

## Dragino LoRaWAN Weather Station User Manual

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## 1. Introduction

### 1.1 Overview

Dragino LoRaWAN weather station series products are designed for measuring atmospheric conditions to provide information for weather forecasts and to study the weather and climate. They consist of a main process device (WSC1-L) and various sensors.

The sensors include various type such as: Rain Gauge, Temperature/Humidity/Pressure sensor, Wind Speed/direction sensor, Illumination sensor, CO2 sensor, Rain/Snow sensor, PM2.5/10 sensor, PAR(Photosynthetically Available Radiation) sensor, Total Solar Radiation sensor and so on.

Main process device WSC1-L is an outdoor LoRaWAN RS485 end node. It is powered by external 12v solar power and have a built-in li-on backup battery. WSC1-L reads value from various sensors and upload these sensor data to IoT server via LoRaWAN wireless protocol.

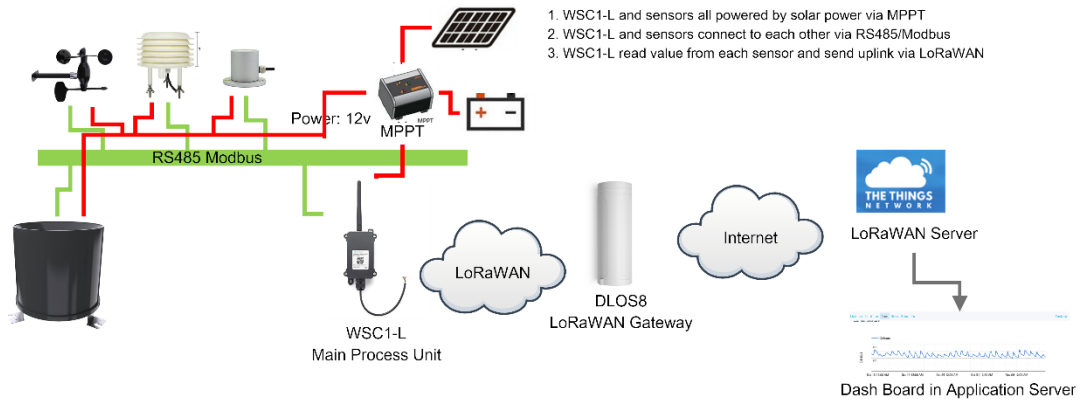
WSC1-L is full compatible with LoRaWAN Class C protocol, it can work with standard LoRaWAN gateway.

## 2. How to use

### 2.1 Installation

Below is an installation example for the weather station. Field installation example can be found at [Appendix I: Field Installation Photo](#).

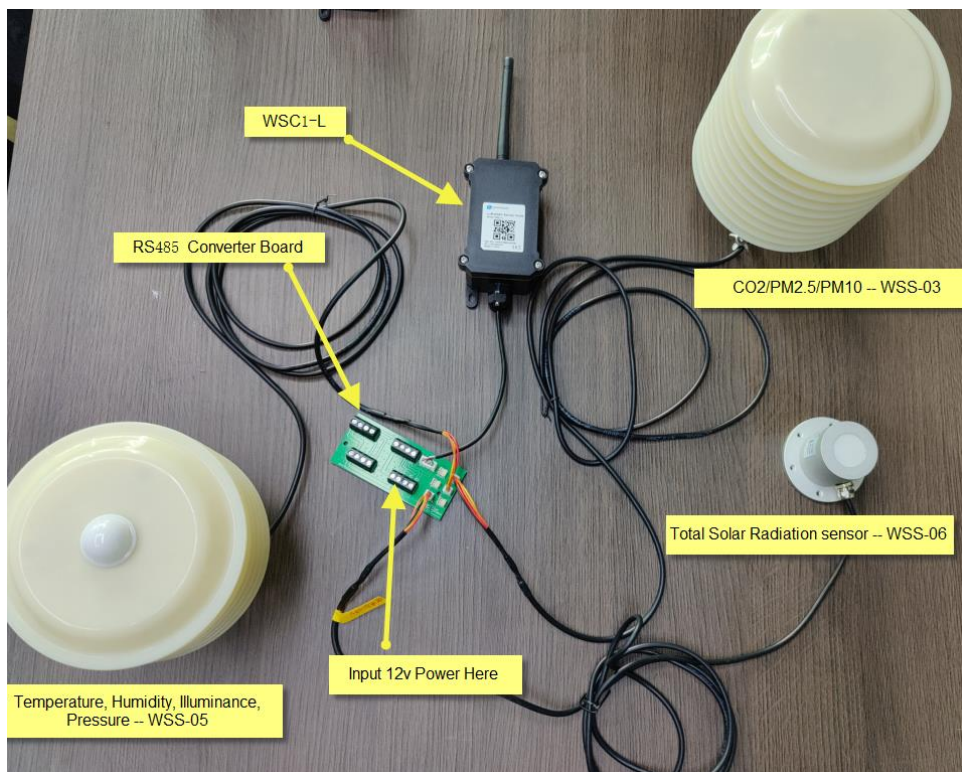
WSC1-L Weather Station Installation Diagram



