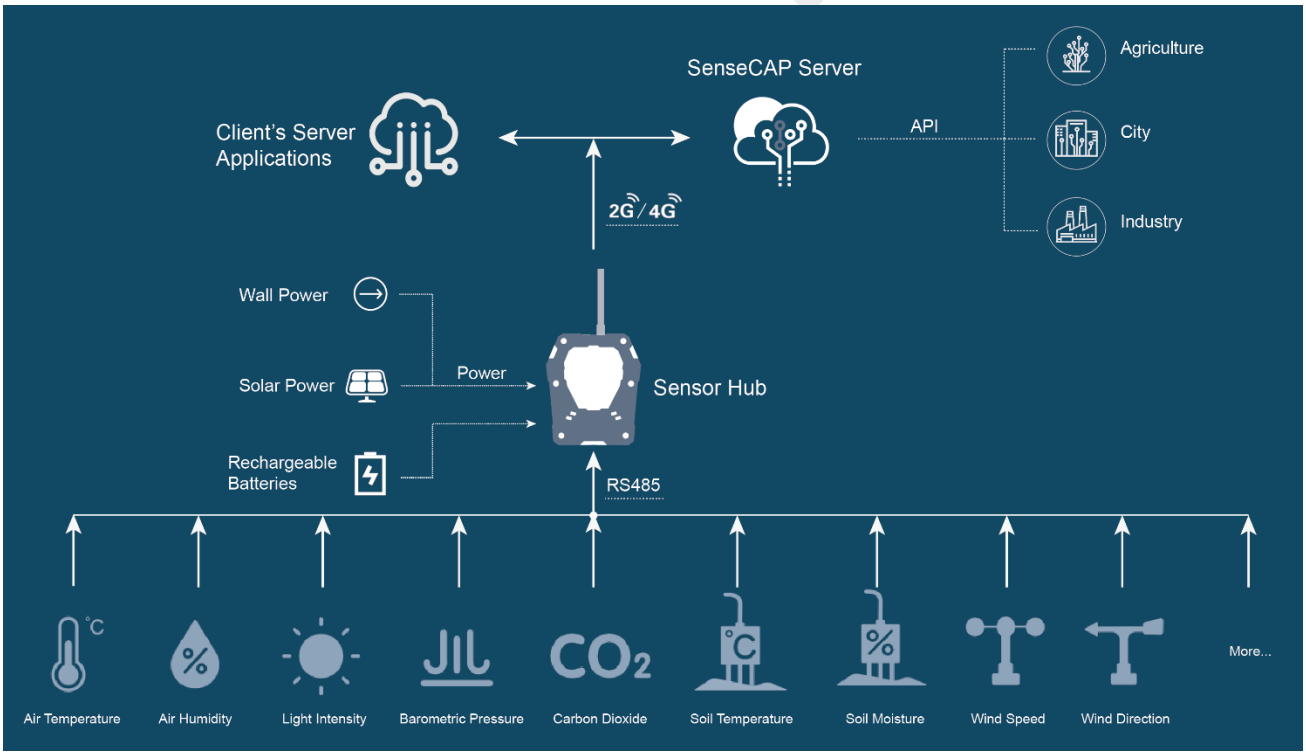
The Sensor Hub series consists of Sensor Hub Data Logger and Sensors. The system uses Modbus-RTU RS485 protocol for communication and can be connected directly to the RS485 sensors that Seeed provides. The Sensor Hub can also be configured to access collect data from third party sensors that use the standard Modbus-RTU RS485 protocol. It has a maximal support for 32 sensors. The device uploads the collected data via 4G/3G/2G to user's private MQTT server or to SenseCAP cloud. There are two types of power supply: wall power and solar power. With a built-in high-capacity rechargeable lithium battery, Sensor Hub can work for up to 2 weeks in rainy days or during power outage. When communication signals are weak or disconnect, the data can be cached locally, greatly reducing the risk of data loss. The equipment is waterproof and resistant to UV and rain, anti-aging, and can be deployed in harsh outdoor environments.

SenseCAP also provides an easy-to-use cloud platform and services. Users can scan QR codes on the devices with mobile apps, bind devices to corresponding accounts, and manage devices and view data on the web portal conveniently. The platform also provides API services that allow users to obtain data from cloud platforms and quickly integrate it for their own applications.

Key Features:

- Support collection of various environmental data simultaneously (up to 32 sensors with four RS485 interfaces and splitters)
- Support using with standard Modbus-RTU RS485 sensors
- Strong compatibility, supporting both 5V and 12V to power the sensors
- The device supports offline data caching at least 10000 measurements. When the communication signal is poor or disconnected, the data is cached locally until the communication resumes and then uploads the cached data to the server
- Support GPS function to real-time fixed-point monitoring
- Two types of power supply available: DC wall power, solar power
- Ultra-low power consumption: with the built-in 6Ah lithium battery, when the solar power is insufficient or power outage, the equipment can work for more than two weeks (when measuring 7 parameters)
- Easy to install and deploy, without requirements of engineering background
- Easy to maintain, supporting OTA for remote updates
- Industrial-grade Environmental Tolerance: working temperature supporting -20℃ ~ +60℃
- IP66 rated, resistant to UV and rain erosion, suitable for outdoor applications

System Architecture:



2. Quick Deployment Guide

For quick deployment, here we are listing the main steps. Please refer to the following chapters for more details.

2.1 Connect Sensor Hub to SenseCAP Cloud Platform

1. Unpack, refer to the packing list and check whether there are missing parts.
2. Bind the device using the SenseCAP APP by scan the QR code on Sensor Hub.
3. Install the SIM card: Use the Allen Hex Key to open the cover of the device and insert the SIM card.
4. Install the antenna.
5. Connect the USB Serial Tool via port B6. Download SenseCAP Sensor Hub Configuration Tool.
6. Set the APN with SenseCAP Sensor Hub Configuration Tool.
7. Install the sensor (channel port 1 to 4).
8. Connect the power supply and plug in to the power port (B6).
9. Turn on the switch(B5): LED on represents normal start. The device initialization takes about 5 minutes.
10. View device status and sensor data on SenseCAP cloud platform.
11. Deploy the device.

1) Check and confirm the location for installing the device.
2) Install poles, brackets, and sensors, etc.

2.2 Connect Sensor Hub to 3rd-party Sensors and Servers

1. Unpack, refer to the packing list and check whether there are missing parts.
2. Install the SIM card: Use the Allen Hex Key to open the cover of the device and insert the SIM card.
3. Install the antenna.
4. Download Sensor Hub Configuration Tool, connect the device (via port B6) to computer with a USB-to-TTL cable.
5. Install the driver, access the above-download tool, and power on the device by pressing the switch (B5). Then configure the followings in the software:
    1) Sensor information.
    2) APN information.
6. Turn off the switch (B5) for 10 seconds and start it again.
7. Check the sensor data on the server.
8. Deploy the device.

1) Check and confirm the location for installing the device.

2) Install poles, brackets, and sensors, etc.

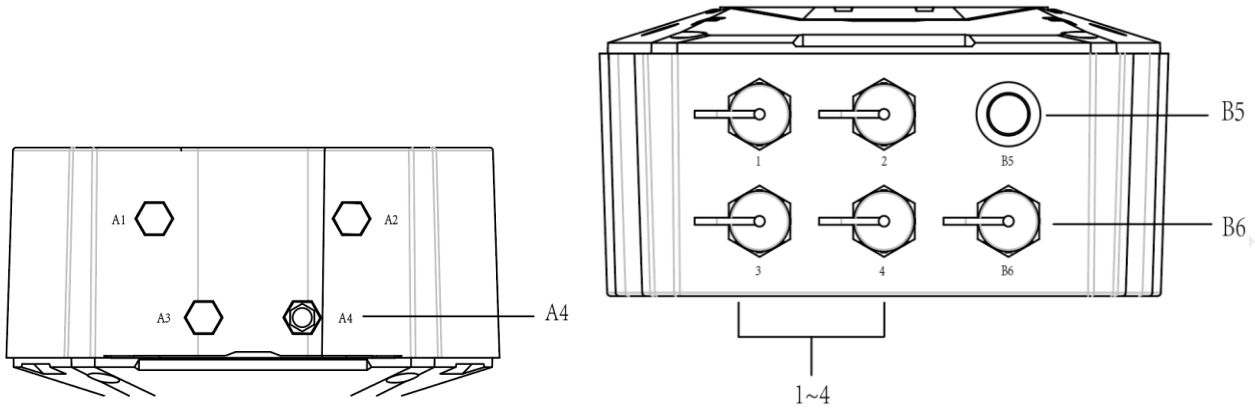
3. Assemble the Device

This chapter mainly describes the basic assembly process. Before installing the device, please check the packing list and make sure there are no missing parts.

3.1 Device Packing List (Sensor Hub).

Number	Parts	Number
1	Sensor Hub	1
2	Antenna	1
3	Power Adapter	1
4	USB Serial Tool	1
5	Allen Hex Key and M5 Self-drilling Screw	1 / 8
6	Mounts	4
7	Ferrules	2
8	Aluminum Mounts	2

3.2 Device Interface Introduction



A4: Antenna connector.

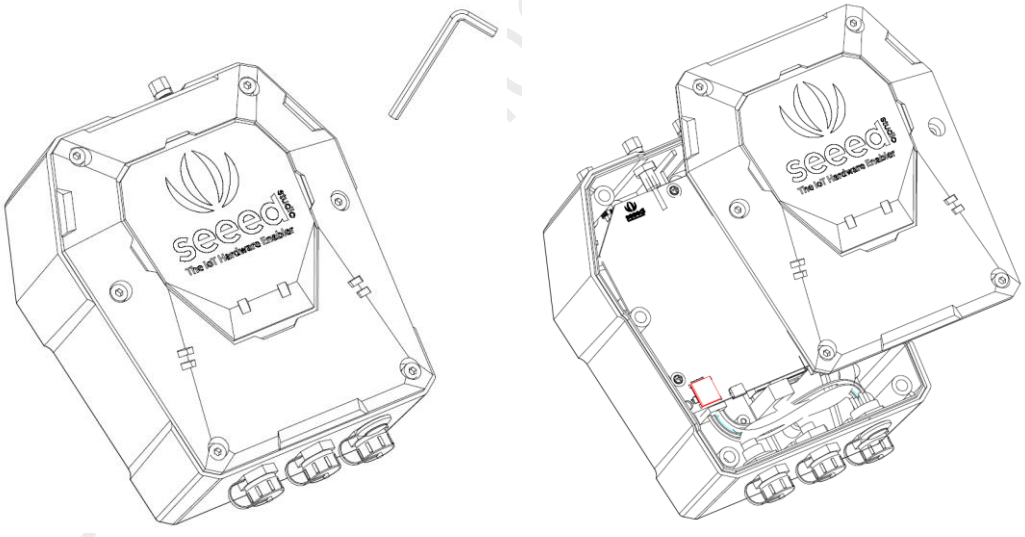
1 to 4: RS-485 channel ports for sensor (Channel Number: 1, 2, 3, 4 from left to right, up to down).

B5: Power switch and status indicator.

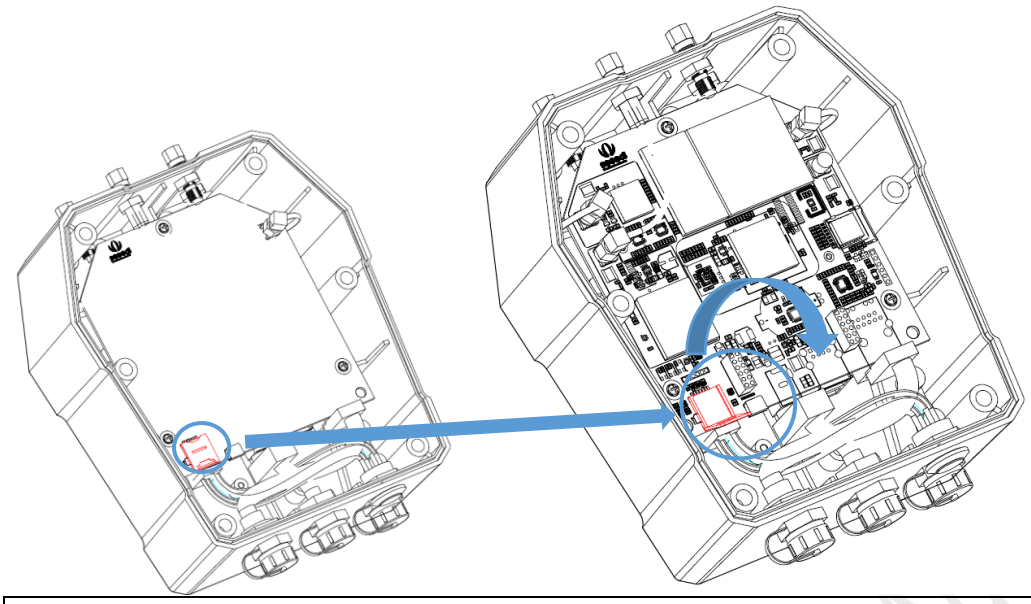
B6: two functions in one: (1) power supply port, (2) serial port.

3.3 Install the SIM card

- Remove the six screws from the top cover with the Allen Hex Key (included in the package) and open the lid.



- Swipe downward to open the SIM card socket, insert the Micro SIM card and swipe upward to lock the SIM card socket. Make sure it is installed correctly and close the lid with the screws.



Note: When installing the cover screws, be sure to lock the screws tight, or it may affect the water resistance of the device!

3.4 Install the Antenna

Remove the plastic cap from the antenna connector and screw the antenna clockwise.

Note: Do NOT connect the power supply when installing the antenna, as this may cause damage to the antenna circuit!

3.5 Connect the Sensors

Unscrew the protective cover of the connector and plug the sensor into the RS-485 connector.

Note:

1. It is recommended that you connect the sensors before connecting to the power supply. Or it the device might not recognize the sensors and requires a restart.
2. When using a splitter, each RS-485 interface cannot connect to sensors with the same Modbus address.
3. Each interface must be connected to sensors of the same voltage. For example, you can connect four 5V sensors to B1 port, while connecting four 12V sensors to B2 port, but do NOT connect both 5V and 12V sensors to the same port.

3.6 Configure APN

Please refer to section 4.

