



THE NEW GENERATION LORAWAN SENSORS OF SENSECAP

S2120 8-in-1 Weather Station User Guide

Version: v1.0.0



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1. Product Introduction

1.1 Introduction

The S2120 Weather Station monitoring Air Temperature, Humidity, Wind Speed/Direction, Rainfall, Light, UV Index, and Barometric Pressure measurements provides you with hyperlocal weather at your fingertips.

Perfect for home, office, or business use, this professional home weather station allows you to monitor your backyard weather conditions from anywhere. Protect your family, the house, and your garden with minutes updates in weather changes. Additionally, S2120 weather stations also support applications in agriculture, meteorology, urban environmental monitoring and other scenarios.

Smart and connected, the S2120 provides data on your phone, tablet, computer browser. We provide the SenseCAP Mate App, users can quickly view data via the App. We also provide SenseCAP Portal to manage your weather station through the Web page.

The S2120 is a standard LoRaWAN sensor that can be connected to any LoRaWAN gateway and service.

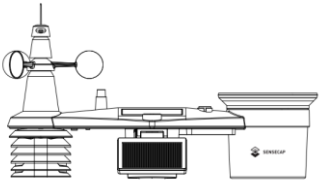
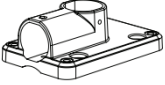

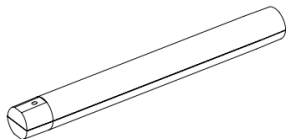
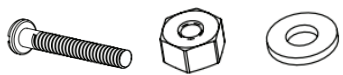

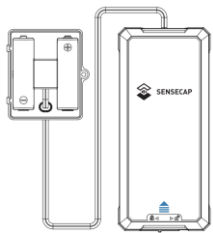
1.2 Quick Start Guide

Step	Description	Section
Step 1	Install the battery	4.4
Step 2	Download App and configure parameters	6.1, 6.3
Step 3	Connect to SenseCAP Portal	7
	Connect to Helium Console	8
	Connect to TTN Server	9



2. Part List

Before installing, please check the part list to ensure nothing is missing.

Picture	Name	Quantity
	Weather Station	1
	Pole mounting stand	1
	Mounting clamp	1
	Plastic pole	1
	Screw, Hex nut and Flat washer	4
	Screw and Hex nut	1
	External battery box (6*AA battery size, 2m cable)	1



3. Key Parameters of the Sensor

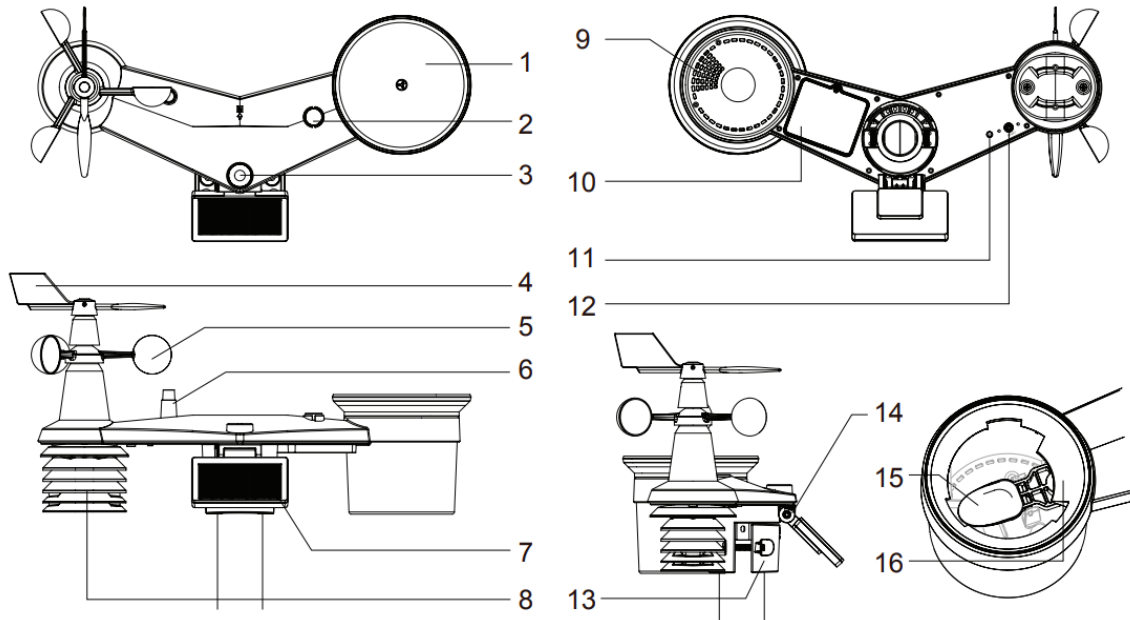
Using the LoRaWAN protocol generally involves the following parameters.

Parameters	Description
LoRaWAN MAC Version	v1.0.3
Join Type	OTAA (Default) ABP (It can be modified via App)
Device EUI	Unique identification of device, one of the join network parameters on OTAA mode. (It can be got via App)
Device Code (KEY)	On the device label, for device binding and API call.
App EUI	Unique identification of application, one of the join network parameters on OTAA mode. (It can be got via App)
App Key	Application key, one of the join network parameters on OTAA mode. (It can be got via App)
DevAddr	This parameter is available only in ABP mode, one of the join network parameters.
NwkSkey	This parameter is available only in ABP mode, one of the join network parameters.
AppSkey	This parameter is available only in ABP mode, one of the join network parameters.



4. Pre-Installation

4.1 Diagram



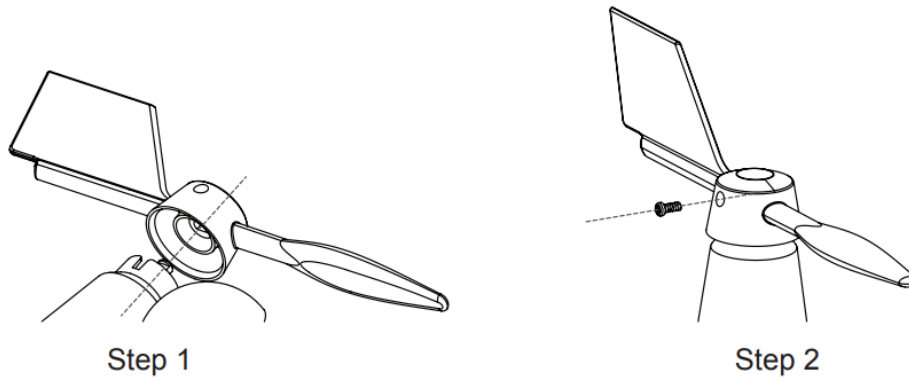
1. Rain gauge	9. Drain holes
2. Balance indicator	10. Built-in battery box
3. UV and Light Intensity sensor	11. Red LED indicator
4. Wind vane	12. Config button
5. Wind cups	13. Mounting clamp
6. Antenna	14. Adjustable hinge of solar panel
7. Solar panel	15. Tipping bucket
8. Radiation shield, temperature and humidity sensor, barometric pressure sensor	16. Rain sensor

4.2 Install the Wind Sensor

With reference to photo below, locate and align the flat are on the wind vane shaft to the flat surface on the wind vane and push the vane onto the shaft. Tighten the set screw with a

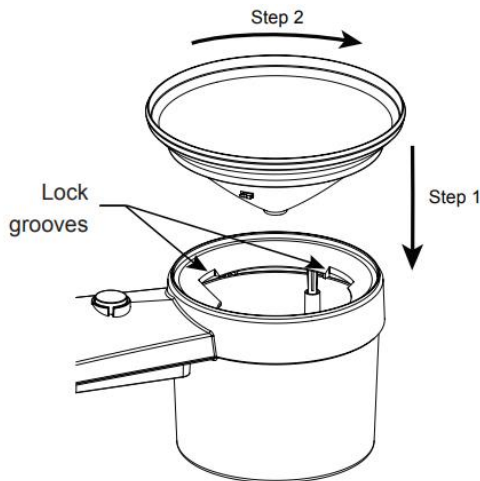


precision screwdriver.



4.3 Install the Rain Gauge

Install the rain gauge funnel and rotate clockwise to lock the funnel to the weather station.



4.4 Power Supply Mode

Weather stations do not contain batteries, so additional batteries are required.

The sensor is powered by a combination of solar panels and batteries. When the solar panels are working, the device is powered by the solar panels; When solar energy is low, it is powered by batteries.

Different types of batteries affect the operating temperature range of the sensor. In addition, Different number of batteries determines the battery life of the sensor.



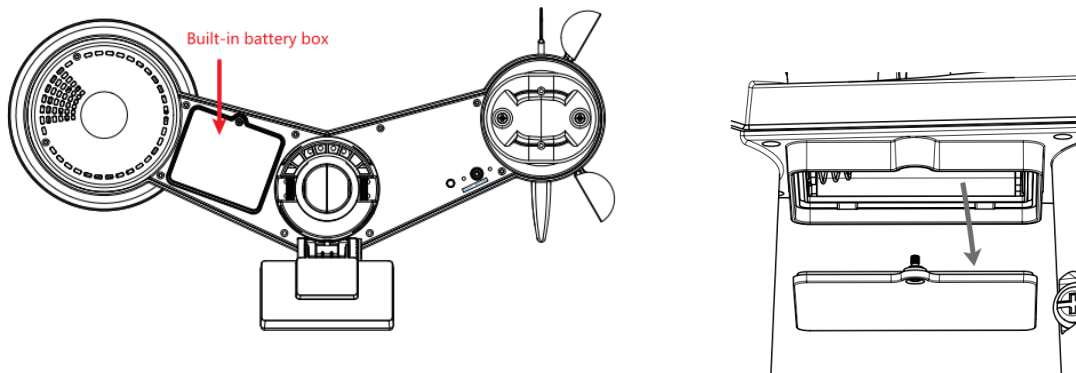
Battery schemes	Advantage and disadvantage
3 * 1.5V AA alkaline battery, built-in battery box	The operating temperature of the sensor depends on the operating temperature of the battery. If the alkaline battery is used, the operating temperature range is -20 ~ 60°C.
3 * 1.5V AA Lithium battery, built-in battery box	If the alkaline battery is used, the operating temperature range is -40 ~ 60°C.
6 * 1.5V AA alkaline battery, external battery box	It will last twice as long as 3 x batteries.
6 * 1.5V AA alkaline battery, external battery box	It will last twice as long as 3 x batteries.

⚠ Note:

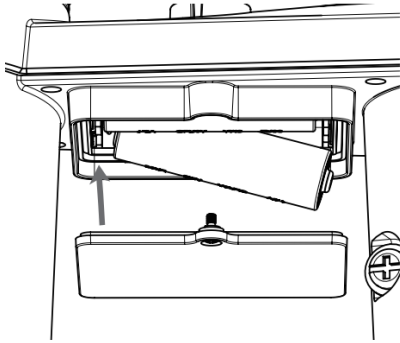
The battery box does not have the charging capability. Therefore, non-rechargeable batteries are recommended. If you choose a rechargeable battery, you need to take out the battery and charge it separately after the battery is exhausted.