#### Wiring:

1. WSC1-L and sensors all powered by solar power via MPPT
2. WSC1-L and sensors connect to each other via RS485/Modbus.
3. WSC1-L read value from each sensor and send uplink via LoRaWAN

WSC1-L is shipped with a RS485 converter board, for the easy connection to different sensors and WSC1-L. Below is a connection photo:



**Notice 1:**

- All weather sensors and WSC1-L are powered by MPPT solar recharge controller. MPPT is connected to solar panel and storage battery.
- WSC1-L has an extra 1000mAh back up battery. So it can work even solar panel and storage battery fails.
- Weather sensors won't work if solar panel and storage battery fails.

**Notice 2:**

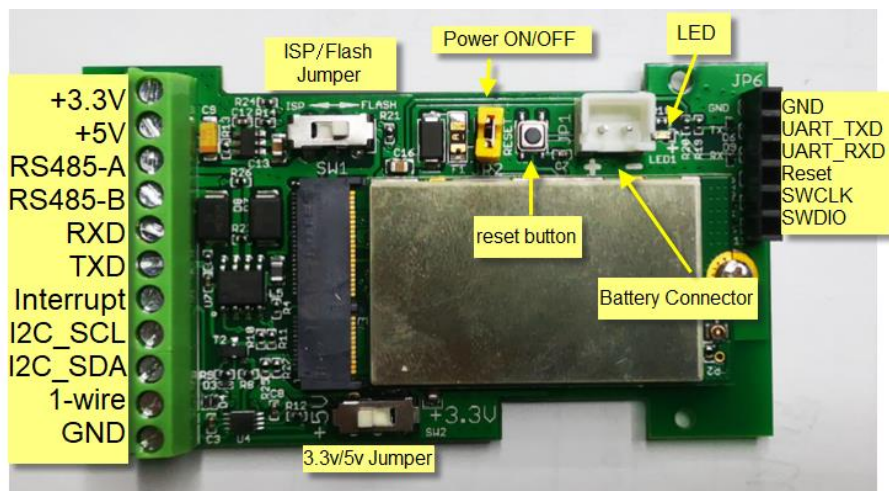
Due to shipment and importation limitation, user is better to purchase below parts locally:

- Solar Panel
- Storage Battery
- MPPT Solar Recharger
- Mounting Kit includes pole and mast assembly. Each weather sensor has it's own mounting assembly, user can check the sensor section in this manual.
- Cabinet.

## 2.2 How it works?

Each WSC1-L is shipped with a worldwide unique set of OTAA keys. To use WSC1-L in a LoRaWAN network, user needs to input the OTAA keys in LoRaWAN network server. After finish installation as above. Create WSC1-L in your LoRaWAN server and Power on WSC1-L , it can join the LoRaWAN network and start to transmit sensor data. The default period for each uplink is 20 minutes.

Open WSC1-L and put the yellow jumper as below position to power on WSC1-L.