3.7 Connect the Power Cord

Unscrew the protective cover of the power supply connector, plug one end of the power extension cord into the power connector and tighten it, plug the other end of the power extension cord directly into the power adapter.

4. Configure the Device to Connect to SenseCAP Cloud Platform

Before you deploy and install the devices, make sure that your device is working properly and uploading data.

4.1 Bind the Device

4.1.1 Create an account

Create your account at https://sensecap.seeed.cc

4.1.2 Download the App

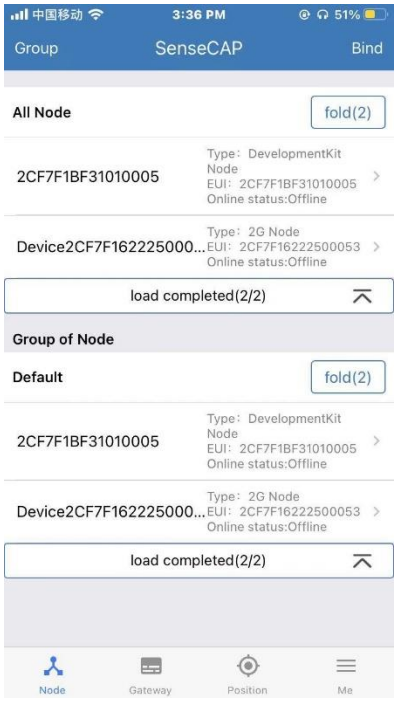
- For iPhone users: search for "SenseCAP" at the App Store to download.
- Android: download the App at http://sensecap-app-download.seeed.cn

Or simply scan the QR code below to download.

iOS Android

Bind Devices and Sensors to your Account

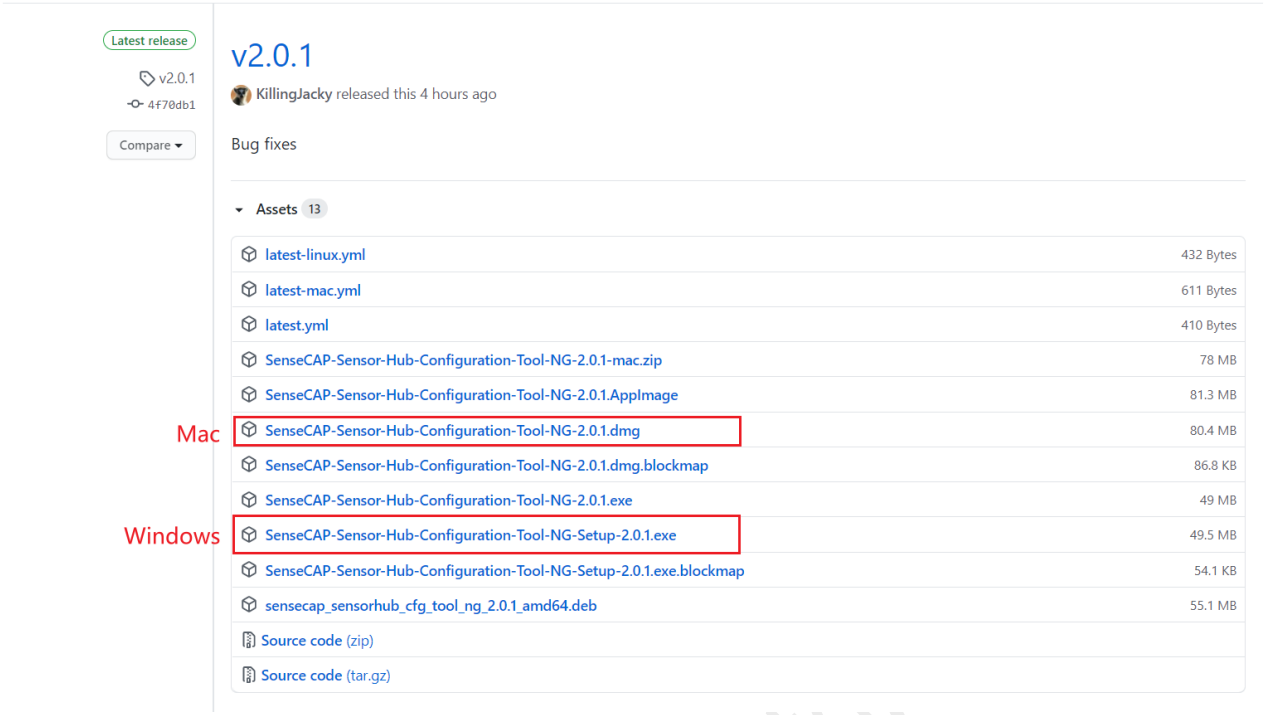
Sign in to SenseCAP App with your account, select Binding in the upper right corner of the home page, scan the QR code on the device, and "confirm" the binding.



4.2 Prepare Tool

4.2.1 Sensor Hub Configuration Tool

Download the Sensor Hub Configuration Tool from GitHub:
https://github.com/Seeed-Solution/SenseCAP-Sensor-Hub-Configuration-Tool-NG/releases
For MacOS, please install: SenseCAP-Sensor-Hub-Configuration-Tool-X.X.X dmg
For Windows, please install: SenseCAP-Sensor-Hub-Configuration-Tool-X.X.exe



Note: The software may be updated, please download the latest version of the software.

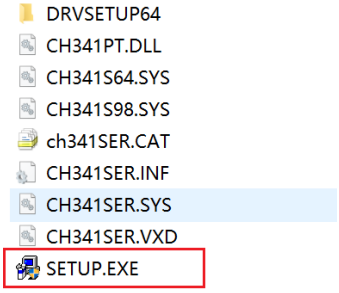
4.2.2 USB-to-TTL Cable and Driver Installation

USB-to-TL serial cable:

The aviation connect (blue part) is connected to the power port (B6) of Sensor Hub Data Logger and the USB port is connected to the computer.

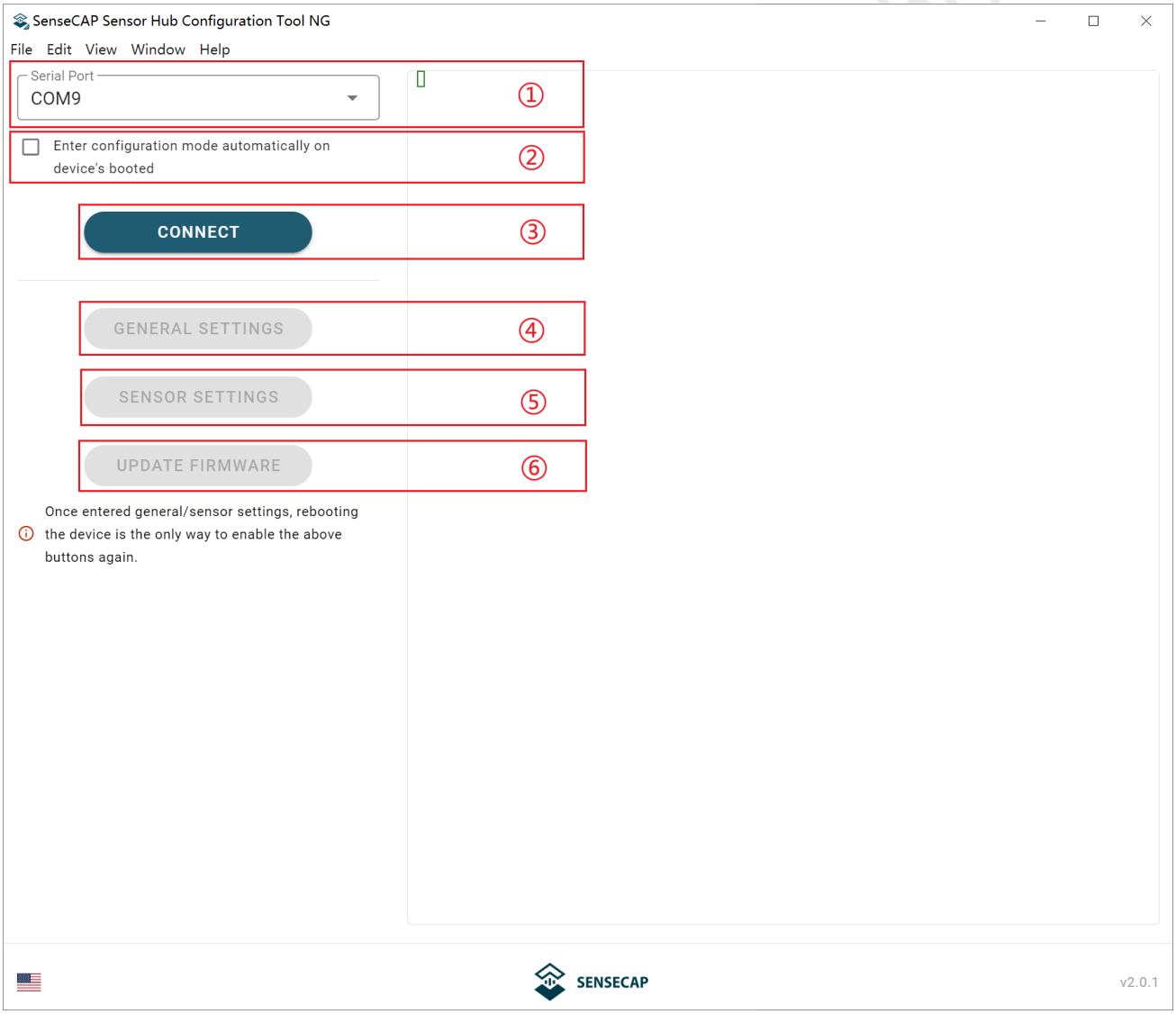
Install the driver:

https://github.com/Jenkinlu001/SenseCAP/tree/master/Drivers



4.3 Configuration Tool Introduction

Access the SenseCAP Sensor Hub Configuration Tool on your computer:



① Select the serial port number.

② The device modes include: (1) Working mode and (2) Configuration Mode:

Unchecked: Device is in the normal working mode, the device starts normally and collects data, you can view the device real-time operation log.
Checked: The configuration mode is activated, and various parameters can be configured after the device is started.

③ To connect: after selecting the serial port number and checking the configuration mode, click "Connect".

After connecting, press the power button of the device, the "General Settings" and other functions will light up, and the device can be configured.

④ Universal settings: Parameters such as device EUI (unique number for each device), server address, port, data acquisition interval, etc. can be configured.

⑤ Sensor settings: you can add new sensors that support standard Modbus-RTU protocol.

⑥ Update Firmware: Upgrade the device.

4.4 Universal Settings

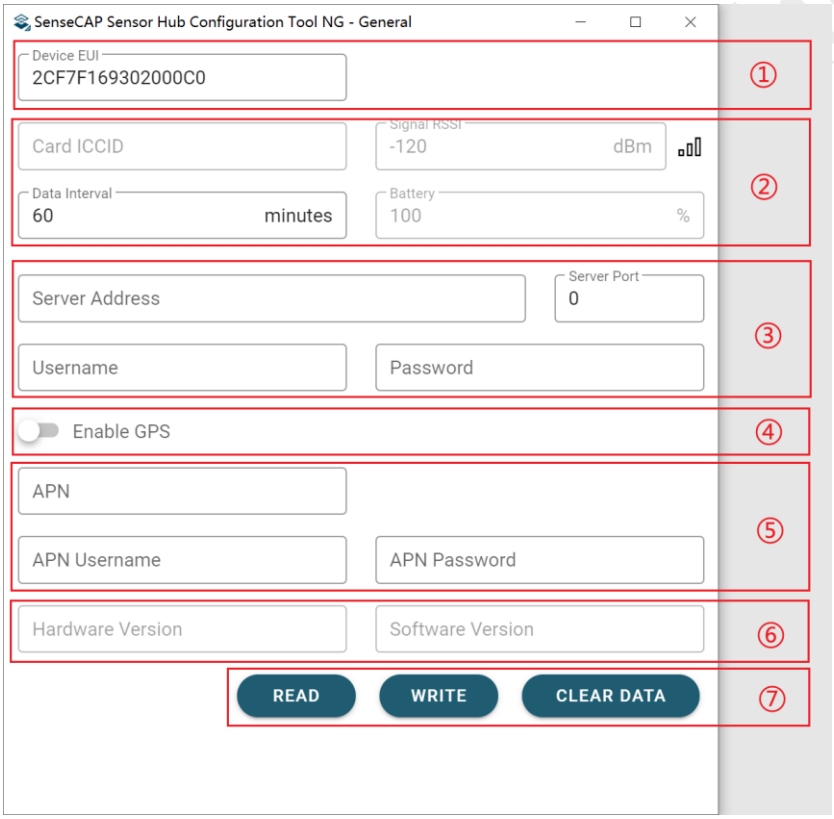
(1) Before the device is turned on, make sure the antenna SIM card are installed. When installing an antenna, make sure the device is turned off or the antenna circuit may be damaged.

(2) Connect the device to the computer with the USB-to-TTL cable, access the Sensor Hub Configuration Tool, select the serial port number, check "The device will automatically enter configuration mode after starting" and click "Connect".

> **Tip:** follow this path on your PC "Manage→ Control Panel→ Port", and you can see the port number of the device you are using.

(3) Press the power switch to turn on the device. After booting, the "General Settings" button will light up, and the device's information will be shown on the right side of the interface.

(4) Click "General Settings" and the configuration interface will pop up.