4.4.1 Install the battery with built-in box

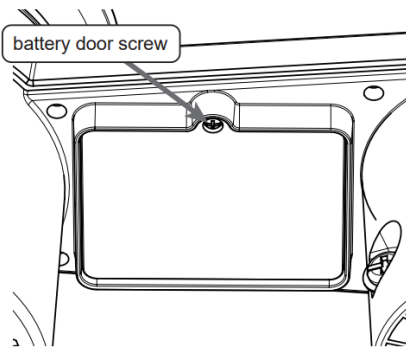
Step 1: Unscrew the battery door at the bottom of weather station.



Step 2: Insert the 3 AA batteries according to the +/- polarity indicated. Then close the battery door.

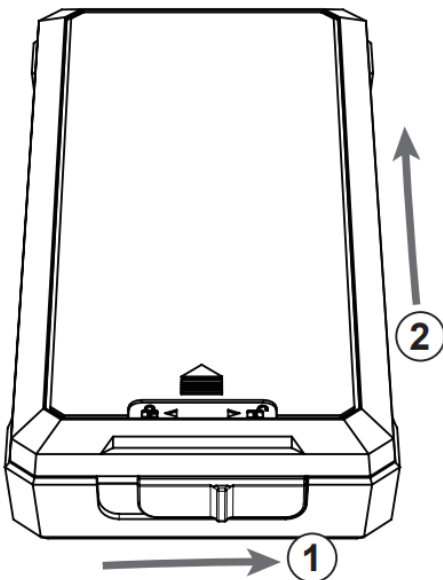


Step 3: Tighten the battery door screw. Once the installation completed, the red LED indicator at the bottom of the weather station will be flashing.

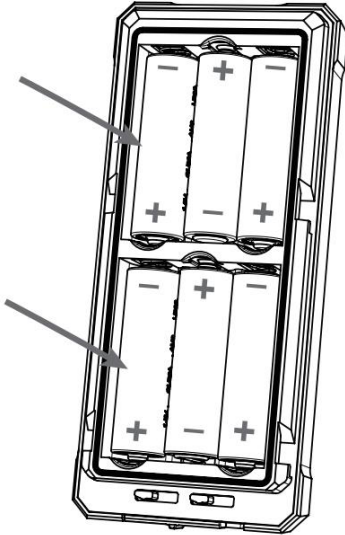


4.4.2 Install the battery with external box

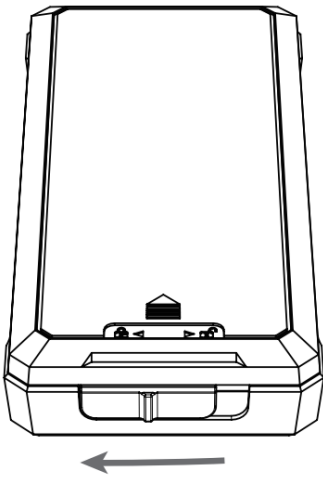
Step 1: Slide the battery box lock switch to unlock position. Push to open the battery box door according to the arrow direction.



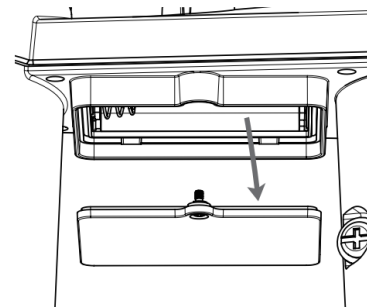
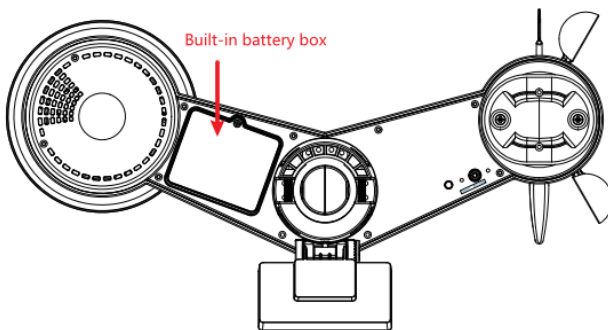
Step 2: Insert the 6 AA batteries according to the +/- polarity indicated.



Step 3: Place and lock the battery box door.

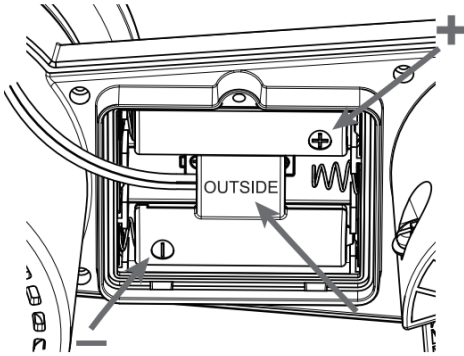


Step 4: Unscrew the battery door at bottom the of weather station.





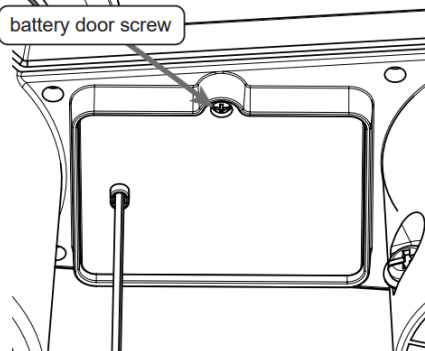
Step 5: Insert the dummy battery to the battery compartment, make sure the “OUTSIDE” marking faces outside and the +/- polarity in correct orientation.



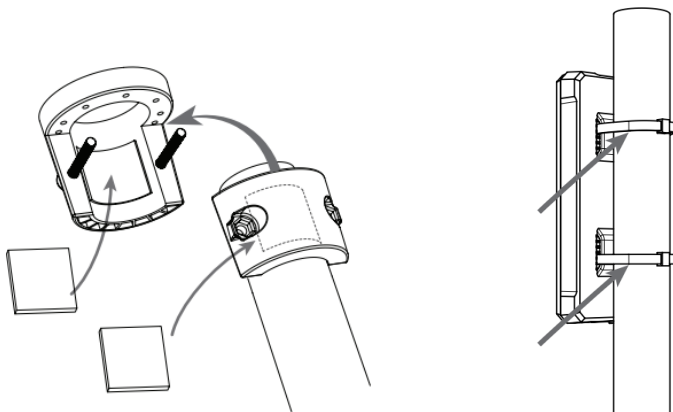
Step 6: Replace with the battery door which come along with the external battery box, then tighten the battery door screw. Once the installation completed, the red LED indicator at the bottom of the weather station will be flashing.

⚠ Note:

If the dummy battery is not installed in correct orientation, battery power connection will be failure and the LED indicator will not be flashing.



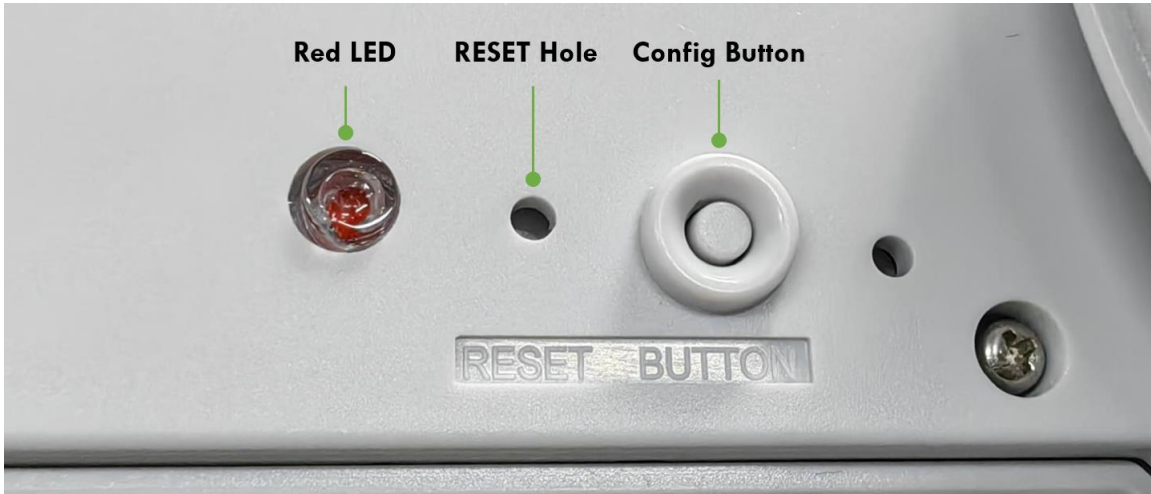
Step 7: Use the cable ties to mount the battery box onto the mounting pole.





5. LED of Sensor Working Status

At the bottom of the weather station are buttons and indicators:



You can refer to the LED indicator for the Sensor for its working status. Please see the status explanations in the chart below:

Actions	Description	Green LED Status
Install the battery, power on for the first time	Power on and activate the Bluetooth	The red LED light will be on. It needs to connect Bluetooth and configure the frequency.
Press "config button" once	Reboot device and join LoRa network	<ol style="list-style-type: none"> 1. Waiting for join LoRa network: the led breathing light flashing 2. Join LoRa network success: LED flashes fast for 2s, then go out 3. LoRa network join failure: LED will always breathe flashing
Press "config button" and hold for 3s	The sensor will be restored to factory Settings	LED flashes fast for 3s

Note:



After the battery is installed for the first time, you must connect the Bluetooth and configure the frequency to join LoRaWAN network and work normally. If the frequency is not set, the red LED is steady on.



6. SenseCAP Mate App

6.1 Download App

As a tool, SenseCAP Mate App is used to config LoRa parameters, set interval, bind devices to your account and check device basic information.

- (1) For iOS, please search for “SenseCAP Mate” in the App Store and download it.



Download SenseCAP Mate App

- (2) For Android, please search for “SenseCAP Mate” in the Google Store and download it.

You can also download App from <https://www.pgyer.com/sensecapmate>



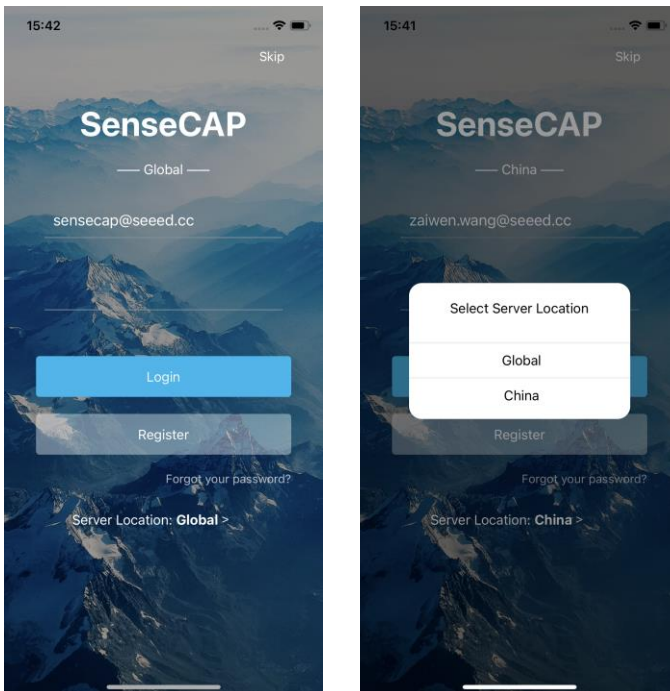
6.2 How to connect sensor to App

6.2.1 Create a New Account

SenseCAP Mate supports device configuration and remote management. To use the SenseCAP Portal platform and other functions, please register an account.