Notice:

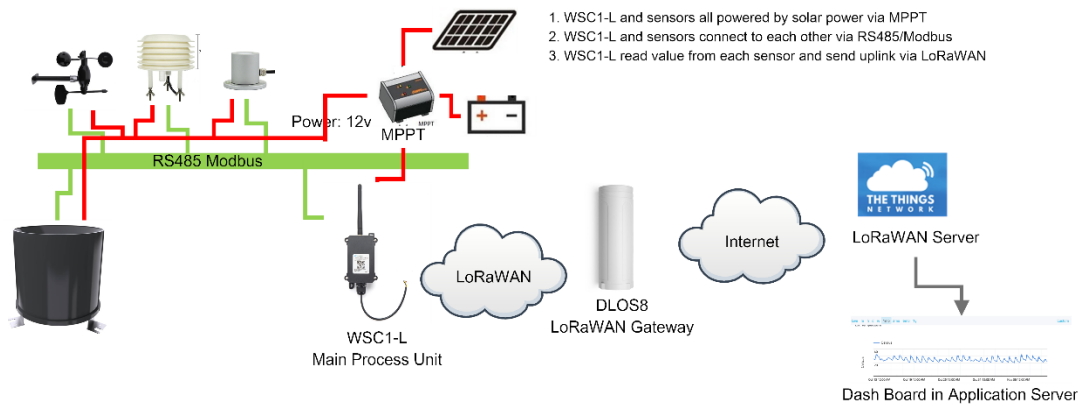
- 1) WSC1-L will auto scan available weather sensors when power on or reboot.
- 2) User can send a **downlink command**( 增加下发命令的连接) to WSC1-L to do a re-scan on the available sensors.



### 2.3 Example to use for LoRaWAN network

This section shows an example for how to join the TTN V3 LoRaWAN IoT server. Usages with other LoRaWAN IoT servers are of similar procedure.

WSC1-L Weather Station Installation Diagram



Assume the DLOS8 is already set to connect to [TTN V3 network](#) . We need to add the WSC1-L device in TTN V3:

**Step 1:** Create a device in TTN V3 with the OTAA keys from WSC1-L.

Each WSC1-L is shipped with a sticker with the default device EUI as below:



User can enter these keys in the LoRaWAN Server portal. Below is TTN V3 screen shot:

Add APP EUI in the application.

## Add application

Owner\*

davidhuang

Application ID\*

my-new-application

Application name

My new application

Description

Description for my new application

Optional application description; can also be used to save notes about the application

Create application



4 End devices 2 Collaborators 2 API keys

Created 95 days ago

### General information

Application ID: 123  
Created at: Feb 2, 2021 11:12:30  
Last updated at: Apr 30, 2021 11:00:33

### Live data

See all activity --

- 10:09:42 1231234234.. Forward data message to Application Server
- 10:09:42 1231234234.. Store upstream data message
- 10:09:42 1231234234.. Forward uplink data message
- 10:09:42 1231234234.. Receive uplink data message
- 10:09:42 1231234234.. Successfully processed data message
- 10:09:42 1231234234.. Drop data message

End devices (4)

Search by ID

Import end devices

+ Add end device

ID

Name

DevEUI

JoinEUI

Created

Choose Manually to add WSC1-L

### Register end device

From The LoRaWAN Device Repository Manually

#### Preparation

Activation mode\*

Over the air activation (OTAA)  
 Activation by personalization (ABP)  
 Multicast  
 Do not configure activation

LoRaWAN version ⓘ \*

Select... | v

Network Server address

eu1.cloud.thethings.network

Application Server address

eu1.cloud.thethings.network

External Join Server ⓘ

Add APP KEY and DEV EUI

## 2. Enter registration data

Frequency plan ⓘ \*

Europe 863-870 MHz (SF12 for RX2) | v

The frequency plan used by the end device

AppEUI ⓘ \*

..... 00

The AppEUI uniquely identifies the owner of the end device. If no AppEUI is provided by the device manufacturer (usually for dev

DevEUI ⓘ \*

.....

The DevEUI is the unique identifier for this end device

AppKey ⓘ \*

.....