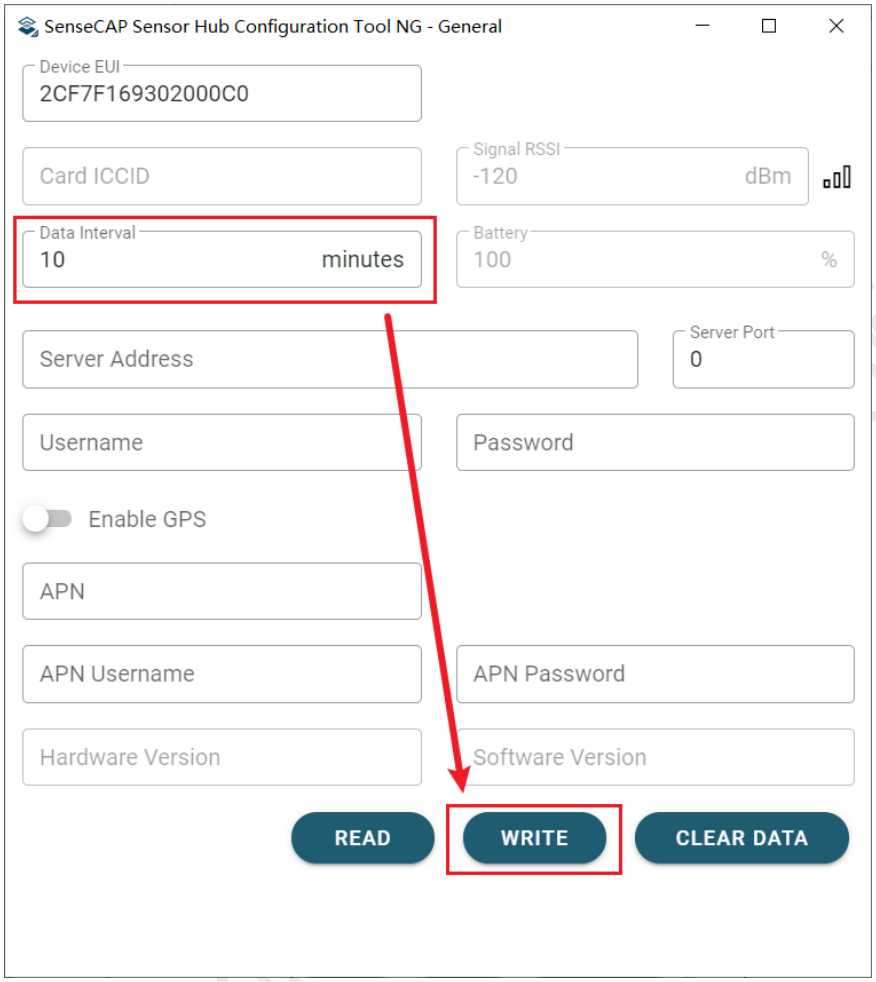


4.4.1 Device EUI and Data Upload Interval Modifications

① Device EUI: The device's unique number, corresponding to the device label, is 16 bits long.
② Card ICCID: SIM card ICCID (readable only in working mode).
Signal RSSI: Cellular (readable only in working mode).

Data Interval: The interval between each data upload, with a minimum of **5 minutes.** After modification, you need to click "Write" to take effect.

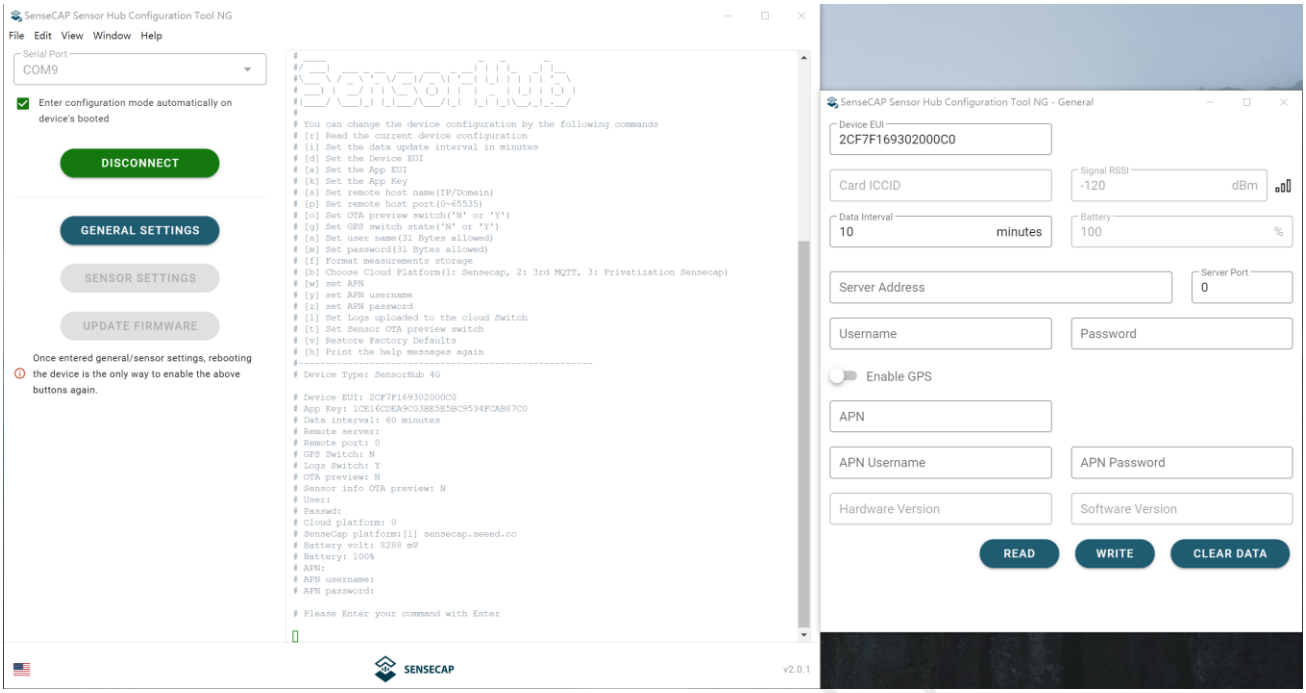
Battery: The remaining power of the built-in lithium battery.



(Change to upload data every 10 minutes)

4.4.2 MQTT Server Configuration

When you access the General Settings, some commands are shown at the right window of the main interface.



(1) Select the cloud platform: Click to enter commands directly at the green cursor below the main interface.

Enter the lowercase letter: b

Tip Input: 1 is the SenseCAP cloud platform (default);
2 is the user's third-party MQTT server;
3 is a SenseCAP private deployment;

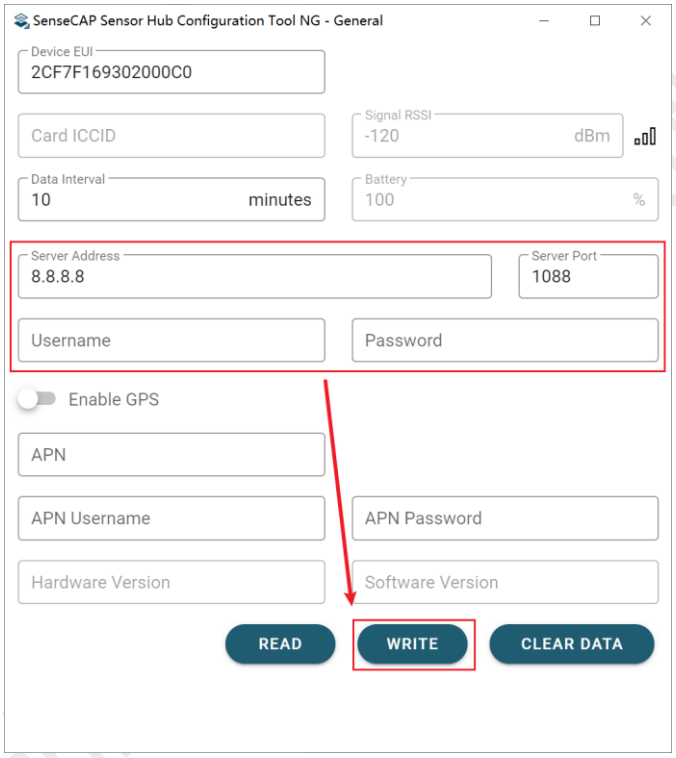
To configure the user's own server, please enter the command 2 and press Enter.

```
# Please Enter your command with Enter

b
Please param, '1': 'Sensecap Platform', '2': '3rd Part MQTT Platform', '3': 'Sensecap Privat
ization Deployment',end with "Enter"
2
New cloud platform: 2
```

As shown in the image, it has switched to the new cloud platform 2.

(2) Type in server address, port number, etc.



③ Server Address, Server Port: To upload the Data to the user's own server, the IP/domain name and port number are configured.
Username / Password: If there is verification code, fill it in.

Note: After completing the parameters, make sure to click "Write".

After configuring the server information, if you want to use the SenseCAP Cloud again, follow the similar method: In the main interface, type the command line: enter b => enter 1, and select SenseCAP Cloud Platform.

4.4.3 GPS configuration

④ Enable GPS: Considering the power consumption, GPS function is turned off in the factory settings. If you need to use GPS function, turn on the switch and click "Write".

4.4.4 APN Configuration

⑤ APN, APN username, APN password: Type in your SIM Card's APN information.

4.4.5 Read and Write button and Clear Data.

⑥ Hardware/Software version: You can view the version info of the device (readable only in working mode).
⑦ Read: After the Write configuration, click Read to check if the information is in effect.
Write: After modifying any parameters, you must click "Write" to save the information.
Clear Data: The device caches data when the network is poor or it's disconnected. After reconnecting to the network, it uploads the cached data to the server. Click "Clear Caches" to delete the data that has been cached on the device.

4.5 Power on the Device

Before powering on the device, make sure the antenna and SIM card are installed, APN is configured. When installing an antenna, make sure that the device is turned off or it may damage the antenna circuit. After connecting to the power adapter and pressing the power switch, the device is turned on and starts working. The initiation process can take up to 5 minutes depending on the type and number of sensors. The data can be viewed on the cloud platform, as shown below:

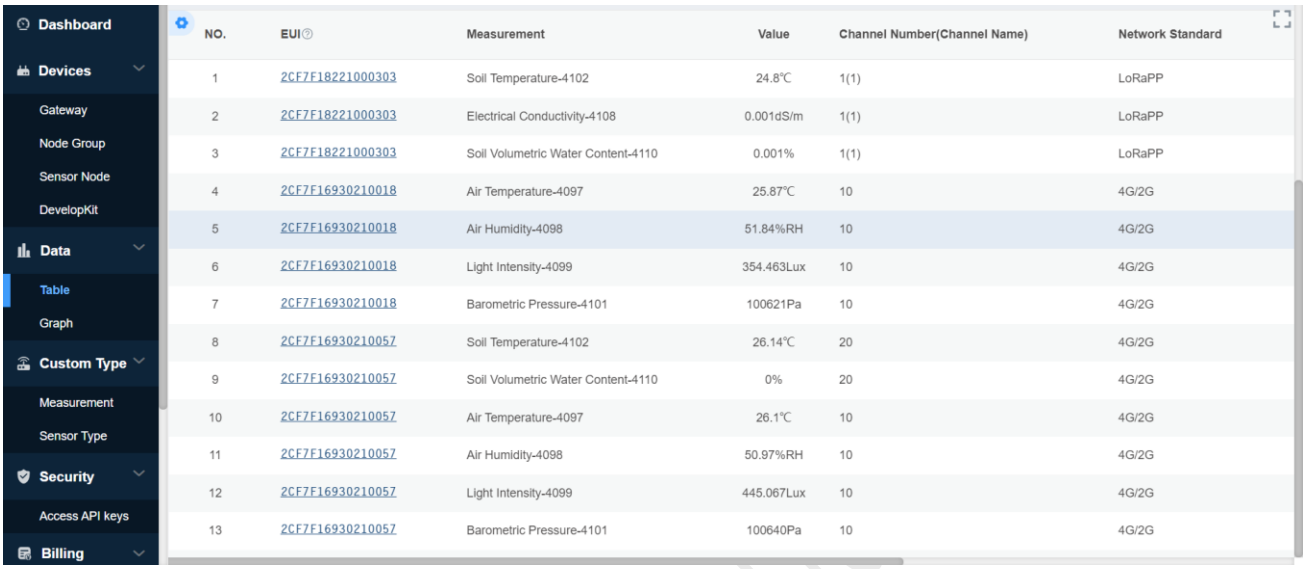
LED Status

After powering on the device

1. Stays ON for 5 seconds, then truns OFF
2. After 90 seconds, the device finishes booting, LED is ON
3. LED is ON for 4 minutes, device finishes initialization and collecting data
4. LED is OFF until its next data collection
5. LED is ON for about 2 minutes for each cycle of data collection.

4.6 View Data and Device Status on SenseCAP Cloud Platform

Sign in to your account at https://sensecap.seeed.cc
Click on the "Table" to see if the data has been uploaded normally.