SenseCAP Mate supports offline functionality, and you can opt out of an account if you only use the configuration sensor. Just click **Skip**.

Please select **Global** of Server Location.



You can also create an account via the SenseCAP Portal: <http://sensecap.seeed.cc>

- 1) Select register account, enter email information and click "register", the registered email will be sent to the user's mailbox.
- 2) Open the "SenseCAP..."Email, click the jump link, fill in the relevant information, and complete the registration.
- 3) Return to the login interface and complete the login.

 **Note:**

If you can't find the email, it may be automatically identified as "spam" and put in the "trash can".



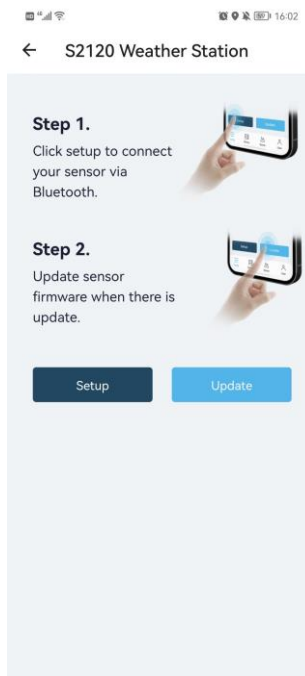
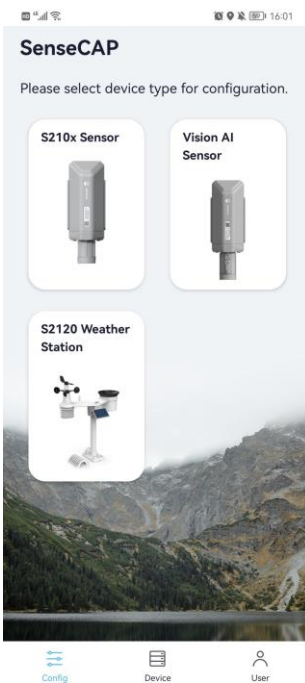
6.2.2 Connect to Sensor to App

- 1) After the battery is installed, the red LED will be steady on. Also activate Bluetooth.

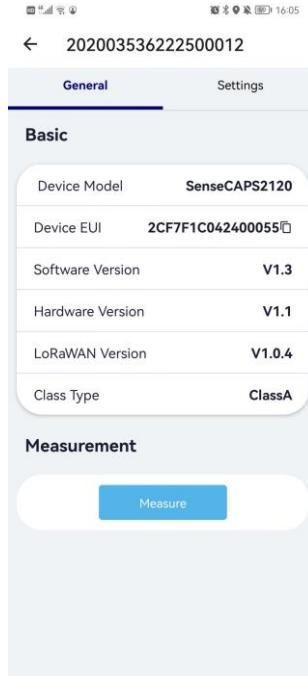
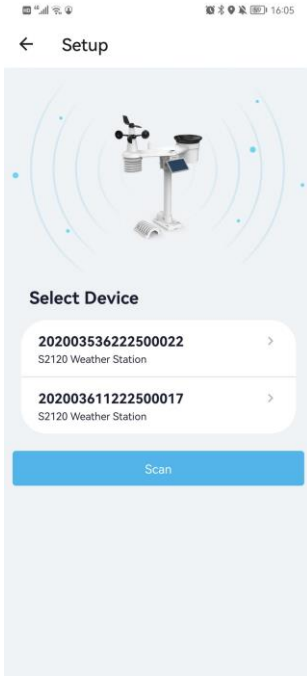


- 2) Please select "S2120 Weather Station".

Please click the "Setup" button to turn on Bluetooth and click "Scan" to start scanning the sensor's Bluetooth.



- 3) Enter the pairing password. **The default password is 000000.**
- 4) Select the Sensor by BT ID (BT ID is on the bottom label of the sensor). Then, the basic information of the sensor will be displayed after entering.

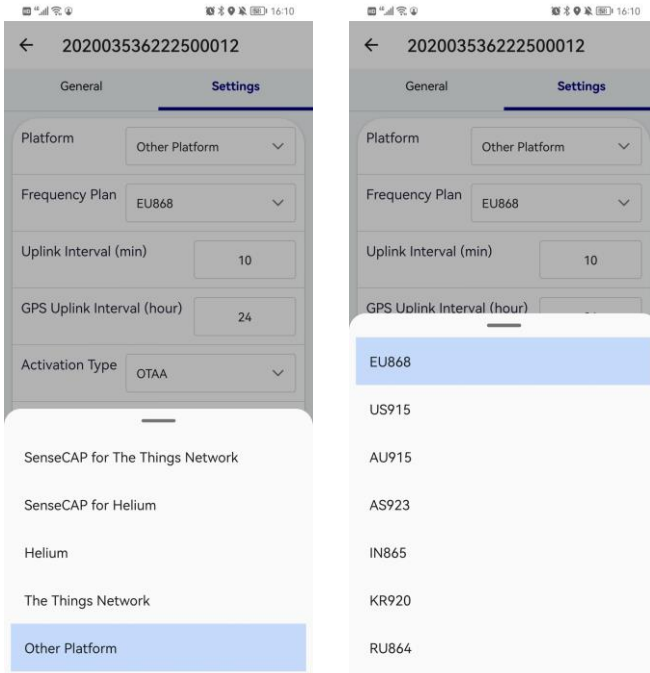




6.3 Configure parameters through App

6.3.1 Select the Platform and Frequency

S2120 weather stations are manufactured to support universal frequency plan from 863MHz ~928MHz in one SKU. That is to say, every single device can support 7 frequency plans.



Platform	Description
SenseCAP for The Things Network	Default platform. It must be used with SenseCAP Outdoor Gateway (https://www.seeedstudio.com/LoRaWAN-Gateway-EU868-p-4305.html). SenseCAP builds a proprietary TTN server that enables sensors to be used out of the box when paired with an SenseCAP outdoor gateway.
SenseCAP for Helium	When there is the Helium network around the user, data can be uploaded using sensors. Devices run on a private Helium console of SenseCAP. Users do not need to create devices on Helium console, right out of the box.
Helium	Connect Sensor to public Helium console.
The Things Network	Connect Sensor to your TTN(TTS) server.
Other Platform	Other LoRaWAN Network Server.



1) SenseCAP for Helium:

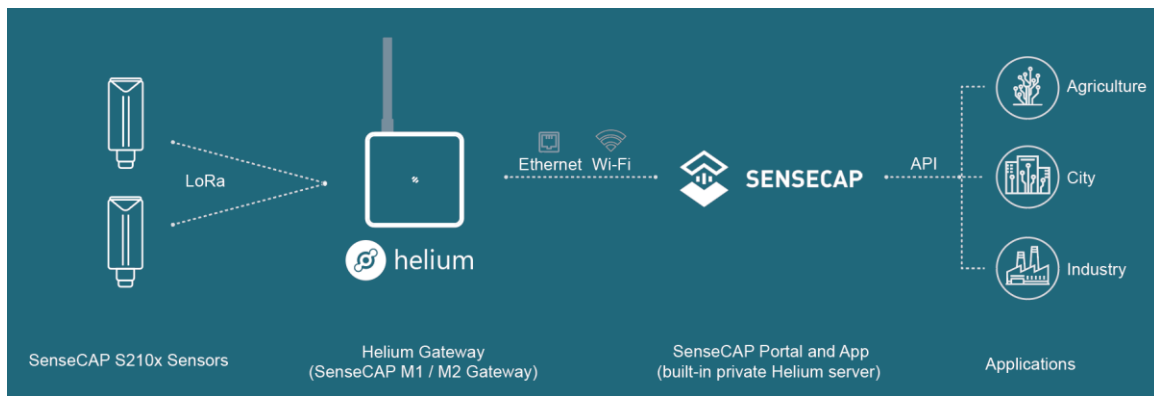
We provide the SenseCAP Portal to manage devices and data: sensecap.seeed.cc

We built a private Helium Console with an embedded SenseCAP Portal. When users get the SenseCAP sensors, you can use it by scanning the code and binding it to the Portal.

“SenseCAP for Helium” is selected by default. The device runs in a fixed main frequency and sub-band, refer to Helium Frequency Plan (<https://docs.helium.com/lorawan-on-helium/frequency-plans/>). You only need to select the main frequency, such as EU868 and US915.

SenseCAP for Helium supports the following frequency plan:

EU868 / US915 / AU915 / KR920 / IN865 / AS923-1 / AS923-2 / AS923-3 / AS923-4



2) SenseCAP for The Things Network

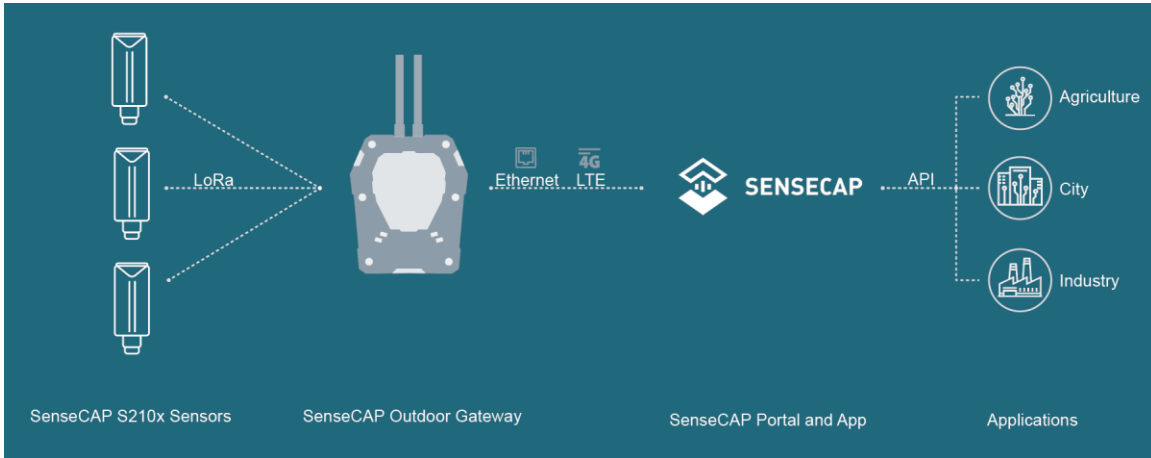
SenseCAP Portal also builds the TTN private server, and the sensor must be used together with the SenseCAP Outdoor Gateway (<https://www.seeedstudio.com/LoRaWAN-Gateway-EU868-p-4305.html>).