The root key to derive session keys to secure communication between the end device and the application

End device ID \*

my-new-device

After registration

**Step 2:** Power on WSC1-L, it will start to join TTN server. After join success, it will start to upload sensor data to TTN V3 and user can see in the panel.

The screenshot shows the Dragino LoRaWAN console interface. The main content area displays a list of events for the application '气象站\_楼顶\_2021/11/30 class C 10min'. The events include:

- 15:45:37 Schedule data downlink for transmission. Ret Delay: 5
- 15:45:37 Forward uplink data message. Payload: [ AZ: 201, TSR: 16 ]
- 15:45:37 Successfully processed data message. DevAddr: 28 08 44 29
- 15:45:26 Forward uplink data message. Payload: [ CO2: 654, HUM: 49.2, PAR: 311, PM2.5: 10, TEM: 21.8, illumination: 77879, pressure: 1009.7, wind\_gauge: 0, wind\_speed: 0, wind\_direction: 100, wind\_direction\_angle: 100.0, wind\_speed\_max: 0 ]
- 15:45:26 Successfully processed data message. DevAddr: 28 08 44 29
- 15:45:01 Schedule data downlink for transmission. Ret Delay: 5
- 15:45:01 Forward uplink data message. Payload: [ bat: 3.036, frequency\_band: "EU868", mode: "FSK1-L", sub\_band: 0, version: "V1.0.0", weather\_sensor\_type: "10000" ]
- 15:45:01 Successfully processed data message. DevAddr: 28 08 44 29
- 15:44:31 Forward join-accept message
- 15:44:30 Accept join-request
- 15:44:25 Forward join-accept message
- 15:44:23 Accept join-request
- 15:44:15 Forward uplink data message. Payload: [ whetimed: "HWK" ]
- 15:44:15 Successfully processed data message. DevAddr: 28 08 3E 34

The interface also shows a sidebar with navigation options like Overview, End devices, Live data, and Payload formatters. The top navigation bar includes 'Applications', 'Gateways', and 'Organizations'.

## 2.4 Uplink Payload

Uplink payloads include two types: Valid Sensor Value and other status / control command.

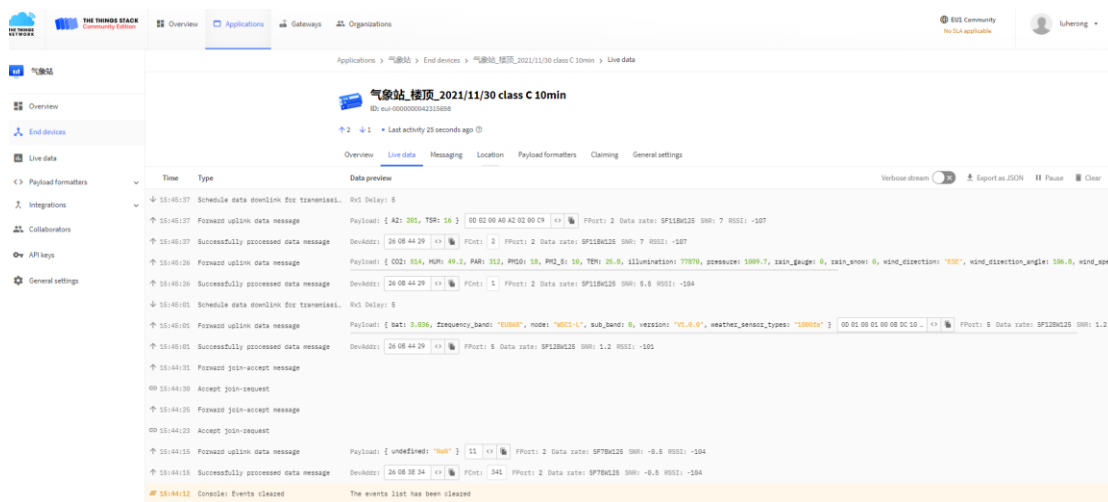
- Valid Sensor Value: Use FPORT=2
- Other control command: Use FPORT other than 2.