NO.	EUI	Measurement	Value	Channel Number(Channel Name)	Network Standard
1	2CF7F18221000303	Soil Temperature-4102	24.8℃	1(1)	LoRaPP
2	2CF7F18221000303	Electrical Conductivity-4108	0.001dS/m	1(1)	LoRaPP
3	2CF7F18221000303	Soil Volumetric Water Content-4110	0.001%	1(1)	LoRaPP
4	2CF7F16930210018	Air Temperature-4097	25.87℃	10	4G/2G
5	2CF7F16930210018	Air Humidity-4098	51.84%RH	10	4G/2G
6	2CF7F16930210018	Light Intensity-4099	354.463Lux	10	4G/2G
7	2CF7F16930210018	Barometric Pressure-4101	100621Pa	10	4G/2G
8	2CF7F16930210057	Soil Temperature-4102	26.14℃	20	4G/2G
9	2CF7F16930210057	Soil Volumetric Water Content-4110	0%	20	4G/2G
10	2CF7F16930210057	Air Temperature-4097	26.1℃	10	4G/2G
11	2CF7F16930210057	Air Humidity-4098	50.97%RH	10	4G/2G
12	2CF7F16930210057	Light Intensity-4099	445.067Lux	10	4G/2G
13	2CF7F16930210057	Barometric Pressure-4101	100640Pa	10	4G/2G

4.7 Instructions for SenseCAP Cloud Platform

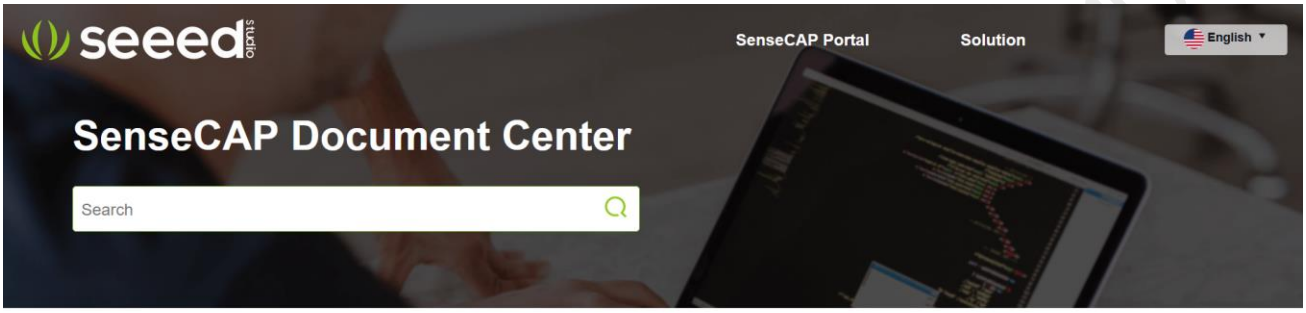
The main function of SenseCAP Cloud Platforms is managing devices and data. The cloud service is built on a secure and reliable cloud services. Users can bind devices to a designated account for convenient management. SenseCAP provides a web portal and API data interface. The web portal provides functions of (1) raw data display, (2) device management, (3) data management, and (4)security management. The API is provided for users to develop applications for their specific needs.
For more information, refer to the online tutorial to get a quick look at the capabilities of the cloud platform.
https://sensecap-docs.seeed.cc/

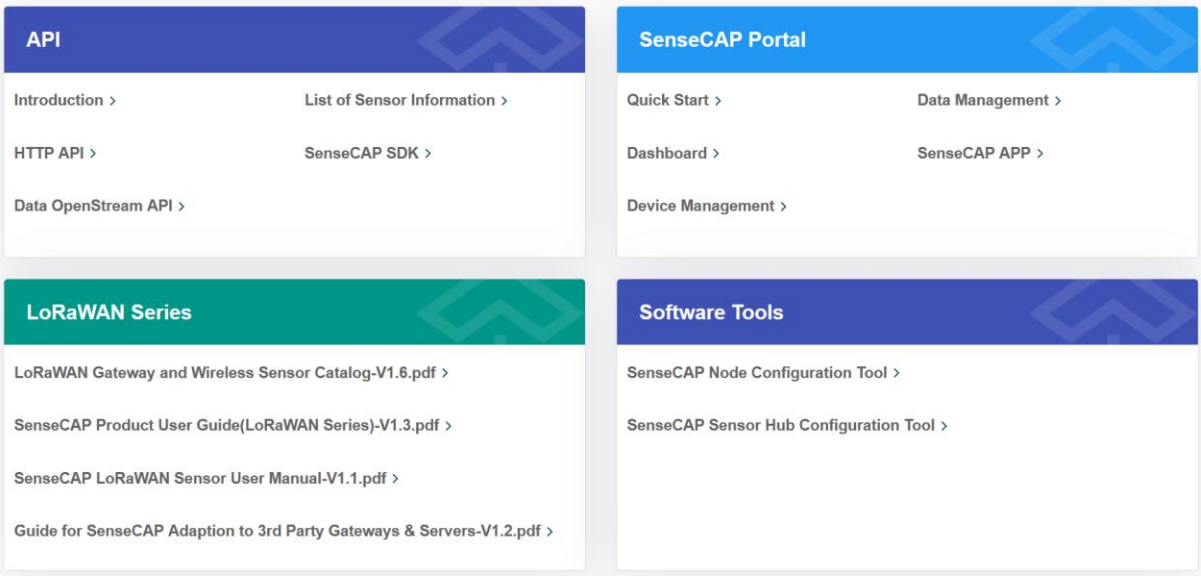
4.8 API Instructions

SenseCAP API is for users to manage IoT devices and data. It combines three types of API methods: HTTP protocol, MQTT protocol, and Websocket protocol.

- With HTTP API, users can manage all devices, to get RAW data or historical data.
- With MQTT API, users can subscribe to the sensors' real-time measurement data through the MQTT protocol.
- With Websocket API, users can get real-time measurement data of sensors through Websocket protocol.

For user guide of SenseCAP API, please refer to https://sensecap-docs.seeed.cc/introduction.html

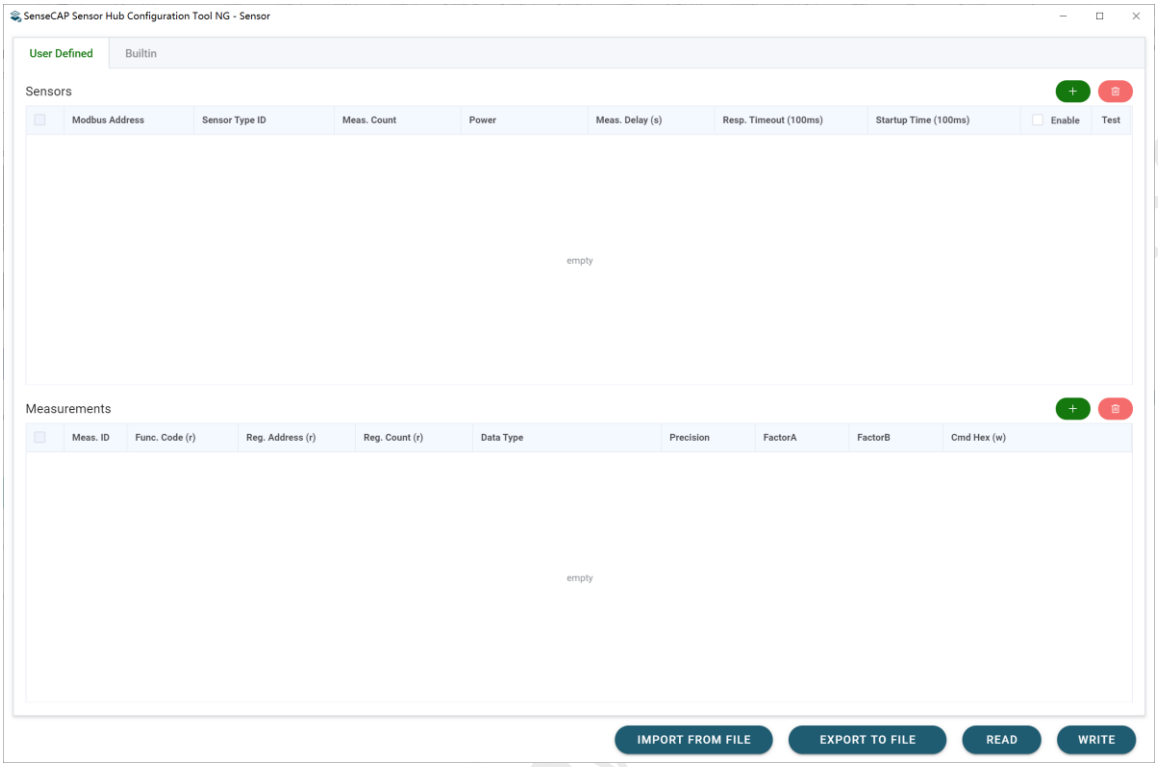


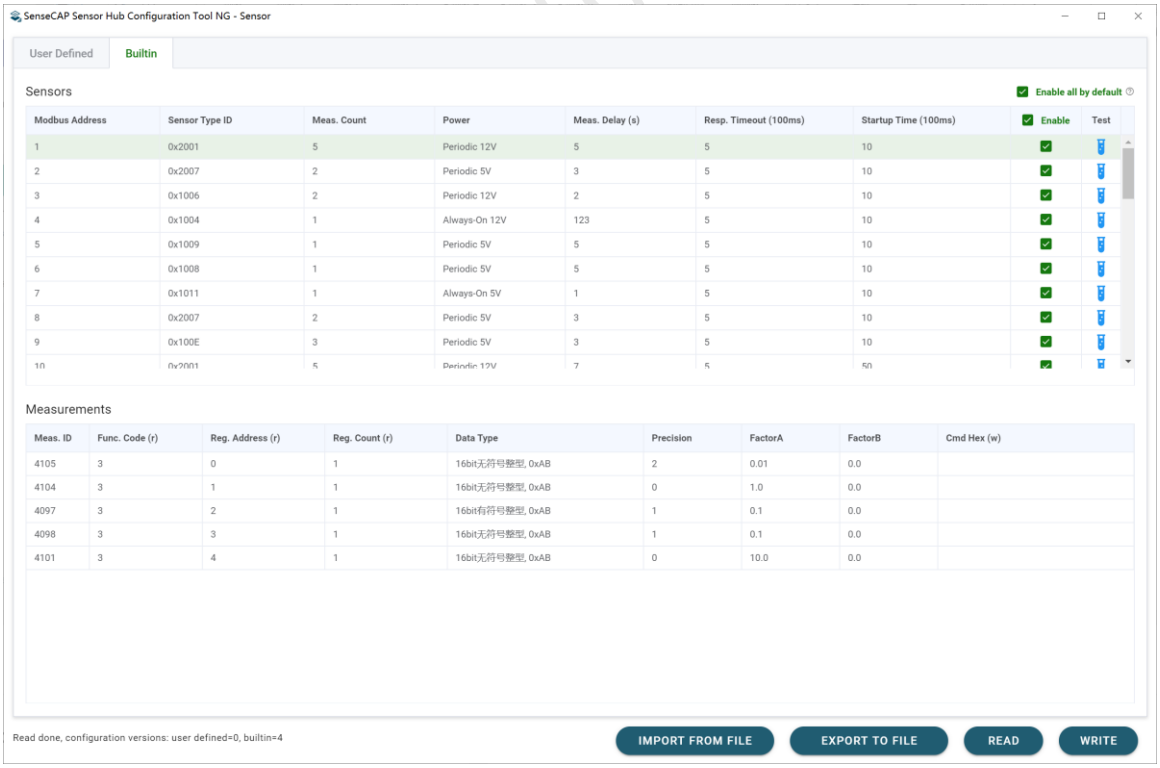


5. Add a Custom Sensor

After exiting the General Settings, press the device switch again to enter Sensor Settings.

Once you have entered the configuration interface, click Read to get the current device configuration information.





5.1 Sensor Categorization

As shown in the image, the sensors are divided into two categories: (1)"Custom sensors" and (2) "built-in support" sensors.

5.1.1 Custom Sensors

Sensor Hub Data Logger supports connecting to the standard Modbus-RTU sensors that meet the following specifications:

Access Protocol	Standard Modbus-RTU RS485 protocol
Modbus Address	[128， 254] (Decimal)
Function Code	03/04
Power Supply	5V or 12V
Working Mode	wake-up(Periodic) mode / normal constant power(Always-On) mode
Measurement Range	Formula: y = a*x + b (x is the measurement value). The values calculated according to the formula must be in the range of -20000000000 to +2000000000

5.1.2 Built-in-Support Sensors

Sensor Hub Data Logger has built-in configuration information for the SenseCAP Modbus-RTU RS485 sensors series (by default). And you can configure to enable or disable this function.
When connected to a SenseCAP Modbus-RTU RS485 sensor, users do not need any configuration, just plug and play. SenseCAP sensors are industry-standard sensors, suitable for outdoor applications scenarios such as agriculture, cities, industry, and more.

To choose the right sensors for your applications, please visit:
https://www.seeedstudio.com/Industrial-IoT-c-1556.html

5.2 Add a Custom Sensor (Example: Soil Temperature & Moisture Sensor)

5.2.1 Preparation

Prepare the sensor: Soil Temperature & Moisture sensor, 5V, Modbus address as 128.
Solder the aviation connector to the sensor: follow the wire number/sequence, and soler the aviation connector to the sensor .

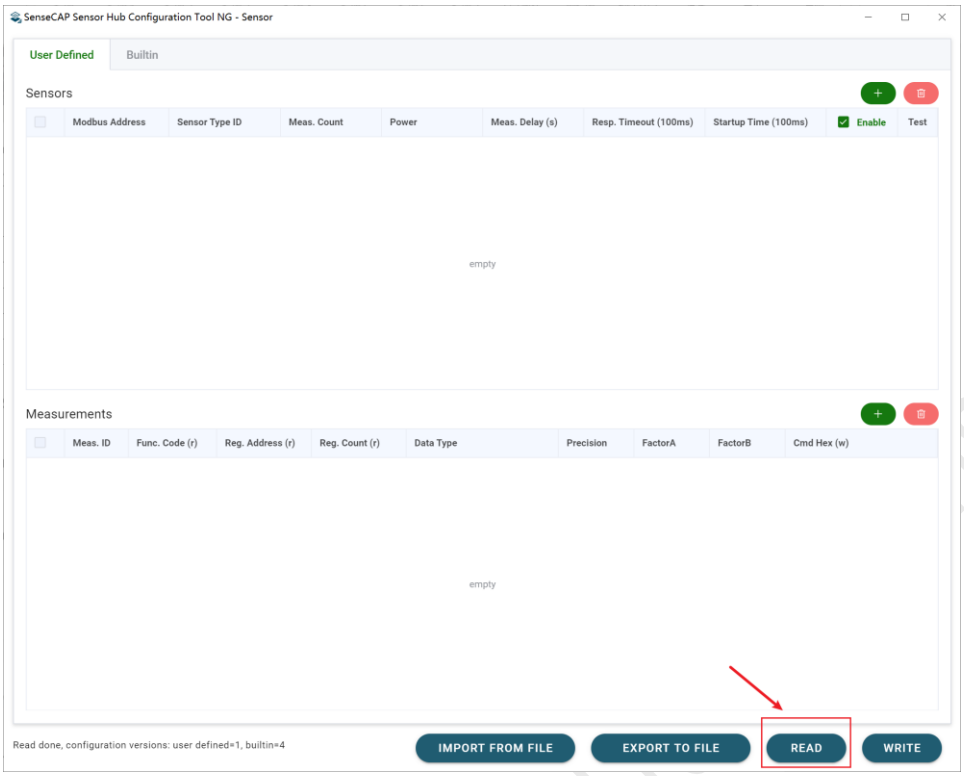
When connecting to a custom sensor, users need to solder the aviation connector to the sensor by following the wire number/sequence below. (contact us if you need to purchase the connector):

Aviation Connector Pin	Sensor Wire Pin	Description
1	12V	If the sensor is powered by 12v, connect this pin
2	5V	If the sensor is powered by 5v, connect this pin
3	RS485 A	-
4	RS485 B	-
5	GND	Ground

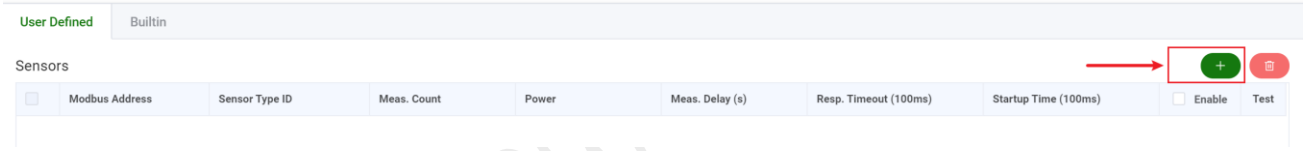
Connect to Sensor Hub: Plug the aviation connector into any port (1 to 4) on Sensor Hub Data Logger.