Due to the limitation of the SenseCAP outdoor gateway frequency, “SenseCAP for TTN” supports the following frequency plan(The sensor is capable of supporting all frequency plan):

Gateway Frequency	Description
EU868	It must be used with SenseCAP EU868 Gateway (https://www.seeedstudio.com/LoRaWAN-Gateway-EU868-p-4305.html)
US915	It must be used with SenseCAP US915 Gateway (https://www.seeedstudio.com/LoRaWAN-Gateway-US915-p-4306.html)



AU915	Need to contact sales to purchase.
AS923-1	Need to contact sales to purchase.
AS923-2	Need to contact sales to purchase.



3) Helium

Users can choose sensors to use on the public helium console:

<https://console.helium.com/>

4) The Things Network

Users can choose sensors to use on the public The Things Network server:

<https://console.cloud.thethings.network/>

5) Other Platform:

When you use other LoRaWAN network server, please select Other Platform.

At this point, you need to determine the sensor frequency band according to the gateway frequency and sub-band.

S210x Sensors support the following frequency plan:

Sensor Frequency	Common Name	Sub-band
EU863-870	EU868	-----



US902-928	US915	Sub band from 1 to 8 (default sub-band 2)
AU915-928	AU915	Sub band from 1 to 8 (default sub-band 2)
KR920-923	KR920	-----
IN865-867	IN865	-----
AS923	AS923-1	Frequency plan for Helium
	AS923-2	
	AS923-3	
	AS923-4	
RU864-867	RU864	-----

⚠️ Note1:

Different countries and LoRaWAN network servers use different frequency plans.

For Helium network, please refer to:

<https://docs.helium.com/lorawan-on-helium/frequency-plans>

For The Things Network, please refer to:

<https://www.thethingsnetwork.org/docs/lorawan/frequency-plans/>

⚠️ Note2:

- 1) *When using the SenseCAP platform, the EUI, APP EUI and APP Key are fixed and are the same as the sensor label.*
- 2) *When the sensor is selected to be used with a public platform such as Helium or TTN, the EUI will not change, and the sensor **will generate a new fixed App EUI and App Key** for network access.*

6.3.2 Set the Interval

The working mode of device: wake up the device every interval and collect measurement values and upload them through LoRa. For example, the device collects and uploads data **every 60 minutes by default.**



Parameter	Type
Uplink Interval	Unit: minutes, number from 1 to 1440.

Uplink Interval (min)	<input type="text" value="60"/>
-----------------------	---------------------------------



Note:

The SenseCAP portal has a limit on uplink interval: minimum interval is **5 minutes**.

The interval using the other platforms ranges from 1 to 1440 minutes.

6.3.3 Set the EUI and Key

The device uses OTAA to join the LoRaWAN network by default. So, it can set the device EUI and App EUI.

Parameter	Type
Device EUI	16 bits, hexadecimal from 0 ~ F
App EUI	16 bits, hexadecimal from 0 ~ F
App Key	32 bits, hexadecimal from 0 ~ F

Device EUI	<input type="text" value="2CF7F1C04160000B"/>
APP EUI	<input type="text" value="577D1C6ECDCC3B8D"/>
APP Key	<input type="text" value="466F991B963100CC478..."/>

6.3.4 Set the Packet Policy

The sensor uplink packet strategy has three modes.



Packet Policy

Parameter	Description
2C+1N (default)	2C+1N (2 confirm packets and 1 none-confirm) is the best strategy, the mode can minimize the packet loss rate, however the device will consume the most data packet in TTN, or date credits in Helium network.
1C	1C (1 confirm) the device will sleep after get 1 received confirm packet from server.
1N	1N (1 none-confirm) the device only send packet and then start to sleep, no matter the server received the data or not.

6.3.5 Set the Activation Type

The sensor supports two network access modes, OTAA by default.

Parameter	Description
OTAA (default)	Over The Air Activation, it joins the network through Device EUI, App EUI, and App Key.
ABP	Activation By Personalization, it joins the network through DevAddr, NwkSkey, and AppSkey.

When using ABP mode, you need to configure the following information:

Parameter	Description
DevAddr	32 bits, hexadecimal from 0 ~ F
NwkSkey	32 bits, hexadecimal from 0 ~ F
AppSkey	8 bits, hexadecimal from 0 ~ F



Activation Type

Nwk Skey

Only hexadecimal numbers of 0-F with a maximum of 32 digits are allowed to be filled in.

APP Skey

Only hexadecimal numbers of 0-F with a maximum of 32 digits are allowed to be filled in.

Dev Addr

Only hexadecimal numbers of 0-F with a maximum of 8 digits are allowed to be filled in.

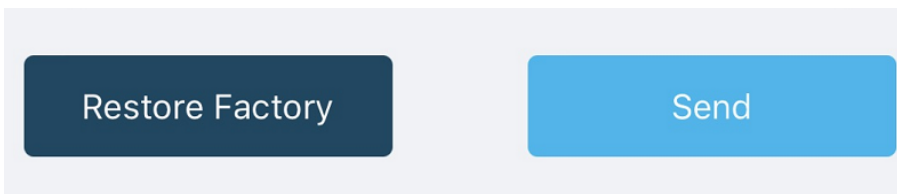


Note:

The factory defaults to a fixed value.

6.3.6 Restore Factory Setting

When selecting the SenseCAP platform, you must use the fixed EUI/App EUI/App Key. Therefore, you need to restore the factory Settings before switching back to the SenseCAP platform from other platforms.



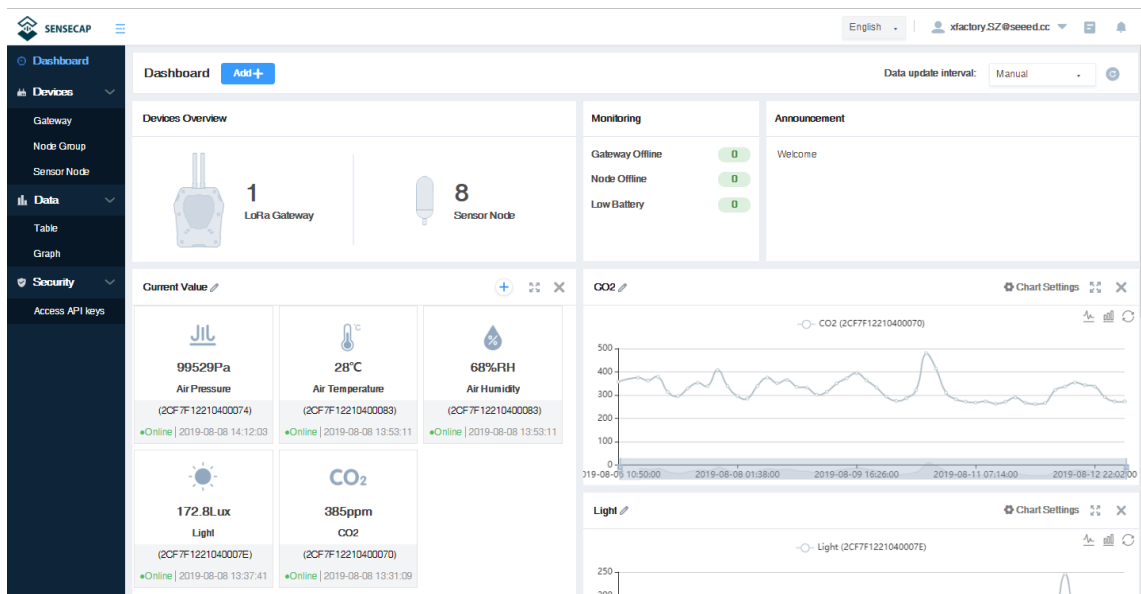
When we make a mistake or want to reset everything, we can click the button. The device will be restored to the factory's default configuration.



7. Connect to the SenseCAP Portal

7.1 SenseCAP Portal

The main function of the SenseCAP Portal is to manage SenseCAP devices and to store data. It is built on Azure, a secure and reliable cloud service from Microsoft. You can apply for an account and bind all devices to this account. SenseCAP provides the web portal and API. The web portal includes Dashboard, Device Management, Data Management, and Access Key Management, while API is open to users for further development.



7.1.1 Create a New Account

Portal Website: <http://sensecap.seeed.cc>

- 4) Select register account, enter email information and click "register", the registered email will be sent to the user's mailbox.
- 5) Open the "SenseCAP..."Email, click the jump link, fill in the relevant information, and complete the registration.
- 6) Return to the login interface and complete the login.

Note:

If you can't find the email, it may be automatically identified as "spam" and put in the "trash can".



7.1.2 Other Functions

- **Dashboard:** Including Device Overview, Announcement, Scene Data, and Data Chart, etc.
- **Device Management:** Manage SenseCAP devices.
- **Data Management:** Manage data, including Data Table and Graph section, providing methods to search for data.
- **Subaccount System:** Register subaccounts with different permissions.
- **Access Key Management:** Manage Access Key (to access API service), including Key Create, Key Update, and Key Check.



Note:

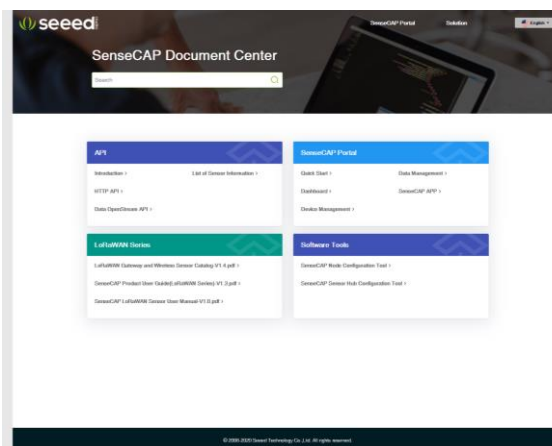
SenseCAP Portal User Guide: <https://sensecap-docs.seeed.cc/quickstart.html>

7.1.3 API Instruction

SenseCAP API is for users to manage IoT devices and data. It includes 3 types of API methods: HTTP protocol, MQTT protocol, and Websocket protocol.

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

Please refer to this link for API User Guide: <https://sensecap-docs.seeed.cc/>

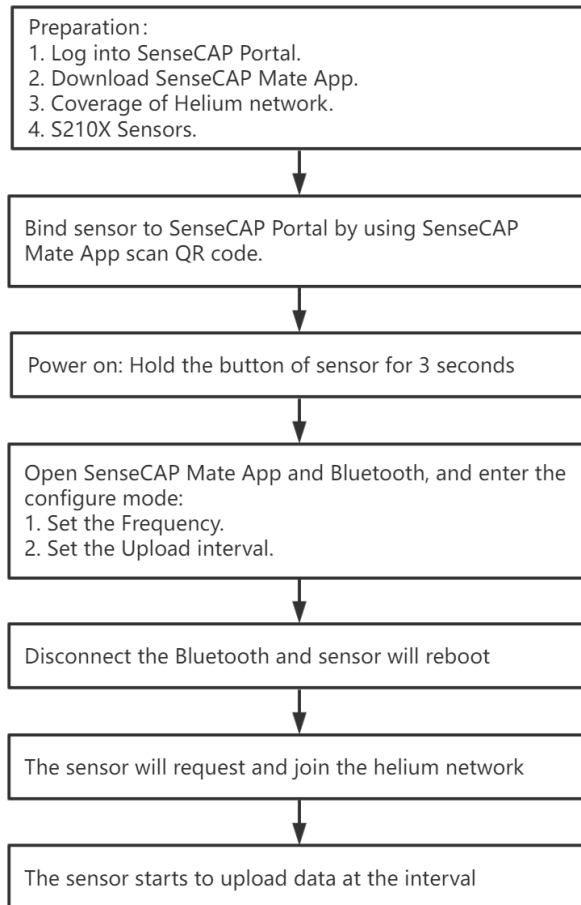




7.2 Connect to SenseCAP with Helium Network

7.2.1 Quick Start

Follow this process to quickly use the sensor, see the following section for details.



7.2.2 Preparation

1) SenseCAP Mate App

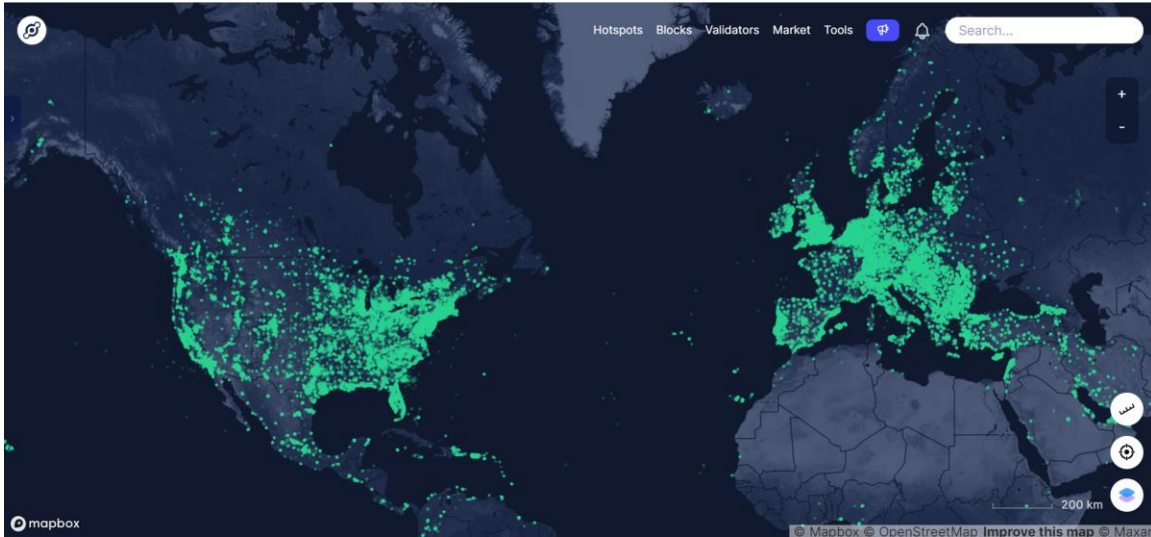
Download the App, please refer to [section 5](#) for using.

2) Coverage of Helium network

Option 1: Use the Helium network that already exists nearby.

Please refer to the map, search your location to see if there's any helium network around: <https://explorer.helium.com/>

A green hexagon indicates the presence of the network.



Option 2: Deploy a new Helium gateway.

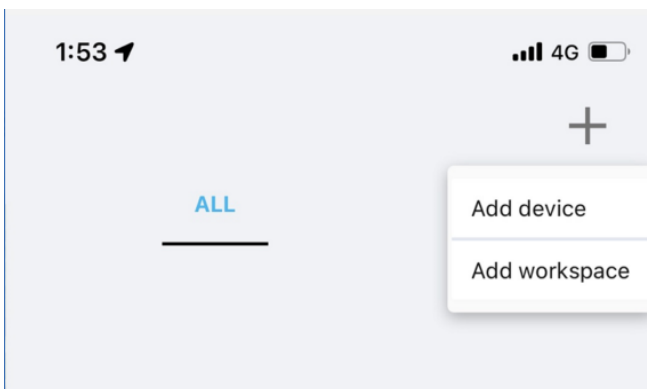
You can purchase M1, M2 gateways to cover your surroundings with the Helium network:
<https://www.sensecapmx.com/>

7.2.3 Bind Sensor to SenseCAP Portal

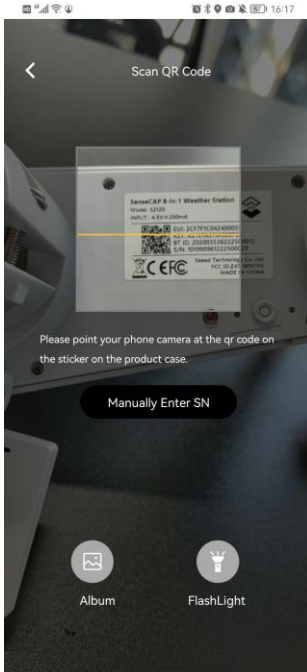
Please open SenseCAP Mate App.

(1) Scan QR Code

- 1) Click “Add device” on the upper-right corner of device page to enter the device binding page.

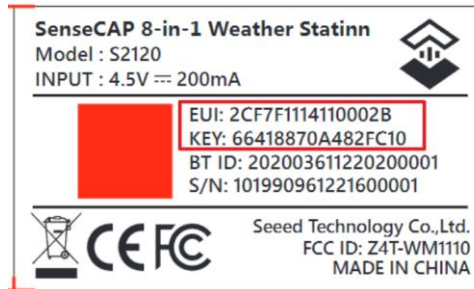


- 2) Scan the QR code on the device to bind the device to your account. If you do not set it to a designated group, the device will be put into the “default” group.



(2) Manually fill in the EUI

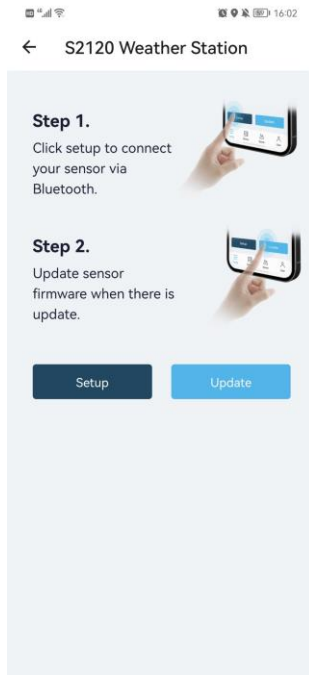
If the QR code sticker is damaged, you can manually fill in the EUI of the device to bind the device to your account. Please make sure you put in the EUI in the format suggested by the system and then click “confirm”.



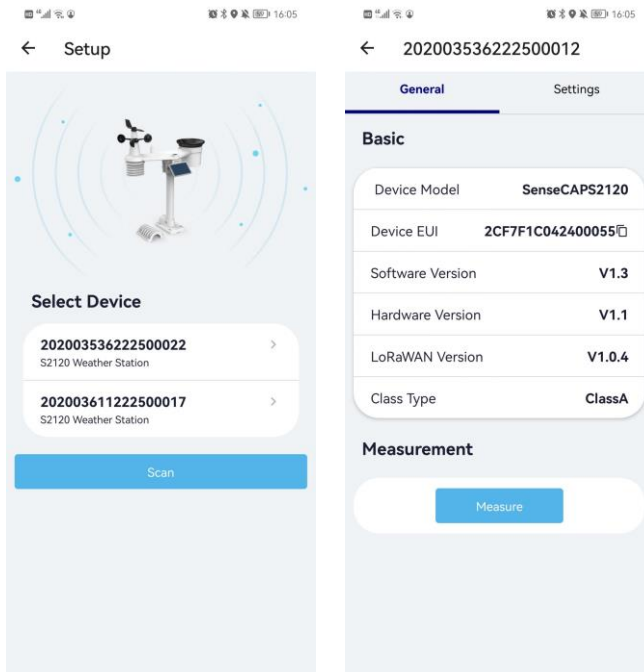


7.2.4 Setup the Sensor

- 1) Open the SenseCAP Mate App
- 2) Please click the “Setup” button to turn on Bluetooth and click “Scan” to start scanning the sensor’s Bluetooth.



- 3) Select the Sensor by BT ID (label). Then, the basic information of the sensor will be displayed after entering.



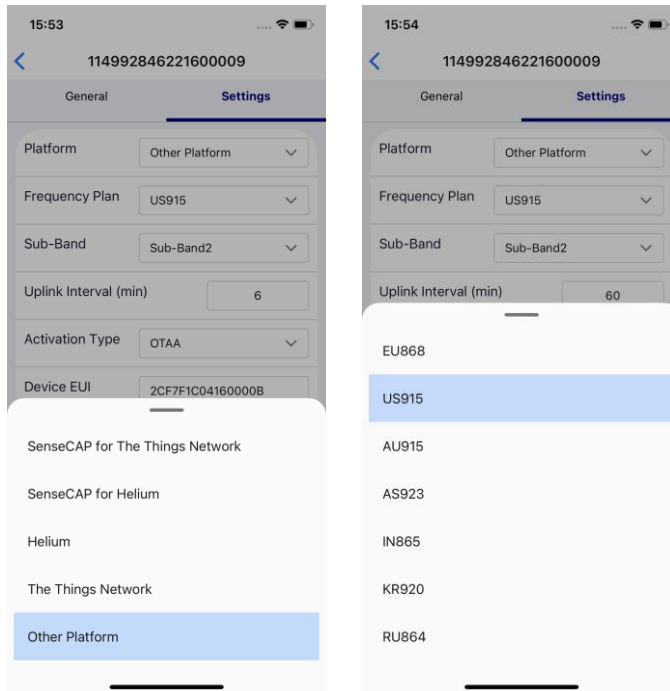


7.2.5 Set Frequency of Sensor via SenseCAP Mate App

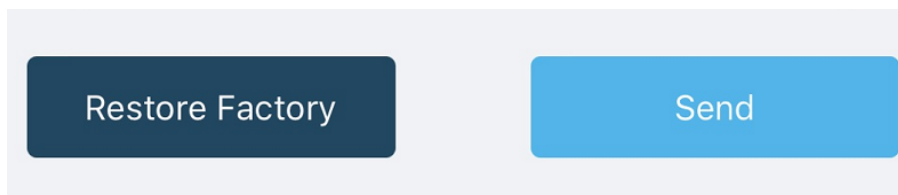
Set the corresponding frequency band based on the frequency band of the gateway.

Please refer to [section 6](#) for detail.

- 1) Click the “Setting” and select the platform is “SenseCAP for Helium”.