5.2.2 Configure Sensors' Basic Information

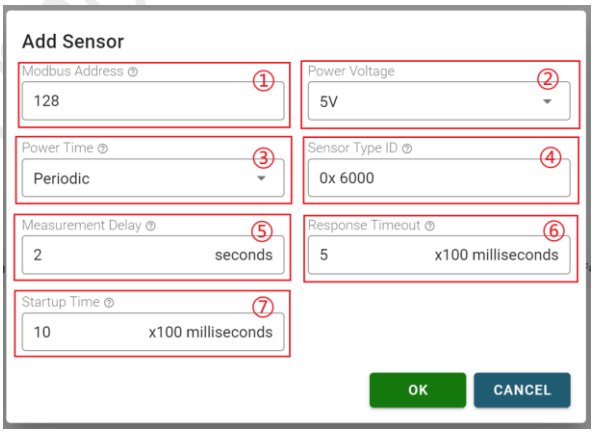
(1) Read the information.



(2) Click on "+", to add a new sensor



(3) Configure the sensor's basic information:



① Modbus Address: you can define the sensor's address in the range of [128, 254]. The chosen soil temperature and moisture sensor has been configured as 128, so enter 128 here.

② Power Voltage: Sensor Hub supports 12V and 5V power supply. The chosen soil temperature and moisture supports 5V power supply, so select 5V here.

③ Power Time:

Periodic: When Sensor Hub enters "Periodic" mode, the sensor's power supply is cut-off, and

resumes when it wakes up to collect data.

Always-On: The sensor is in constant power supply no matter Sensor Hub is in “sleep” or “wake-up” mode.

The soil temperature and moisture sensor does not require constant power supply, so choose " Periodic ".

Note:

1. Usually the device is " Periodic ", except for some special sensors, such as rain gauge, evaporation and other sensors need constant power supply.
2. Sensor Hub’s each port (1~4) can support access to sensors with the same Modbus address. However, it can only connect to **ONE** constant-power sensor with the same address. For example: for soil temperature and humidity sensors with address 128 (Periodic mode), you can connect 1 sensor to each port at the same time, hence a total of **four** soil sensors; For CO2 sensor with address 129 (Always-On mode), then only **ONE** CO2 sensor can be connected to Sensor Hub. If you need to connect more sensors of the same type, you need to modify the sensor address and add configuration information to Sensor Hub.

④ Sensor Type ID: The unique number of each sensor, which is the Hex type, with a valid range of [0x6000, 0x6150]. Here we set the soil temperature and moisture sensor to 0x6000.

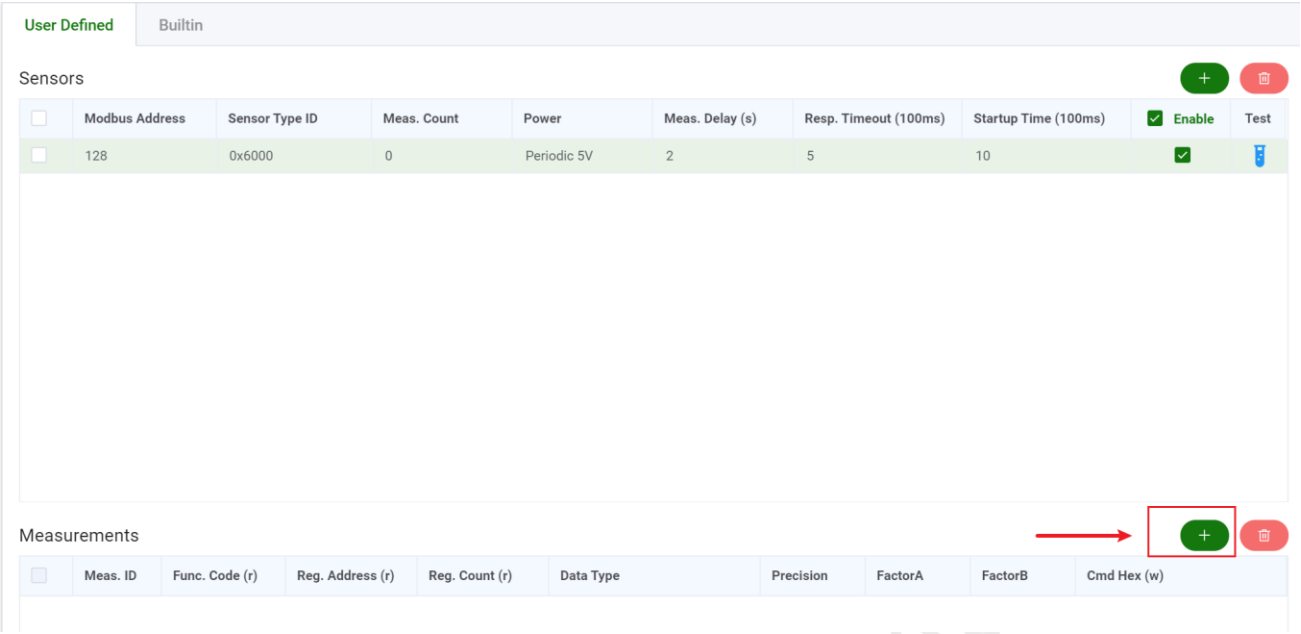
⑤ Measurement Delay: The length of time (in sec) from the time the sensor is powered on to the time it can obtain valid data.

⑥ Response Timeout: After Sensor Hub initiates a data read request to the sensor, it waits for the timeout time for a response. If this time is exceeded, the command will be resent; unit: 100 milliseconds.

⑦ Startup Time: The length of time the sensor can communicate from powered -on to communicating with Modbus, unit: 100 milliseconds.

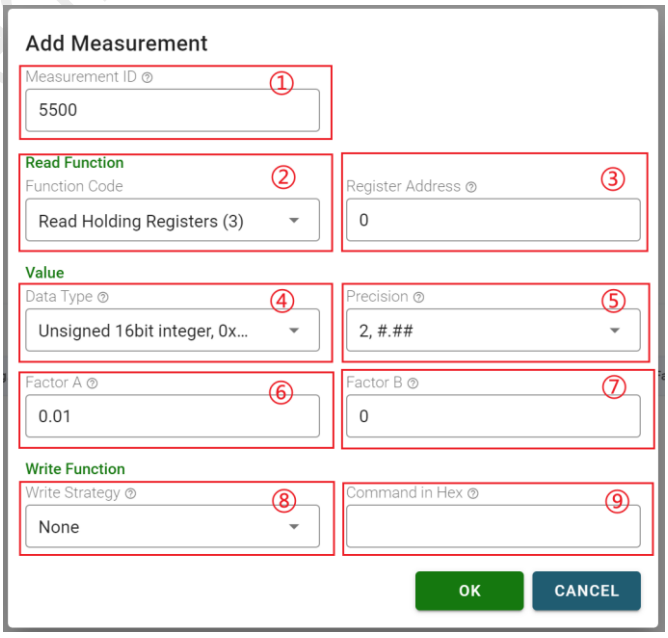
5.2.3 Configure Measurement Value

(1) Select Sensor, and in the list of measured values, click on the"+"



(2) Configure Measurement Value:

Measurement	Register Address (decimal)	Measurement Type	Modbus Function Code	Measurement Range and Description
Soil Temperature Value	0	INT16/ read-only	3	-4000- +8000 Divide by 100 to get the actual temperature value, 2 decimal places, unit: °C
Soil Moisture Value	1	INT16/ read-only	3	0-10000 Divide by 10000 to get the actual humidity value, 2 decimal places, unit: %

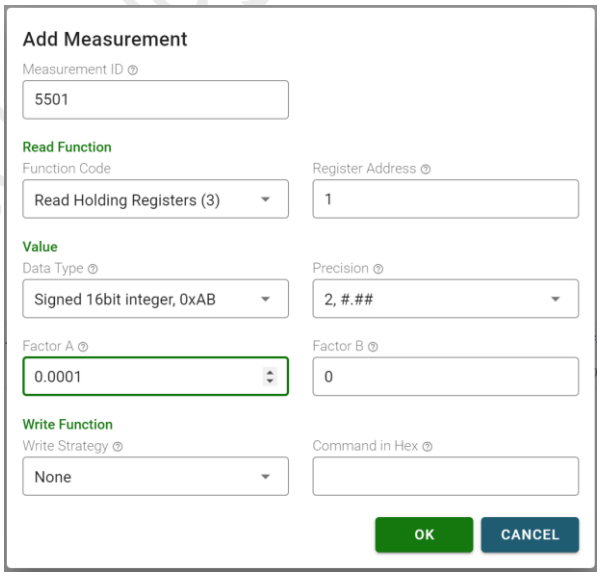


① Measurement ID: The unique ID of the sensor's custom measured value, the value is an integer, and the range is [5500, 5999] and [4097, 4099]. For example, set the ID of the measured value of soil temperature to 5500, that is, 5500 represents the value of soil temperature.
② Function Code: Modbus function code, supports 03 and 04 function code.
③ Register Address: The register address of the measured value in the sensor, which is an integer. For example, the soil temperature value register address is 0.
④ Data type: The data type determines the number of registers read from the sensor and how the data should parse the value. If the soil temperature and moisture is INT16, select "signed 16bit integer,0xAB".
⑤ Precision: The number of places of the acquisition value, affecting only the numeric output format, independent of parsing.
⑥ Factor A: The data will be parsed in the format of formula Ax + B, with both A and B as coefficients for single-precision floating points and x as measurements. If the value read from the temperature register is 2555, the actual value is 2555/100. A is set to 0.01, B is set to 0, and the actual value is (0.01, 25 55 ,0) according to formula A*x + B, the actual value is 0.01*2555+0 = 25.55 °C
⑦ Factor B: The data will be parsed in the format of formula A*x + B, with a single-precision floating point.
⑧ Write Strategy: Special types, such as rainfall, need to be written at a specific point in time: after reading zero or after the date changes (CST 00:00 per day).
⑨ Command in Hex: Once the writing strategy is determined, fill in the write command that needs to be executed, which is Modbus' HEX command string, which is "function code + data", for example, "06 00 00 00 00", the maximum support for command A is 10 bytes.

Measurements

Meas. ID	Func. Code (r)	Reg. Address (r)	Reg. Count (r)	Data Type	Precision	FactorA	FactorB	Cmd Hex (w)
5500	3	0	1	Signed 16bit integer, 0xAB	2	0.01	0.0	

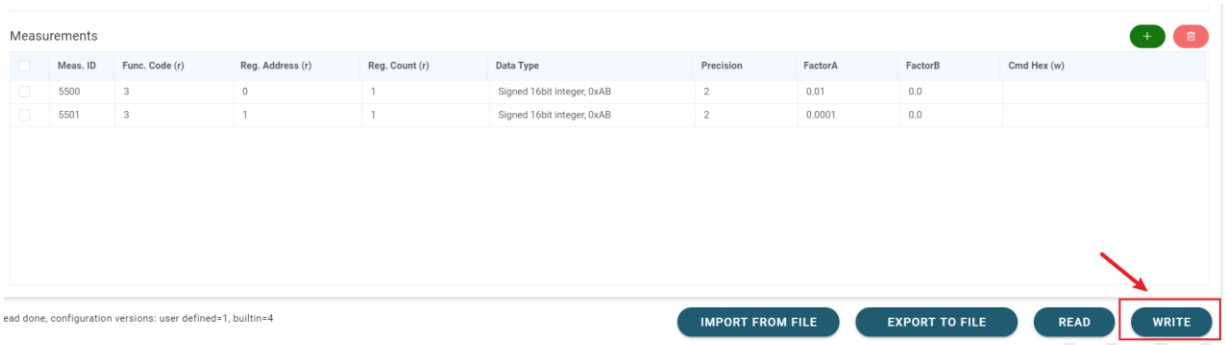
Following the above method, add a soil moisture value and set the measurement ID to 5501:



Measurements

Meas. ID	Func. Code (r)	Reg. Address (r)	Reg. Count (r)	Data Type	Precision	FactorA	FactorB	Cmd Hex (w)
5500	3	0	1	Signed 16bit integer, 0xAB	2	0.01	0.0	
5501	3	1	1	Signed 16bit integer, 0xAB	2	0.0001	0.0	

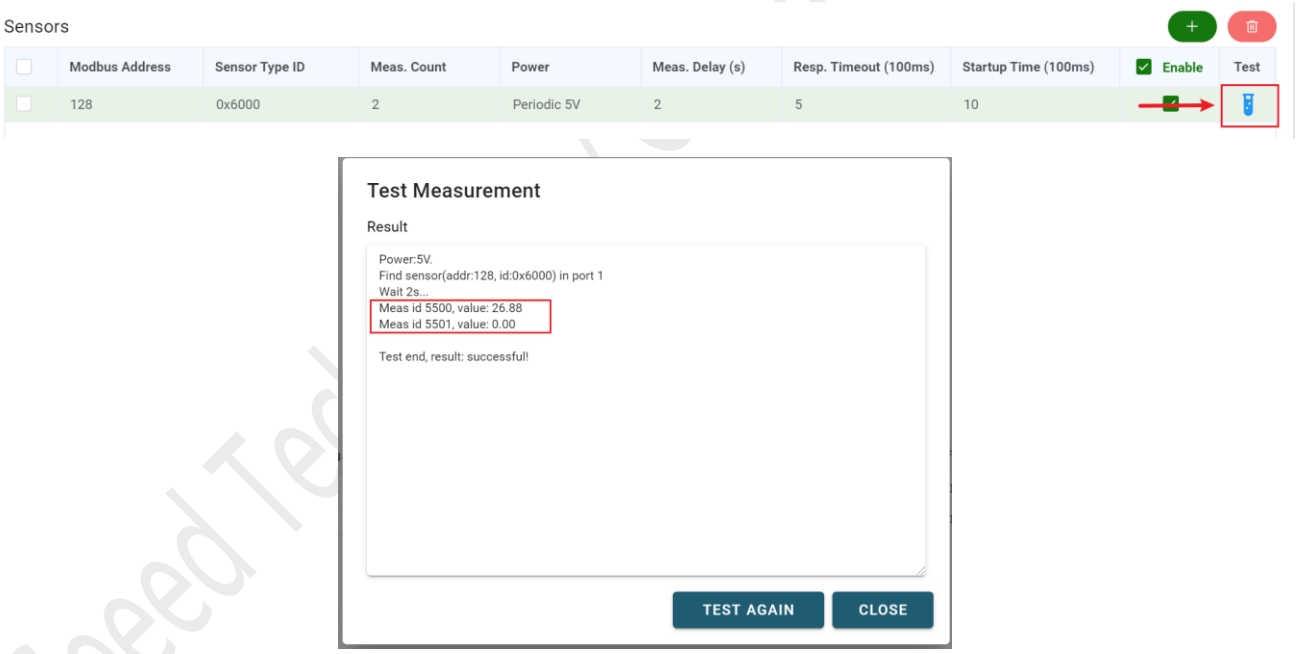
Note: After you have configured the parameters, be sure to click Write.