- 2) Select the Frequency Plan, if the gateway is US915, set the sensor to US915.
- 3) Click the “Send” button, send the setting to the sensor for it to take effect.



- 4) Click the “Home” button, the App will disconnect the Bluetooth connection.
Then, the sensor will reboot.
- 5) When the device is disconnected from Bluetooth, the LED flashes as a **breathing light**.
- 6) After joining the network successfully, LED **flashes fast for 2s**.



7.2.6 Check Data on SenseCAP Portal

On the SenseCAP App or the website <http://sensecap.seeed.cc/>, you can check the device online status and the latest data. In the list for each Sensor, you can check its online status and the time of its last data upload.

The screenshot shows the SenseCAP web portal interface. The left sidebar contains navigation options: Dashboard, Devices (Gateway, Node Group, Sensor Node), Data (Table, Graph), and Security (Access API keys). The main content area is titled 'Devices / Sensor Node' and includes search filters for EUI, Device Group, Frequency, and Online Status. Below the filters is a table with 4 search results. The table columns are: NO., EUI, Device Name, Sensor Count, Device Group, Online Status, Operation, and Last Message Time. The 'Sensor Count' and 'Online Status' columns for all four rows are highlighted with red boxes.

NO.	EUI	Device Name	Sensor Count	Device Group	Online Status	Operation	Last Message Time
1	2CF7E12210400070	CO2 Sensor	1	station-1	Online	Move	2019-11-15 10:28:16
2	2CF7E12210400074	Barometric Pressure Sensor	1	station-1	Online	Move	2019-11-15 10:09:27
3	2CF7E1221040007E	Light Intensity Sensor	1	station-1	Online	Move	2019-11-15 09:43:47
4	2CF7E12210400083	Air Temperature and Humidity Sensor	1	station-1	Online	Move	2019-11-15 10:02:47

The screenshot shows the SenseCAP mobile app interface. At the top, there are tabs for 'All', 'Default', and 'Home'. Below the tabs, it says '6 Device'. There are six device cards arranged in a 3x2 grid. Each card displays the device name, EUI, online status, and battery level. The bottom navigation bar has three icons: 'Config', 'Device', and 'User'.

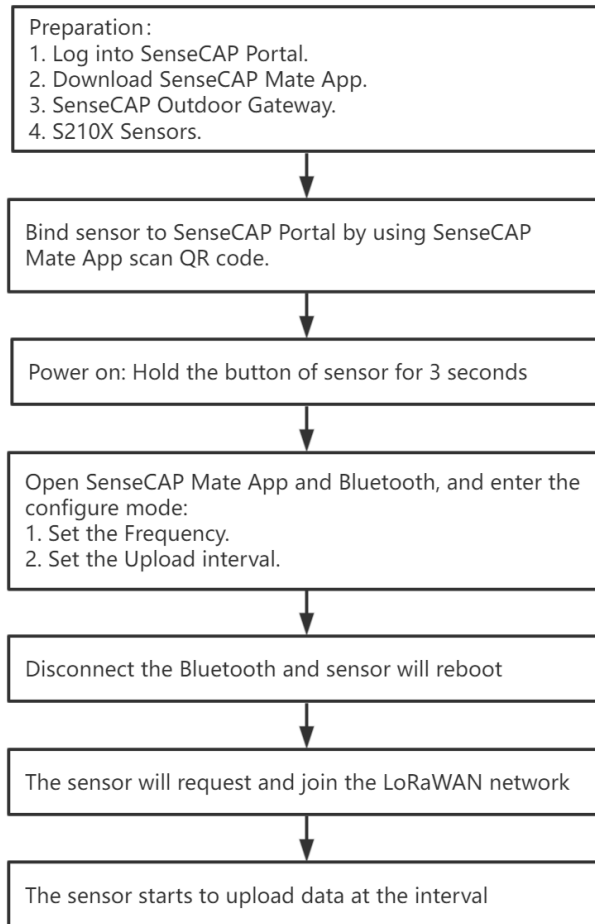
Device Name	EUI	Online Status	Battery Level
Air TH -Home	2CF7F1C042300093	Online Home	100%
Light Intensity	2CF7F1C042300112	Offline Default	100%
Weather Station	2CF7F1C042400055	Online Default	100%
CO2, Temp&Humi	2CF7F1C042300312	Offline Default	100%
Soil Moisture, Te...	2CF7F1C042300399	Offline Default	100%
Soil TH-Home	2CF7F1C0423001CF	Online Home	100%



7.3 Connect to SenseCAP with private TTN

7.3.1 Quick Start

Follow this process to quickly use the sensor, see the following section for details.



7.3.2 Preparation

1) SenseCAP Mate App

Download the App, please refer to [section 6](#) for using.

2) SenseCAP Outdoor Gateway

Now, the sensor needs to be used with the SenseCAP Outdoor Gateway (<https://www.seeedstudio.com/LoRaWAN-Gateway-EU868-p-4305.html>) to transmit data to the SenseCAP Portal.

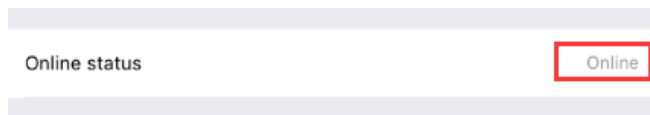
a) Setup the Gateway, connect to power cable and Internet.



- b) Bind the gateway to SenseCAP Portal.
- c) Ensure the gateway indicator is steady on.



- d) Ensure the gateway is displayed online on the portal.



7.3.3 Bind Sensor to SenseCAP Portal

Please refer to the [section 7.2.3](#)

7.3.4 Setup the Sensor

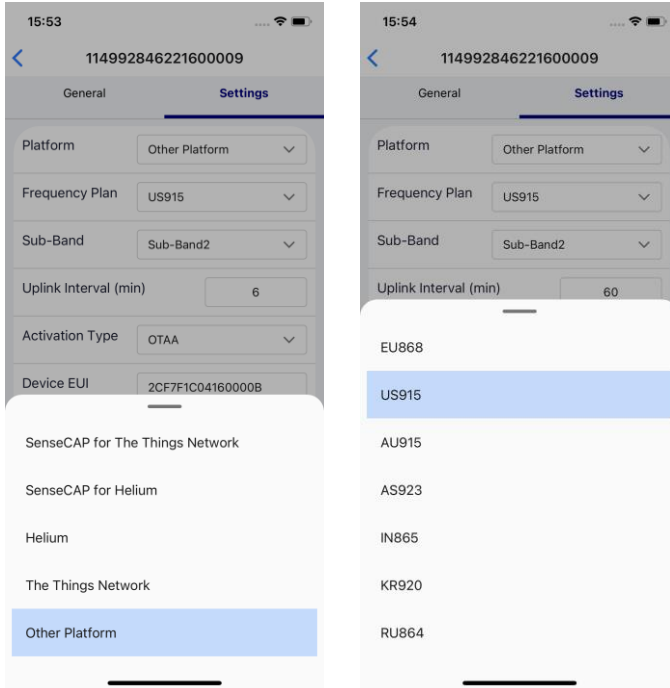
Please refer to the [section 7.2.4](#)

7.3.5 Set Frequency of Sensor via SenseCAP Mate App

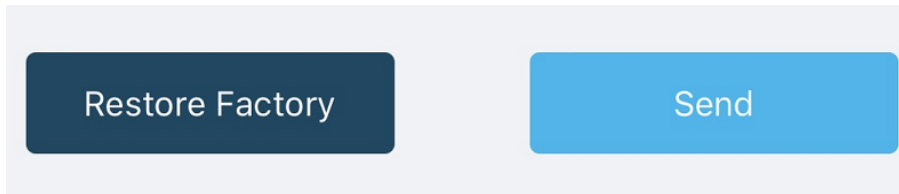
Set the corresponding frequency band based on the frequency band of the gateway.

Please refer to [section 6](#) for detail.

- 1) Click the “Setting” and select the platform is “**SenseCAP for The Things Network**”.



- 2) Select the Frequency Plan, if the gateway is US915, set the sensor to US915.
- 3) Click the “Send” button, send the setting to the sensor for it to take effect.



- 4) Click the “Home” button, the App will disconnect the Bluetooth connection.
Then, the sensor will reboot.
- 5) When the device is disconnected from Bluetooth, the LED flashes as a **breathing light**.
- 6) After joining the network successfully, LED **flashes fast for 2s**.

7.3.6 Check Data on SenseCAP Portal

Please refer to the [section 7.2.6](#)



8. Connect to Helium Network

Please refer to the manual to connect sensors to Helium public console:

<https://files.seeedstudio.com/products/SenseCAP/S210X/How%20to%20Connect%20SenseCAP%20S210X%20to%20Helium%20Network.pdf>

9. Connect to The Things Network

Please refer to this manual:

<https://files.seeedstudio.com/products/SenseCAP/S210X/How%20to%20Connect%20SenseCAP%20S210X%20to%20The%20Things%20Network.pdf>

Please refer to the link to use the TTN platform:

The Things Network website: <https://www.thethingsnetwork.org>

The Things Industries login: <https://accounts.thethingsindustries.com/login>

TTN Quick Start: <https://www.thethingsnetwork.org/docs/quick-start/>



10. Payload Decoder

10.1 Decoder Code

TTN payload decoding script for SenseCAP LoRaWAN:

https://github.com/Seeed-Solution/TTN-Payload-Decoder/blob/master/SenseCAP_S2120_Weather_Station_Decoder.js



10.2 Packet Parsing

After being powered on or reboot, SenseCAP Sensors will be connected to the network using the OTAA activation method. Each Sensor Node will send data packets to the server, including the following data:

The weather station data protocol provides 6 types of packets to correspond to different information such as measurements, and the number of bytes of each packet may vary. The structure of the frame is shown in the image below. The frame content is sent in **big-endian byte order**.

01	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10	Byte11
ID	Temperature	Humidity	Light Intensity				UV	Wind Speed		

02	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9
ID	Wind Direction	Rainfall Hourly				Barometric Pressure		

03	Byte2
ID	Battery Level

04	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10
ID	Battery Level	Software & Hardware Version			Measurement Uplink Interval		GPS Uplink Interval (reserved)		

05	Byte2	Byte3	Byte4	Byte5
ID	Measurement Uplink Interval		GPS Uplink Interval (reserved)	

06	Byte2
ID	Error Code



10.3 Data Parsing Example

10.3.1 Measurement data packets

Measurements list:

Measurements	Resolution	Unit
Air Temperature	0.1	°C
Air Humidity	1	%RH
Light Intensity	1	Lux
UV Index	0.1	(None)
Wind Speed	0.1	m/s
Wind Direction	0.1	°
Rainfall Hourly	0.001	mm/hour
Barometric Pressure	1	Pa

The raw payload: 010115410000005E00000002015600000FE2703

01 0115 41 0000005E 05 0011 02 0156 000000FE 2703

Part	Value	Raw Data	Description
1	Frame ID 01	01	01 is the frame ID.
2	Air Temperature	0115	0115 is actually 0x0115 (signed number), whose equivalent decimal value is 277. Divide it by 10, and you will get the actual value for air Temperature as 27.7 °C.
3	Air Humidity	41	41 is actually 0x41 (unsigned number), whose equivalent decimal value is 65. You will get the actual value for air humidity as 65%RH.
4	Light Intensity	0000005E	0000005E is actually 0x5E (unsigned number), whose equivalent decimal value is 94. You will get the actual value for light intensity as 94 Lux.