5.2.4 Sensor Test

Tip: After configuring the parameters, make sure that the sensor is connected to the device port before powering on. And if not, turn off the power and connect the sensor before re-entering the Sensor Configuration Interface.

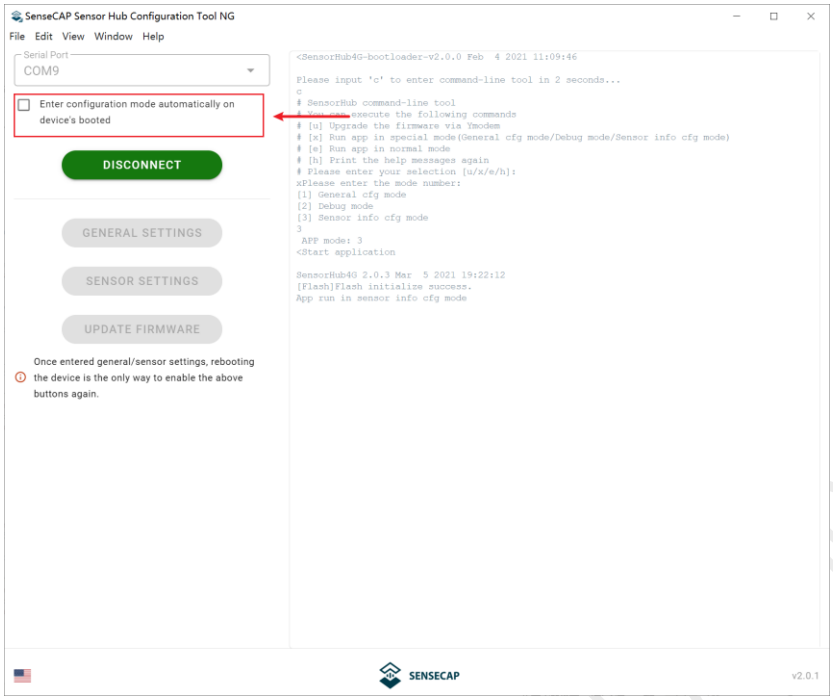
Click the test button to see the test results: 5500(soil temperature value) = 26.88, 5501(soil moisture) =0.00, and check if it is correct. If the values are abnormal, refer to the 7 section of the manual for analysis and debugging.



5.2.5 Check & Confirm Data's Upload to the Server

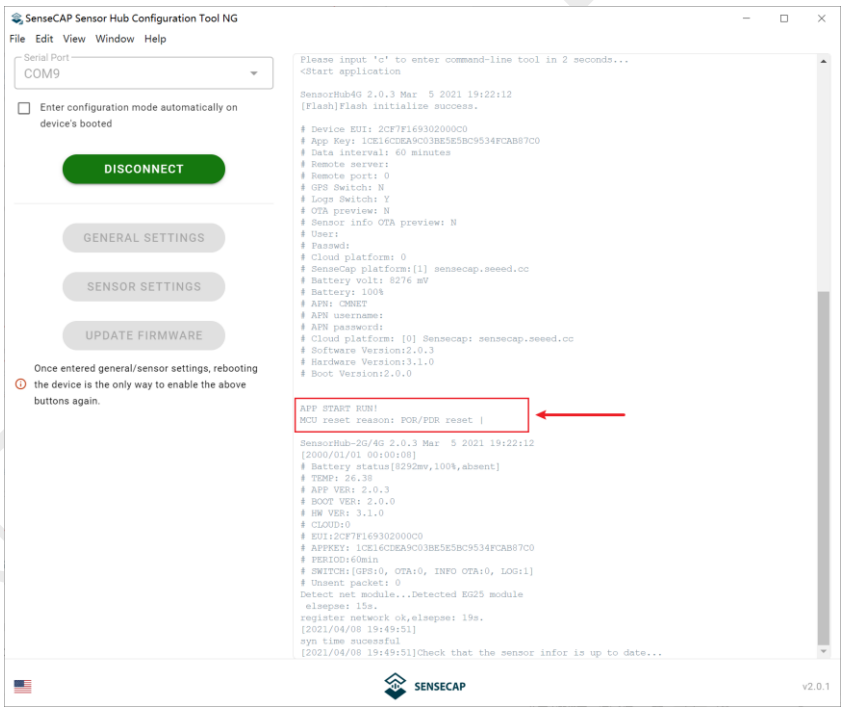
When finishing the testing on the software, turn off Sensor Hub and the Sensor Configuration Interface.

(1) Uncheck " Enter configuration mode automatically on device's booted " .



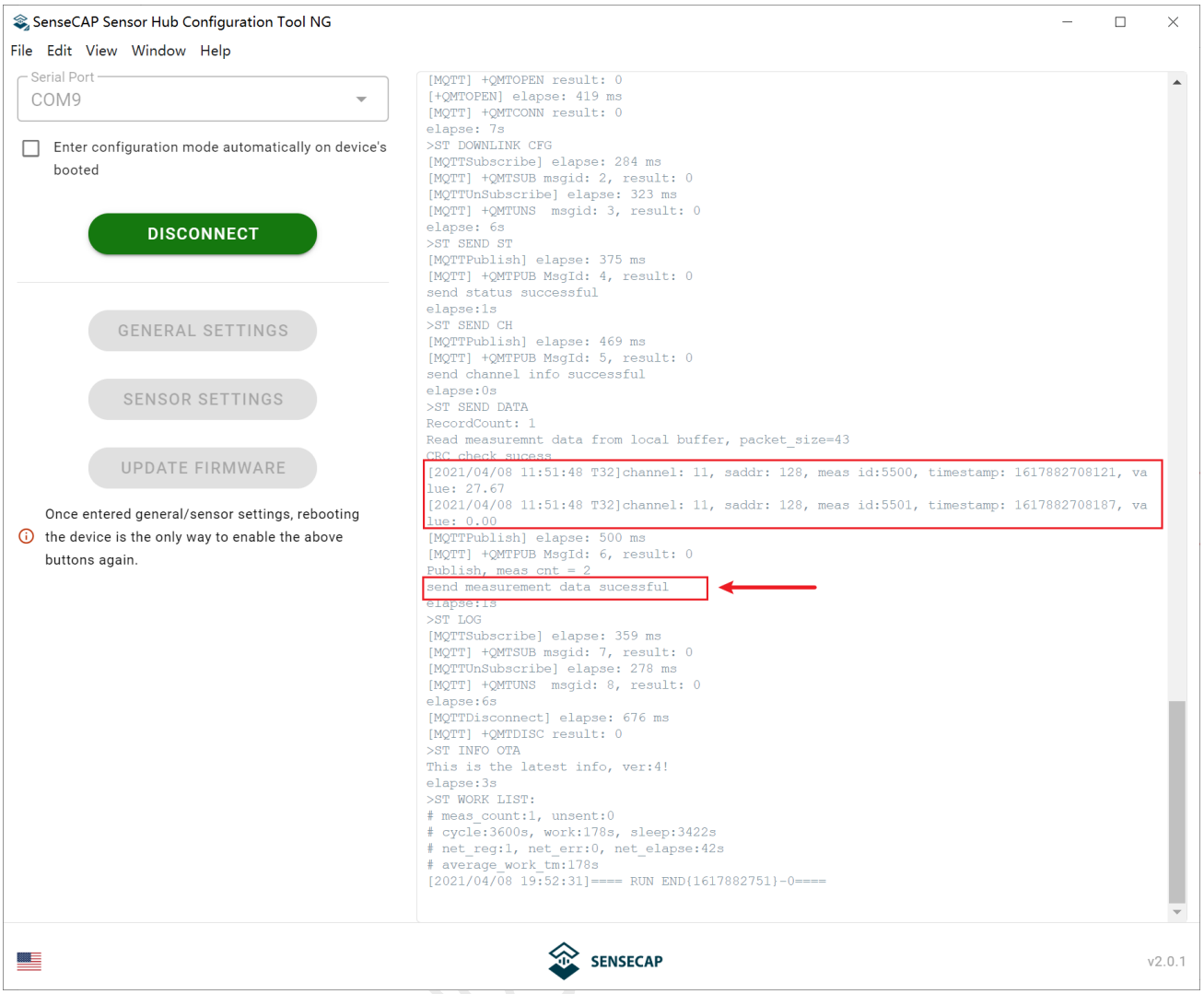
(2) Click "Disconnect" and then "Connect." Turn Sensor Hub back on and the device goes into working mode.

On the right side of the main interface, you can see the real-time running log.

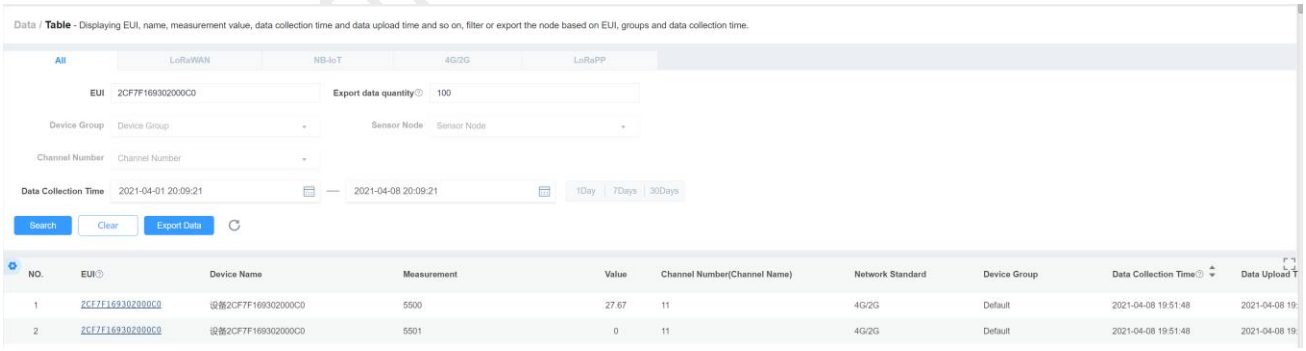


After the device is working for a while, you can see the actual data and send prompts.

For an explanation of the detailed log, you can view at the 7 chapter of Log Analysis.



Now you can view the data on the SenseCAP cloud platform or your own server and confirm that the data is uploaded correctly.

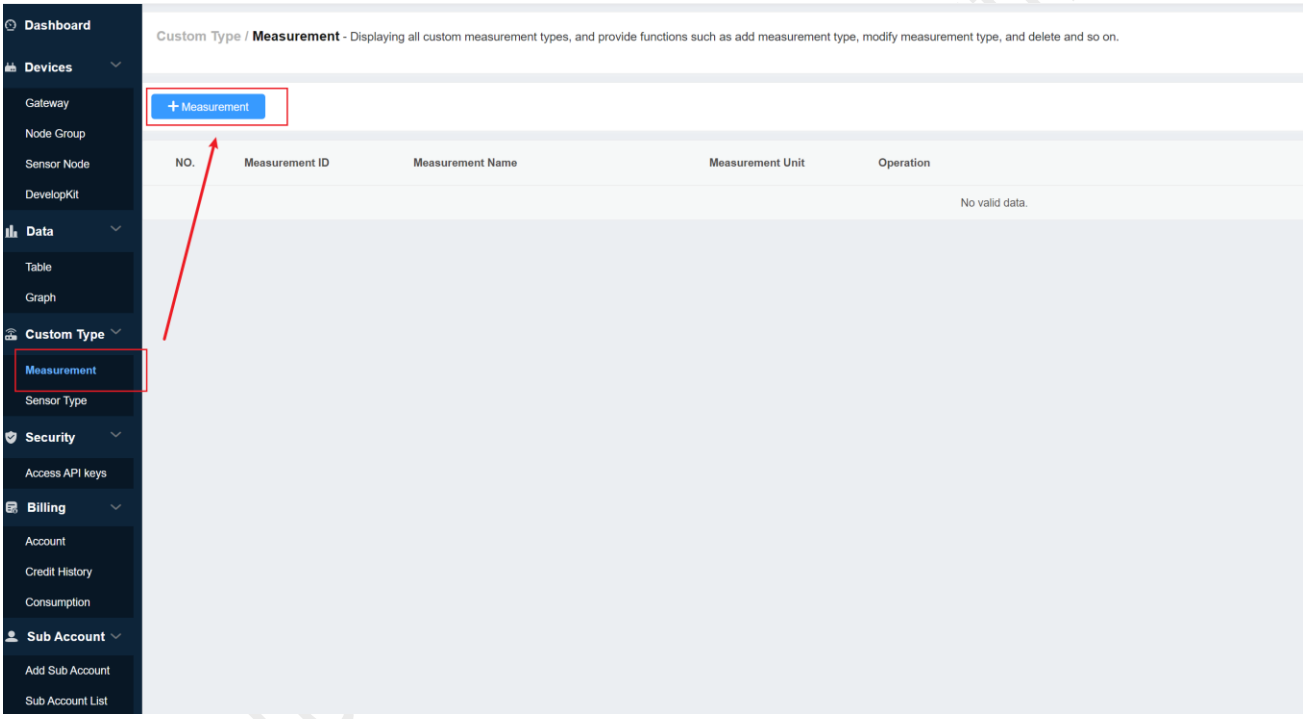


5.3 Add Custom Measurement Types and Sensor Type IDs to the SenseCAP Cloud Platform

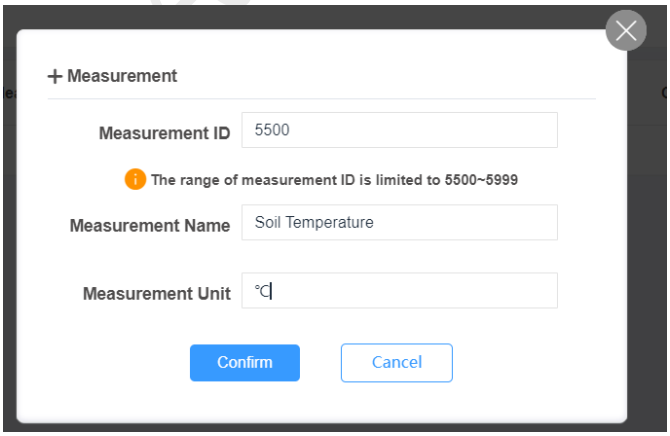
The measurement value ID and the sensor type ID are defined in the Sensor Hub Configuration Tool above. The cloud platform supports adding measurement type and sensor type ID for user's convenient management.

5.3.1 Add a Measurement Type

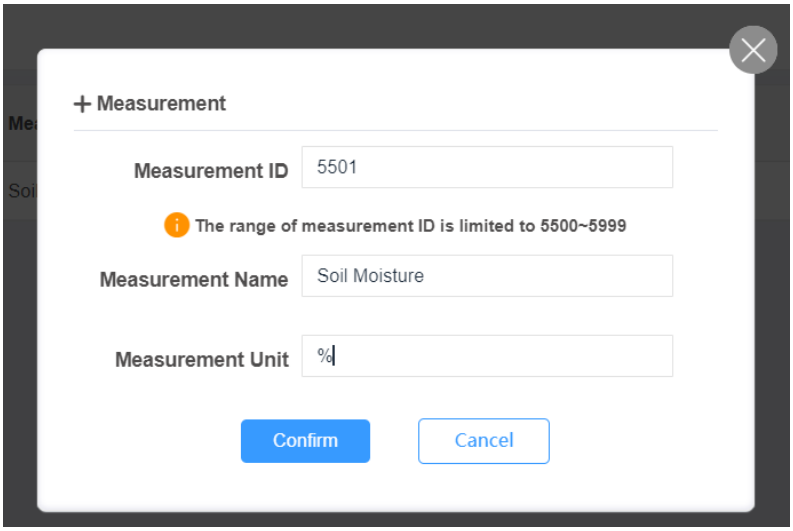
(1) Once you're on the cloud platform, click "Custom Type" in the left function bar, and then click "Measurement".



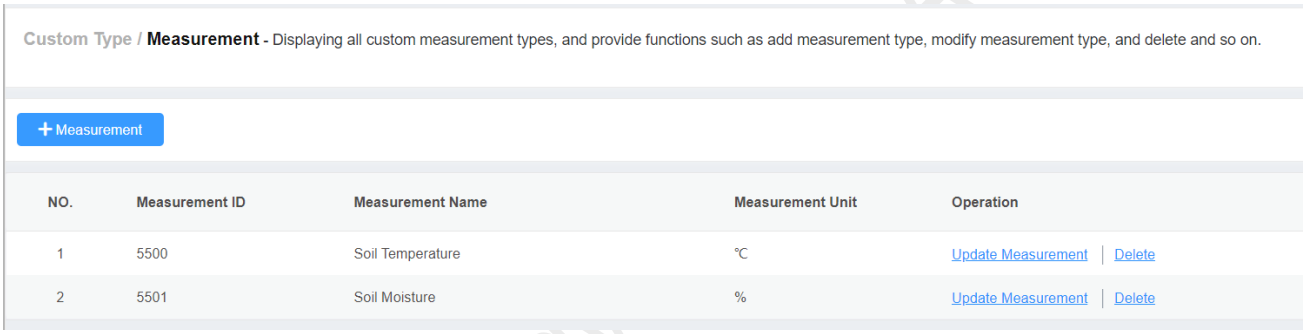
(2) In the case of soil temperature, for example, the soil temperature measurement ID is 5500, unit: °C



soil moisture measurement ID is 5501 and unit: %:

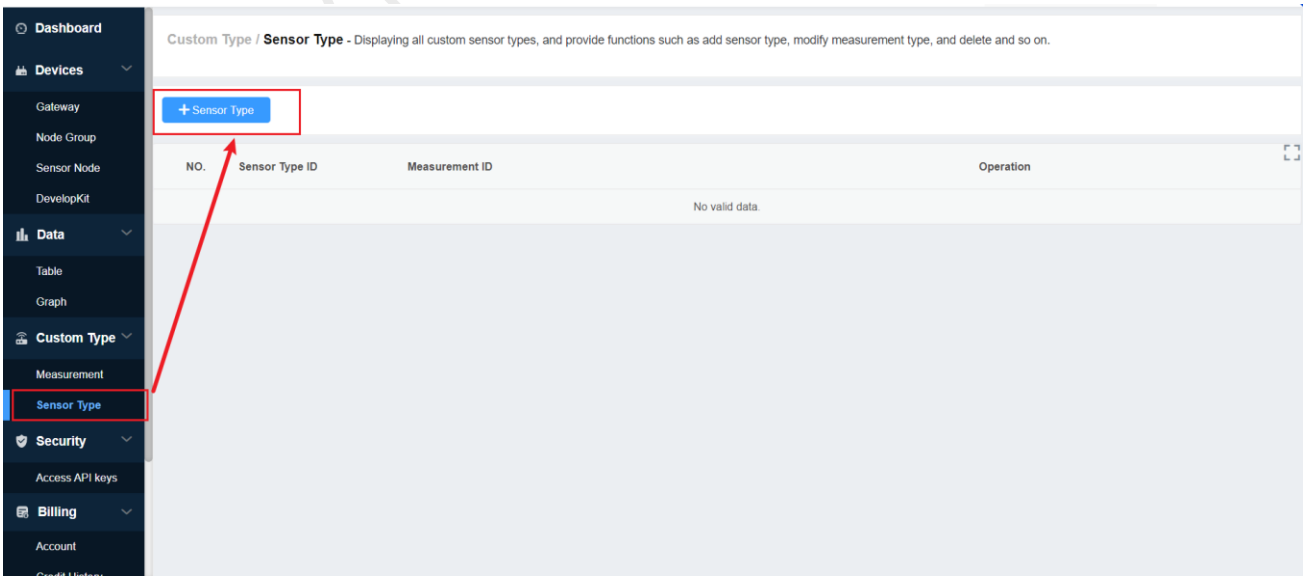


(3) Complete adding measurement type.



5.3.2 Add Sensor Type

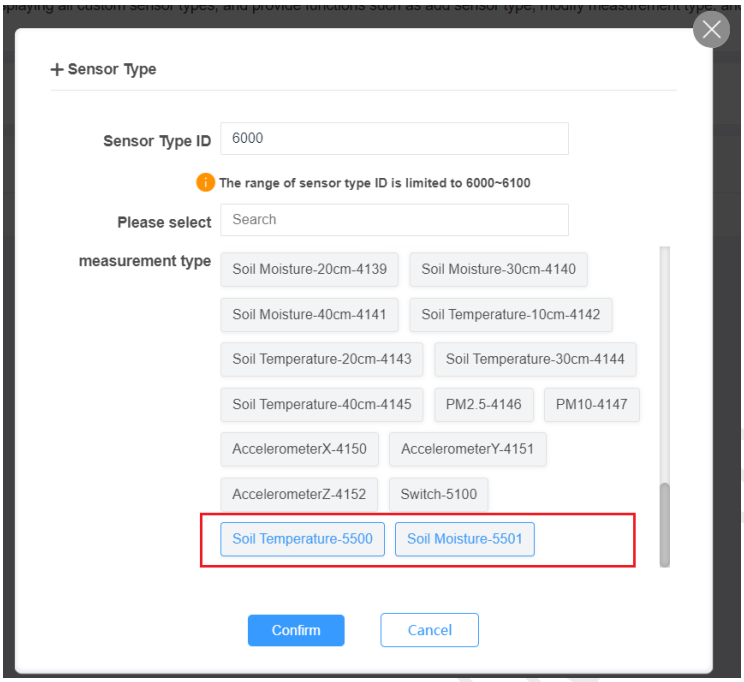
(1) Select the "Sensor Type".



The sensor ID of soil temperature and moisture is defined as 6000, the measurement value is soil

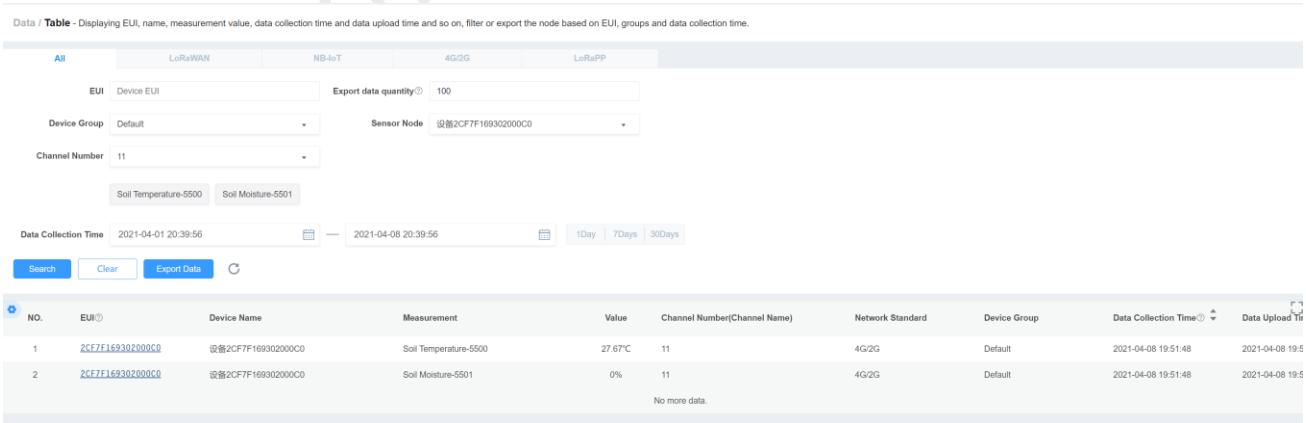
temperature 5500,soil moisture 5501;

Fill in sensor type ID:6000 and select the measurement (multiple options) in the list.



(2) Complete adding the Type IDs.

The measurement type, units, and so on are displayed for the added custom sensor.



6. Troubleshooting and Log Analysis

6.1 Common Abnormality Debugging

6.1.1 Abnormal Channel Status

A normal or abnormal channel is used to describe whether the RS485 physical link is working. That is:
(1) When communication timeouts occur for all measurements of a sensor, the channel is set to abnormal;
(2) When a sensor has at least one measured value that gets transmitted (no matter if it is an error code or data returned by the sensor), the channel status is normal

6.1.2 Error: No sensor found. Is the sensor connected

Debug from the following aspects:

- Make sure the sensor is connected to one of the four ports on Sensor Hub;
- Make sure the wire sequence (positive and negative / RS485 A, B) of the sensor wiring is correct;
- Make sure the sensor Modbus address is consistent with the address set in the Sensor Hub Configuration Tool;
- Make sure that the sensor power supply mode configuration is correct;
- Ensure that the warm-up time, start-up time and response timeout meet the sensor requirements;
- Check that the function codes and registers of the measurements are configured correctly;

6.1.3 Error: [ERROR] rs485 err code: XX XX

For some sensors that require a certain warm-up time, the sensor will return a function error code if it is not provided enough warm-up time before communicating actively.

When testing the sensor, firstly check the presence of the sensor. To check that you need to wait for the start-up time instead of waiting for the warm-up time. For example, the sensor startup time is 1s, and the warm-up time takes 5 minutes. After Sensor Hub powers on the sensor, it only takes 1s to communicate. In this case, you will receive a function code error. [ERROR] rs485 err code will appear in the window, and when collecting data, it will wait for the warm-up time before communicating to ensure that the right data can be obtained.