5	UV Index	05	05 is actually 0x05(unsigned number), whose equivalent decimal value is 5. Divide it by 10, You will get the actual value for UV index as 0.5.
6	Wind Speed	0011	0011 is actually 0x11(unsigned number), whose equivalent decimal value is 17. Divide it by 10, you will get the actual value for UV index as 1.7 m/s.
7	Frame ID 02	02	02 is the frame ID.
8	Wind Direction	0156	0156 is actually 0x0156(unsigned number), whose equivalent decimal value is 342. You will get the actual value for wind direction as 342° .
9	Rainfall Hourly	000000FE	000000FE is actually 0x000000FE (unsigned number), whose equivalent decimal value is 254. Divide it by 1000, you will get the actual value for rainfall hourly as 0.254 mm/hour.
10	Barometric Pressure	2703	2703 is actually 0x2703 (unsigned number), whose equivalent decimal value is 9987. Multiply it by 10, you will get the actual value for barometric pressure as 99870 Pa.

10.3.2 Battery information packets

A packet of battery information will be uploaded when the device is powered on or reboot for the first time. Thereafter, the battery information will be uploaded once a day.

The first pack of battery information is uploaded together with software, hardware version, measurements information and etc.

The raw payload (Combined data packet):

04 64 01010103 000A 05A0 01011043000000000000000002011A000000002702

Part	Value	Raw Data	Description
1	Frame ID 04	04	04 is the frame ID.
2	Battery Level	64	64 is actually 0x64 (signed number), whose equivalent decimal value is 100. You will get the actual value for battery level as 100. Batteries have only two states: a value of 0



			means they may only last for 1~2 weeks. A value of 100 means the battery is sufficient.
3	Hardware and Software Version	01010103	01010103 is actually 0x01010103 (unsigned number). HW.HW-SW.SW 0101: HW 1.1 0103: SW 1.3
4	Measurement Uplink Interval	000A	000A is actually 0x000A (unsigned number), whose equivalent decimal value is 10. You will get the actual value for Measurement Uplink Interval as 10 minutes.
5	GPS Uplink Interval (reserved)	05A0	05A0 is actually 0x05A0 (unsigned number), whose equivalent decimal value is 1440. You will get the actual value for GPS Uplink Interval as 1440 minutes. GPS is used in the customized version. The common version does not have the GPS function.
6	Measurements packet of 01 and 02	010110430000000000000000 02011A0000000002702	Please refer to 01/02 packets.

The raw payload (Combined data packet):

0101104300000000000000000000000002011A0000000002702 03 64

Part	Value	Raw Data	Description
1	Measurements packet of 01 and 02	010110430000000000000000 02011A0000000002702	Please refer to 01/02 packets.
2	Frame ID 03	03	03 is the frame ID.
3	Battery Level	64	64 is actually 0x64 (signed number), whose equivalent decimal value is 100. You will get the actual value for battery level as 100. Batteries have only two states: a value of 0 means they may only last for 1~2 weeks. A value of 100 means the battery is sufficient.



11. LoRaWAN Downlink Command

11.1 Set the Data Uplink Interval

- (1) Using the Network Server's portal or API to send downlink command, then the Node will respond to the ack. The downlink command takes effect and responds the next time the node uploads data.
- (2) Downlink as follow:

0x00	0x89	0x00	prepareId_L	prepareId_H	duty_L	duty_H	crc-L	crc-H
------	------	------	-------------	-------------	--------	--------	-------	-------

0x00	Fixed field
0x89	Fixed field
0x00	Fixed field
prepareId_L	Command ID low byte, you can customize the values, it allows each command ID to be the same
prepareId_H	Command ID high byte, you can customize the values, it allows each command ID to be the same
duty_L	Data interval low byte, you can set the data interval, unit: minute
duty_H	Data interval high byte, you can set the data interval, unit: minute
crc-L	CRC low byte, it's calculated by the CRC-16/KERMIT
crc-H	CRC low byte, it's calculated by the CRC-16/KERMIT

- (3) When you send the downlink command, the Node responds to the ack command.

0x00	0x1F	0x00	prepareId_L	prepareId_H	result	0x00	crc-L	crc-H
------	------	------	-------------	-------------	--------	------	-------	-------

0x00	Fixed field
0x1F	Fixed field
0x00	Fixed field
prepareId_L	Command ID low byte, it is the same as the downlink command
prepareId_H	Command ID high byte, it is the same as the downlink command
result	If the downlink command is in force, it responds 0x01, else it responds 0x00
0x00	Fixed field
crc-L	CRC low byte, it's calculated by the CRC-16/KERMIT
crc-H	CRC low byte, it's calculated by the CRC-16/ KERMIT

- (3) Use the FPort = 2

CRC Tool: <https://crccalc.com/> , select the algorithm of CRC-16/KERMIT.



Example: Set the Node's data interval is 10 minutes.

Send the downlink command (HEX) via FPort=2:

00 89 00 11 22 0A 00 38 B4

0x00	0x89	0x00	prepareId_L	prepareId_H	duty_L	duty_H	crc-L	crc-H
00	89	00	11	22	0A	00	38	B4

ACK Response:

00 1F 00 11 22 01 00 78 0F

0x00	0x1F	0x00	prepareId_L	prepareId_H	result	0x00	crc-L	crc-H
00	1F	00	11	22	01	00	78	0F

Command List:

Description	Command
Set Uplink interval = 1 minute	008900112201009050
Set Uplink interval = 5 minutes	00890011220500F037
Set Uplink interval = 10 minutes	00890011220A0038B4
Set Uplink interval = 15 minutes	00890011220F0080CA
Set Uplink interval = 20 minutes	0089001122150061A2
Set Uplink interval = 30 minutes	00890011221E00C946
Set Uplink interval = 60 minutes	00890011223C004A56

11.2 Reboot the device

FPort = 2

Command: **00C800000000002B26**



11.3 How to send downlink

Example: use the Helium Console to send

Add Downlink Payload


Scheduling FPort Region

First **Last** 2 US915

Payload

00890011220500F037 Base64 **Text**

I'd like confirmation of response





12. Device Installation

12.1 Select an Appropriate Installation Location

Before installing the weather station, please consider the followings:

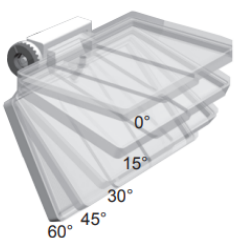
- 1) Rain gauge must be clean every few months.
- 2) Avoid radiant heat reflected from any adjacent buildings and structures. Ideally, the weather station should be installed at 1.5m (5') from any building, structure, ground or roof top.
- 3) Choose an area of open space in direct sunlight without any obstruction of rain, wind, and sunlight.
- 4) Transmission range between weather station and gateway could reach a distance of 2~10 km at line of sight, providing there are no interfering obstacles in between or nearby such as trees, towers, or high voltage line. Check the reception signal quality to ensure good reception.
- 5) Household appliance such as fridge, lighting, dimmers may pose Electro-magnetic interference (EMI), while Radio Frequency Interference (RFI) from devices operating in the same frequency range may cause signal intermittent. Choose a location at least 1-2 meter (3-5 feet) away from these interference sources to ensure best reception.

12.2 Installing the Weather Station

12.2.1 Adjust the solar panel

The tilting angle of solar panel can be adjusted vertically from 0° into 15°, 30°, 45° and 60° positions depending on the area you are living in. For optimal power output year-round, please set the tilt angle that is closest to your latitude.

Location (latitude, longitude)	Solar panel tilt angle
Hamburg (53.558, 9.7874)	60°
Chicago (42.1146, -88.0464)	45°
Houston (29.7711, -95.3552)	30°
Bangkok (14.2752, 100.5684)	15°
Sydney (-33.5738, 151.3053) *	30°

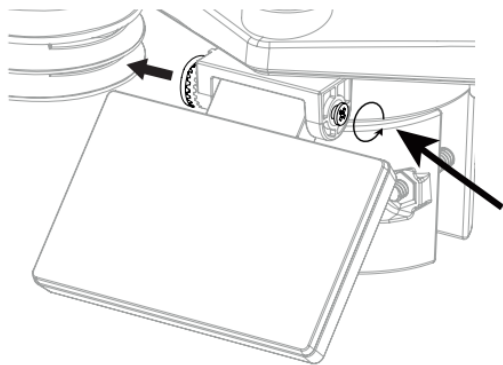


*Sensors installed in Southern Hemisphere must have their solar panels facing North.

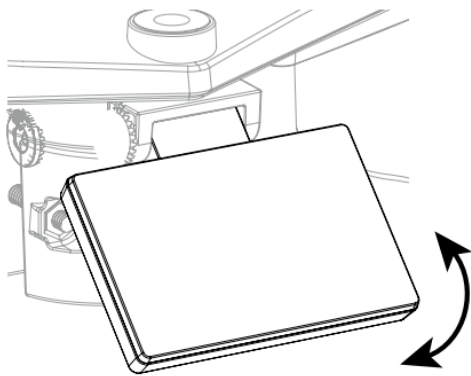
Step 1: Remove the solar panel protection film.



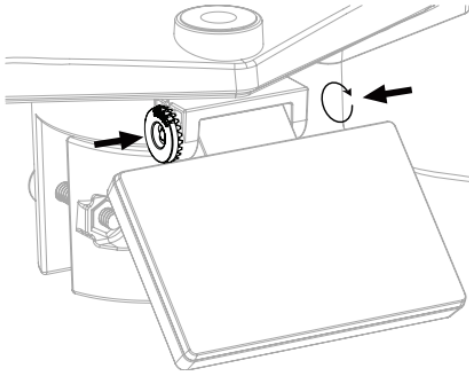
Step 2: Loosen the screw lightly until the gears on the opposite side separated from lock position.



Step 3: Adjust the vertical angle of the solar panel (0°, 15°, 30°, 45°, 60°) according to the latitude of your location.



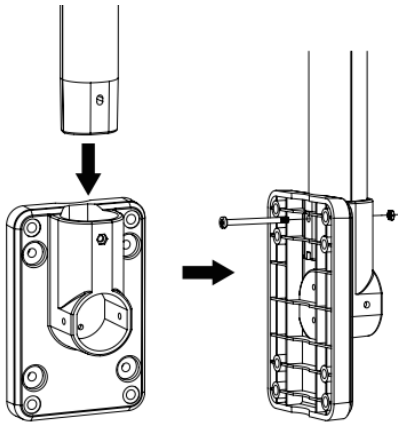
Step 4: Push the gear and tighten the screw until the gears are securely locked.



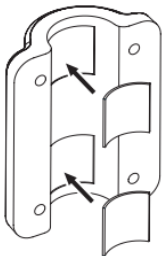
12.2.2 Install the Mounting Pole

Step 1: Fasten the plastic pole onto your fix pole with mounting base, clamp, washers, screws and nuts. Following below sequences:

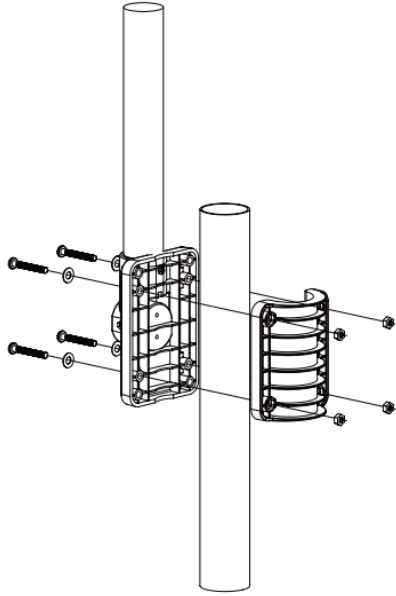
- 1) Insert the plastic pole into the hole of the mounting stand, and then secure it with the screw and nut.



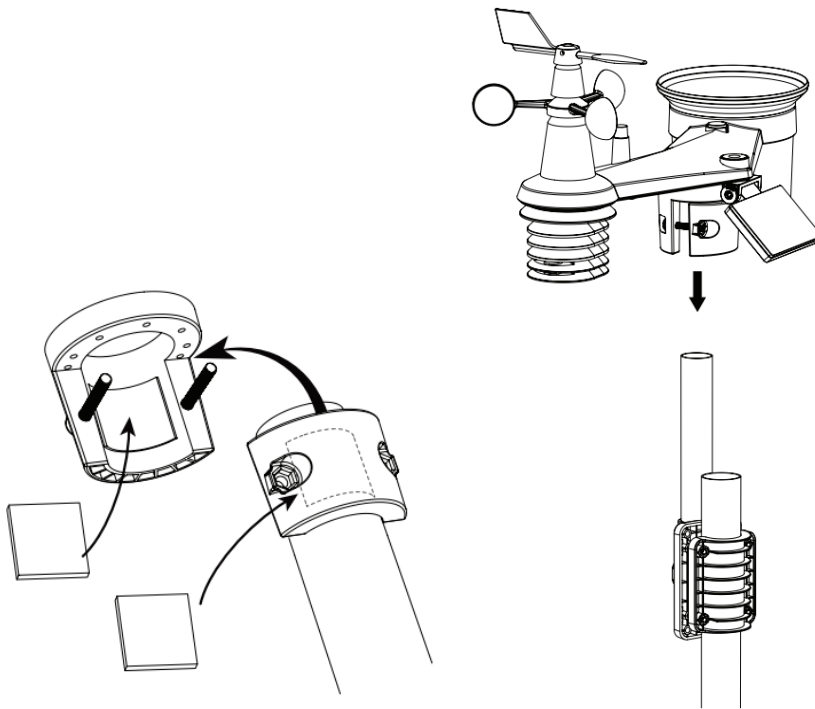
- 2) Apply 2 rubber pads on the mounting clamp.



- 3) Fasten the mounting stand and clamp together onto a fix pole with 4 long screws and nuts.



Step 2: Apply 2 rubber pads on the inner sides of the mounting base and clamp of the weather station, and loosely fasten them together.



Step 3: Place the weather station over the mounting pole and align it to North direction before fastening the screws.

⚠ Note:

1. Any metal object can attract lightning strikes, including the mounting pole. Never



install weather station in stormy days.

2. *If you want to install a weather station on a house or building, consult a licensed electrical engineer to ensure proper grounding. Direct lightning impact on a metal pole can damage or destroy your home.*

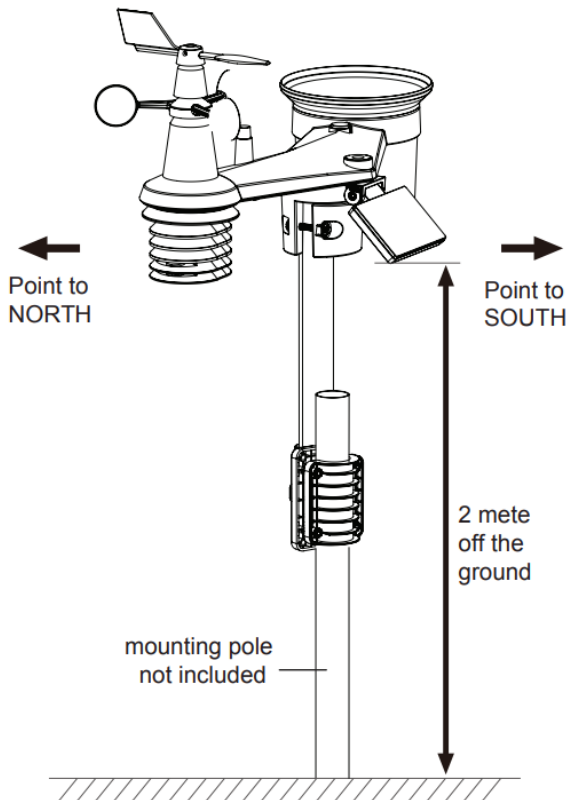
3. *Installing the sensor at high location may result in personal injury or death. Perform as many initial inspections and operations as possible on the ground and in buildings or houses. Only install the weather station on clear, dry days.*

12.2.3 Direction Alignment

Install the weather station in an open location with no obstructions above and around the sensor for accurate rain and wind measurement.

Locate the North (N) marker on top of the weather station and align the marker to point North upon final installation with a compass or GPS. Tighten the mounting bracket around a 30 to 40 mm diameter pole (not included) using two screw and nuts provided.

Use the bubble level on the weather station to make sure the sensor is completely level for proper measurement of rainfall, UV and light intensity.

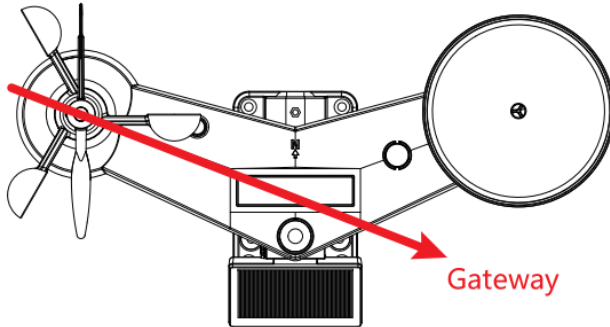




12.2.4 Recommendation for best wireless communication

Effective wireless communication is susceptible to noise interference in the environment, and distance and barriers between the sensor transmitter and the gateway.

- 1) Installation direction. When installing equipment, in addition to the direction of wind direction, also need to consider the direction of wireless transmission. In the direction shown, pointing to the gateway will get a better signal.



- 2) Distance. Path loss occurs naturally with distance. This device is rated to 10km by line of sight (in interference free environment and without barriers). However, typically you will get 1~3km maximum in real life installation, which includes passing through barriers.
- 3) Barriers. Radio signal are blocked by metal barriers such as aluminum cladding. Please align the weather station and gateway to get them in clear line of sight through window if you have metal cladding.

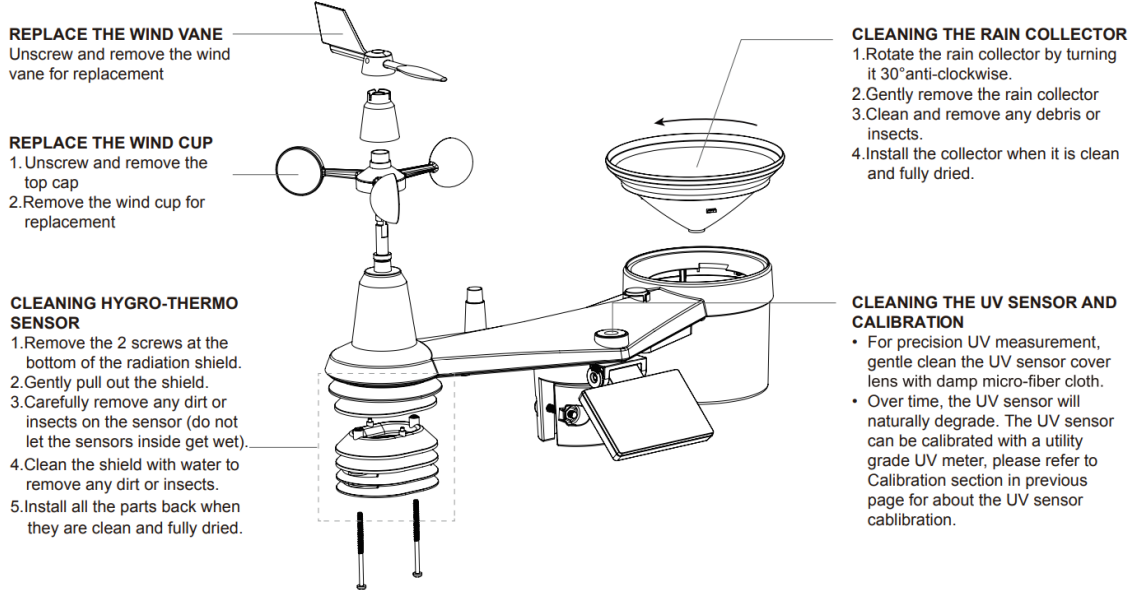
The table below show a typical level of reduction in signal strength each time the signal passed through these building materials (RF signal reduction for reference):

Materials	Signal strength reduction
Glass (untreated)	10 ~ 20%
Wood	10 ~ 30%
Plasterboard / drywall	20 ~ 40%
Brick	30 ~ 50%
Foil insulation	60 ~ 70%
Concrete wall	80 ~ 90%
Aluminum siding	100%
Metal wall	100%



13. Trouble Shooting

13.1 Maintenance of Weather Station



13.2 Sensors can't join LoRa network, how to do?

- 1) Check the gateway frequency configuration. Make sure the gateway and sensor have the same uplink and downlink frequency.
- 2) Check the real-time log and click config button of the sensor to see if there are any sensor data packets. If there are packets, check whether the gateway is sending downlink packets.
- 3) If the channels and other configurations are correct and the gateway logs do not have packets, please contact technical support.

13.3 Battery Life Prediction

The power consumption table is for reference only. The battery life depends on various factors, such as frequency band, distance from the gateway, and ambient temperature.

https://files.seeedstudio.com/products/SenseCAP/S210X/SenseCAP_S21XX_Sensor_Battery_Life_Prediction.xlsx

13.4 Support

Support is provided 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 in the before-mentioned schedule.



Provide as much information as possible regarding your enquiry (product models, accurately describe your problem and steps to replicate it etc.) and send a mail to: sensecap@seeed.cc

13.5 Document Version

Version	Date	Description	Editor
V1.0.0	5/01/2022	First edition	Jenkin Lu