6.2 Log Analysis

The user can view the logs in the Sensor Hub's working mode through the Sensor Hub Configuration Tool. When abnormal activity occurs, it can be diagnosed through the log.

```
Enter working mode and print the hardware and software version:
<SensorHub4G-bootloader-v2.0.0 Feb 4    2021 11:09:46

Please input 'c' to enter command-line tool in 2 seconds...
<Start application

SensorHub4G 2.0.2 Mar 1    2021 19:23:12
[Flash] Flash initialize success.

Device Basic Configuration Information:
Device EUI: 2CF7F16924410088 / /Device Unique Code EUI
# App Key: 656A1B1A98EA1846037A1FA34A831572
Data interval: 5 minutes // data upload interval
Remote server: . . . / /IP domain name
Remote port: 0 / / port number
GPS Switch: N //GPS switch: N for off, Y for on, off by default
Logs Switch: Y / /Log Print:    N for Off, Y for On, On by default
OTA preview: N / / Remote firmware test switch: N for off, Y for on, off by default
Sensor info OTA preview: N // Remote information test switch: N for off, Y for on, off by default

User: / / username for the server, leave blank if not applicable
Passwd: / / Password for the user server, leave blank if not applicable
Cloud platform: 1 // Data upload server: 1 for Sense CAPcloud, 2 for user server, 3 for reservation
# SenseCap    platform:[0] sensecap.seeed.cn
Battery volt: 7236 mV // Built-in battery voltage
Battery: 56% // battery power

APN configuration information:
# APN: CMNET
# APN username: ***
# APN password: ***

# Cloud platform: [1] Sensecap: sensecap.seeed.cn

Hardware and software version:
# Software Version:2.0.2
# Hardware Version:3.1.0
# Boot Version:2.0.0

The application starts running
APP START RUN!
MCU reset reason: POR/PDR reset |

SensorHub-2G/4G 2.0.2 Mar 1    2021 19:23:12
[2000/01/01 00:00:03]
# Battery status[7268mv,57%,absent]
# TEMP: 24.88
# APP VER: 2.0.2
# BOOT VER: 2.0.0
```

```
# HW VER: 3.1.0
# CLOUD:1
# EUI:2CF7F16924410088
# APPKEY: 656A1B1A98EA1846037A1FA34A831572
# PERIOD:5min
# SWITCH:[GPS:0, OTA:0, INFO OTA:0, LOG:1]
# Unsent packet: 0
Detect net module... Detected EC25 module
  elsepse: 12s.
register network ok,elsepse: 14s. // Successful networking

[2021/03/08 17:04:07]
syn time successful // Synchronization time was successful

Check the list of sensor information
[2021/03/08 17:04:07] Check that the sensor infor    is up to date...
This is the latest info, ver:2!
================================
sinfo list: total:36 => [1,2,3,4,5,6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,24,25,26,27,28,29,30,31,32,33,34,35,36,37,128,]
En list: total:36 => [1,2,3,4,5,6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,24,25,26,27,28,29,30,31,32,33,34,35,36,37,128,]
```

```
Scan the channel information for the data collector:
Scan port: 1 //channel 1, Port 1 on Sensor Hub
[! Finds RS485 device    addr:128 in port1   // Discover the Modbus address of 128 sensor in channel 1
[! News Save new sensor    addr: 128 to channel 13    //    Store Modbus address 128 sensor in channel 13
================================
Scan port: 2
================================
Scan port: 3
================================
Scan port: 4

Constant-power Sensor information:
5V UPS num:0, 12V UPS num:0, list:
port1 UPS power:
port2 UPS power:
port3 UPS power:
port4 UPS power:


Channel usage status, the channel number is the main channel + sub-channel, the measured value of the sensor carries this numeric as the identification number
<Channel status
channel: 10, saddr:20,      sensorID:0x0000, status: IDLE   /channel 10 for primary channel 1, subchannel 0;
channel: 11, saddr: 130,    sensorID: 0x0000, status: IDLE
channel: 12, saddr: 131,    sensorID: 0x0000, status: IDLE
channel: 13, saddr:128,    sensorID:0x6000, status: NORMAL    // In channel 1 of the collector is connected to a sensor with address 128, sensor ID is 0x6000, in good condition
channel: 14, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 15, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 16, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 17, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 18, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 19, saddr: 0,    sensorID: 0x0000, status: IDLE
```

```
channel: 20, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 21, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 22, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 23, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 24, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 25, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 26, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 27, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 28, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 29, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 30, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 31, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 32, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 33, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 34, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 35, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 36, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 37, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 38, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 39, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 40, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 41, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 42, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 43, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 44, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 45, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 46, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 47, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 48, saddr: 0,    sensorID: 0x0000, status: IDLE
channel: 49, saddr: 0,    sensorID: 0x0000, status: IDLE
Finish RS485 scanning, elapse 102s.

Sensor Measurement Value
>ST MEASURE
2021/03/08 09:05:54 T32 channel:13, addr:128,    meas    id:5500, decimals: 2,value: 24.89    //channel 13, address
128,measurement ID    5500, two decimal places, value24.89
[2021/03/08 09:05:54 T32]channel : 13,    addr: 128,    meas    id:5501, decimals: 2,value: 0.00
ch: 13,    st:normal, timeout:0, abnormal:0,    data:valid
elapse:3s

Network information
>ST NETWORK
ICCID: 89860403102090527718    / /SIM card ICCID
[2021/03/08 17:05:55]
syn time sucessful
net rssi: -51    //network signal strength
Network latency: 92ms // network latency
>ST APP OTA
OTA elapse: 4s

Log information for communication with the server
>ST CONNECT SERVER
[2021/03/08 17:05:59]need get token
server_url: 39.108.230.236
server_port: 1883
```

```
[MQTT] +QMTOPEN result: 0
[+QMTOPEN] elapse: 319 ms
[MQTT] +QMTCONN result: 0
elapse: 5s
>ST DOWNLINK CFG
[MQTTSubscribe] elapse: 304 ms
[MQTT] +QMTSUB msgid: 2, result: 0
Can't receive config message
[MQTTUnSubscribe] elapse: 184 ms
[MQTT] +QMTUNS    msgid: 3, result: 0
elapse: 4s
>ST SEND ST
[MQTTPublish] elapse: 235 ms
[MQTT] +QMTPUB MsgId: 4, result: 0
send status successful
elapse:0s
>ST SEND CH
[MQTTPublish] elapse: 249 ms
[MQTT] +QMTPUB MsgId: 5, result: 0
send channel info successful
elapse:0s
>ST SEND DATA
RecordCount: 1
Read measuremnt    data from local buffer,    packet_size=43
CRC check sucess
[2021/03/08 09:05:54 T32]channel : 13,    saddr: 128,    meas    id:5500, timestamp: 1615194354797, value: 24.89
[2021/03/08 09:05:54 T32]channel : 13,    saddr: 128,    meas    id:5501, timestamp: 1615194354864, value: 0.00
[MQTTPublish] elapse: 260 ms
[MQTT] +QMTPUB MsgId: 6, result: 0
Publish, meas    cnt    = 2
Send measurement data successful // represents the successful sending of data to the server
elapse:1s
>ST LOG
[MQTTSubscribe] elapse: 139 ms
[MQTT] +QMTSUB msgid: 7, result: 0
[MQTTUnSubscribe] elapse: 178 ms
[MQTT] +QMTUNS    msgid: 8, result: 0
elapse:5s
[MQTTDisconnect] elapse: 236 ms
[MQTT] +QMTDISC result: 0
>ST INFO OTA
This is the latest info, ver:2!
elapse:3s
>ST WORK LIST:
# meas_count:1, unsent:0
# cycle:300s, work:146s, sleep:154s
# net_reg:1, net_err:0, net_elapse:23s
# average_work_tm:146s
[2021/03/08 17:06:17]= === RUN END{1615194377}-0====
```

7. Do's & Don'ts

7.1 Low Temperature Environment Precautions (MUST-READ for Built-in Battery Version).

Battery normal discharge temperature range: -20 °C to 60 °C
Battery normal charging temperature range:0 °C to 45 °C
Note that if the Sensor Hub you use has a built-in lithium battery, when powered by solar energy or a DC power adapter:
1) If the ambient temperature is below zero, the battery will stop charging and resume charging only when the temperature is higher than 0℃.

2) While it stops charging, if the battery is exhausted, the device cannot rely on the solar power or DC power to work. You need to wait for the ambient temperature to be higher than zero and the lithium battery is charged to a safe use level before the device can work.

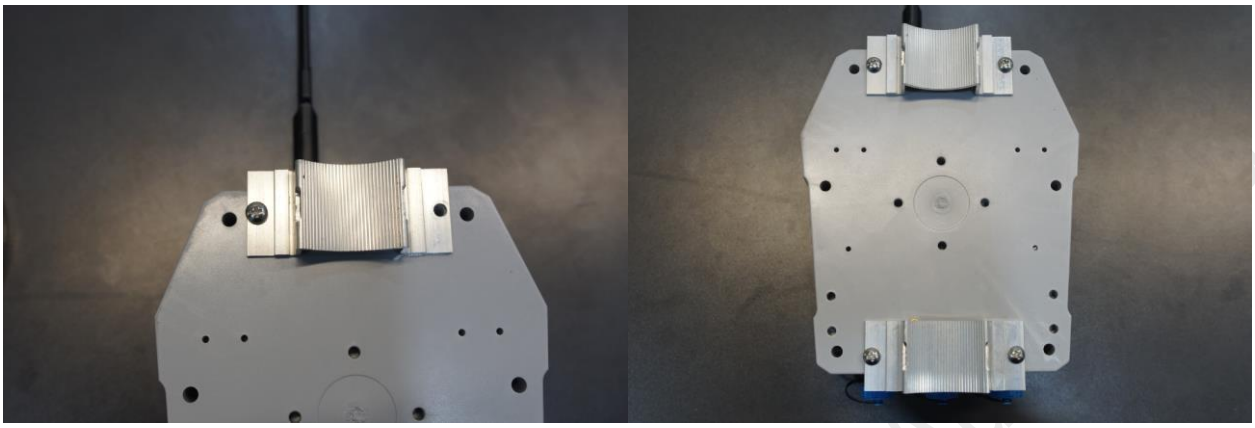
7.2 Aviation Connector Port Number (Wire Sequence)

When connecting to a custom sensor, users need to solder the aviation connector to the sensor by following the wire number/sequence below. (contact us if you need to purchase the connector):

Plug pin	Sensor line order	Describe
1	12V	If the sensor is powered by 12v, connect this pin
2	5V	If the sensor is powered by 5v, connect this pin
3	RS485 A	-
4	RS485 B	-
5	GND	Ground

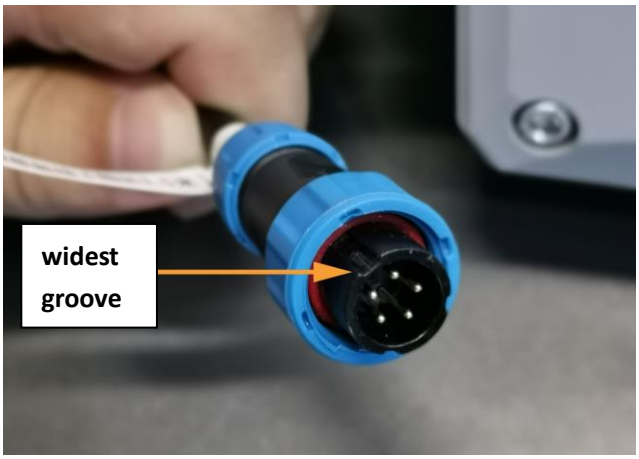
7.3 Installation Guide – Sensor Hub Data Logger

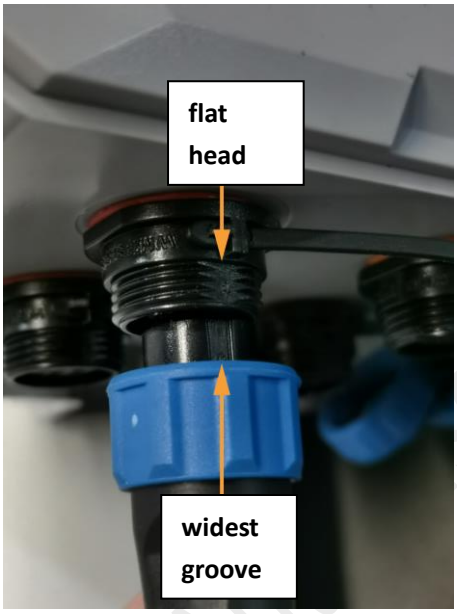
(1) Install the aluminum pads on the back of the data collector.



(2) Install the hoops and mount the collector to the pole.

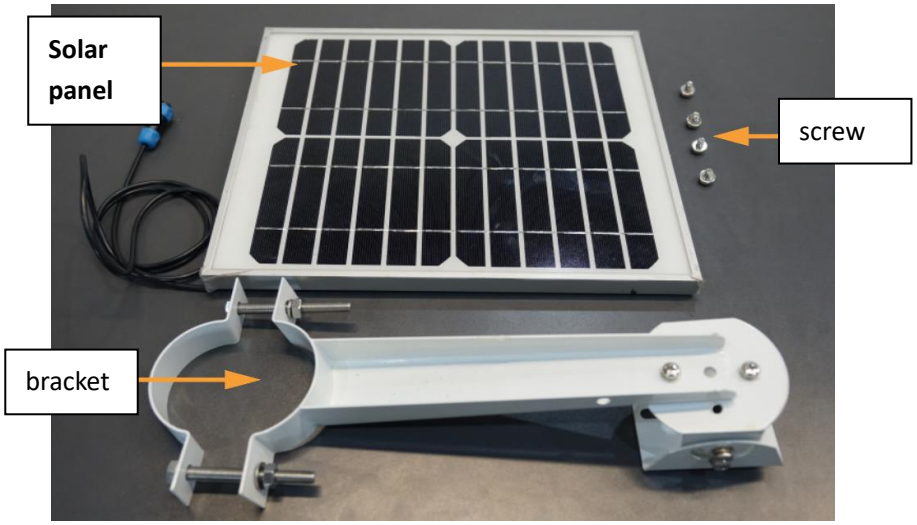
(3) When connecting the aviation connectors, align the **widest groove** on the male head to the position of **the flat head**, insert and tighten.



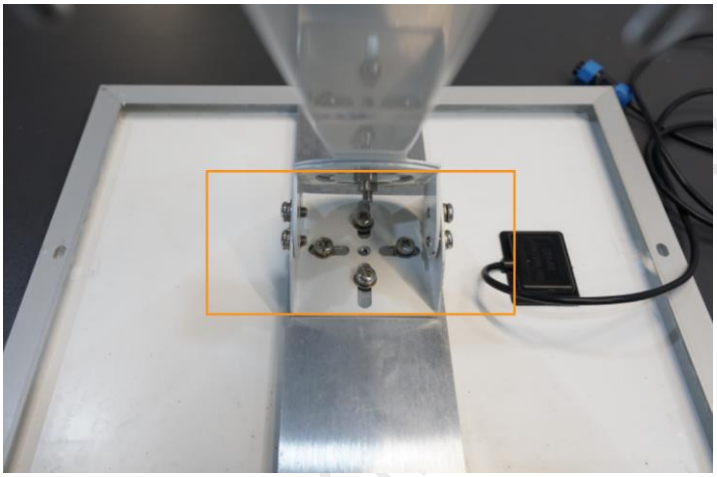


Note: If installing the devices outdoors for a long time, it is recommended to use a threaded tube to protect the exposed cables and increase their service life.

7.4 Installation Guide - Solar Panels



(1) Mount the bracket to the solar panel.



(2) Install the solar panel through the U-hoop of the bracket to the pole (recommended pole diameter 76mm).

Note:

1. Solar panels must face the direction which accumulates the strongest & longest duration sunlight in the day.
2. Do not have any shields around the solar panel.
3. Sensor Hub Data Logger is installed under the solar panel to reduce the impact of direct sunlight on the equipment and increase the life of the equipment.