### 2.4.1 Uplink FPORT=5, Device Status

Uplink the device configures with FPORT=5. Once WSC1-L Joined the network, it will uplink this message to the server. After first uplink, WSC1-L will uplink Device Status every 12 hours

User can also use downlink command(0x2301) to ask WSC1-L to resend this uplink

Size (bytes)	1	2	1	1	2	3
Value	<a href="#">Sensor Model</a>	<a href="#">Firmware Version</a>	<a href="#">Frequency Band</a>	<a href="#">Sub-band</a>	<a href="#">BAT</a>	<a href="#">Weather Sensor Types</a>



Example Payload (FPort=5):

**0D 01 00 01 00 0B D6 10 00 FE**

**Sensor Model:** For WSC1-L, this value is 0x0D.

**Firmware Version:** 0x0100, Means: v1.0.0 version.

**Frequency Band:**

- \*0x01: EU868
- \*0x02: US915
- \*0x03: IN865
- \*0x04: AU915

- \*0x05: KZ865
- \*0x06: RU864
- \*0x07: AS923
- \*0x08: AS923-1
- \*0x09: AS923-2
- \*0x0a: AS923-3

**Sub-Band:** value 0x00 ~ 0x08(only for CN470, AU915,US915. Others are0x00)

**BAT:** shows the battery voltage for WSC1-L MCU.

Ex1: 0x0BD6/1000 = 3.03 V

**Weather Sensor Types:**

Byte3	Byte2	Byte1
-------	-------	-------

Bit = 1 means this sensor is connected, Bit=0 means this sensor is not connected

Byte3	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
	N/A	Customize-A4	Customize-A3	Customize-A2	Customize-A1	N/A	N/A	N/A
Byte2	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Byte1	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	WSS-07	WSS-06	WSS-05	WSS-04	WSS-03	WSS-02	WSS-01	N/A

Eg: 0x1000FE = 1 0000 0000 0000 1111 1110(b)

External sensors detected by WSC1-L include :

- custom sensor A1,
- PAR sensor (WSS-07),
- Total Solar Radiation sensor (WSS-06),
- CO2/PM2.5/PM10 (WSS-03),
- Wind Speed/Direction (WSS-02)

User can also use downlink command(0x26 01) to ask WSC1-L to resend this uplink :

**Downlink:0x26 01**

The screenshot displays the Dragino LoRaWAN Weather Station interface. The main content area shows a list of data messages with columns for Time, Type, and Data preview. The Data preview column contains detailed sensor data and network parameters. Two specific messages are highlighted with red boxes:

- The first highlighted message (at 15:34:39) shows a payload with the following fields: `[ bat: 3.05, ztevendor_band: "10000", mode: "MCC-1", sub_band: 0, version: "V1.0.0", weather_sensor_types: "10000" ]`. The `weather_sensor_types` field is highlighted.
- The second highlighted message (at 15:34:04) shows a payload with the following fields: `[ MAC payload: 20 00 ]`. The `MAC payload` field is highlighted.

The interface also includes a sidebar with navigation options like Overview, End devices, Live data, Payload formatters, Integrations, Collaborators, API keys, and General settings. The top navigation bar shows the current application and gateway information.

### 2.4.2 Uplink FPORT=2, Real time sensor value

WSC1-L will send this uplink after Device Config uplink once join LoRaWAN network successfully.

And it will periodically send this uplink. Default interval is 20 minutes and [can be changed](#).

Uplink uses FPORT=2 and every 20 minutes send one uplink by default.

The upload length is dynamic, depends on what type of weather sensors are connected. The uplink payload is combined with sensor segments. As below:

**Uplink Payload:**

Sensor Segment 1	Sensor Segment 2	.....	Sensor Segment n
------------------	------------------	-------	------------------

**Sensor Segment Define:**

Type Code	Length (Bytes)	Measured Value
-----------	----------------	----------------

Sensor Type Table:

Sensor Type	Type Code	Range	Length ( Bytes)	Example
<b>Wind Speed</b>	0x01	Speed: 0~60m/s Level: 0~17	0x03	0x0024/10=3.6m/s (0x02FE: No Sensor, 0x02FF: Value Error) 0x02=2 (0x14: No Sensor, 0x15: Value Error)
<b>Wind Direction</b>	0x02	Angel: 0~360° Direction: 16 positions	0x03	0x029A/10=66.6° (0x0EFE: No Sensor,0x0EFF: Value Error) 0x03=3(ENE) (0x14: No Sensor,0x15: Value Error)
<b>Illumination</b>	0x03	0~200000Lux	0x02	0x04D2 *10=12340Lux (0x4EFE: No Sensor,0x4EFF: Value Error)
<b>Rain / Snow</b>	0x04	00: No, 01 Yes.	0x01	0x00 (00) No Rain or snow detected (0x02: No Sensor,0x03: Value Error)
<b>CO2</b>	0x05	0~5000ppm	0x02	0x0378=888ppm (0x14FE: No Sensor,0x14FF: Value Error)
<b>Temperature</b>	0x06	-30℃~70℃	0x02	0xFFDD/10=-3.5℃ (0x02FE: No Sensor,0x02FF: Value Error)
<b>Humidity</b>	0x07	0~100%RH	0x02	0x0164/10=35.6%RH (0x03FE: No Sensor,0x03FF: Value Error)
<b>Pressure</b>	0x08	10~1100hPa	0x02	0x2748/10=1005.6hPa (0x00: No Sensor,0x01: Value Error)
<b>Rain Gauge</b>	0x09	0mm/min~100mm/min	0x02	0x0000/10=0mm /min (0x03FE: No Sensor,0x03FF: Value Error)
<b>PM2.5</b>	0x0A	0~1000µg/m³	0x02	0x0023=35µg/m³ (0x03FE: No Sensor,0x03FF: Value Error)



<b>PM10</b>	0x0B	0~1000μg/m <sup>3</sup>	0x02	0x002D=45μg/m <sup>3</sup> (0x03FE: No Sensor,0x03FF: Value Error)
<b>PAR</b>	0x0C	0~2500μmol/m <sup>2</sup> •s	0x02	0x00B3=179μmol/m <sup>2</sup> •s (0x09FE: No Sensor,0x9FF: Value Error)
<b>Total Solar Radiation</b>	0x0D	0~2000W/m <sup>2</sup>	0x02	0x0073/10=11.5W/m <sup>2</sup> (0x4EFE: No Sensor,0x4EFF: Value Error)

Below is an example payload:

01 03 00 14 02 02 03 02 C9 03 03 02 11 90 04 02 00 0A 05 02 02 1C 06 02 00 FA 07 02 02 62 08 02 27 63 09 02 00 00 0A 02 00 23 0B 02 00 2D 0C 02 00 B3 0D 02 00 73

When sending this payload to LoRaWAN server. WSC1-L will send this in one uplink or several uplinks according to LoRaWAN spec requirement. For example, total length of Payload is 54 bytes.

- When WSC1-L sending in US915 frequency DR0 data rate. Because this data rate has limitation of 11 bytes payload for each uplink. The payload will be split into below packets and uplink. Uplink 1: 01 03 00 14 02 02 03 02 C9 03

Uplink 2: 03 02 11 90 04 02 00 0A 05 02 02 1C 06 02 00 FA 07 02 02 62 08 02 27 63 09 02 00 00 0A 02 00 23 0B 02 00 2D 0C 02 00 B3 0D 02 00 73

- When WSC1-L sending in EU868 frequency DR0 data rate. The payload will be split into below packets and uplink:

Uplink 1: 01 03 00 14 02 02 03 02 C9 03 03 02 11 90 04 02 00 0A 05 02 02 1C 06 02 00 FA 07 02 02 62 08 02 27 63 09 02 00 00 0A 02 00 23 0B 02 00 2D 0C 02 00 B3

Uplink 2: 0D 02 00 73

### 2.4.3 Decoder in TTN V3

In LoRaWAN platform, user only see HEX payload by default, user needs to use payload formatters to decode the payload to see human-readable value.

Download decoder for suitable platform from:

[https://www.dragino.com/downloads/index.php?dir=LoRa\\_End\\_Node/Weather\\_Station/WSC1-L](https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/Weather_Station/WSC1-L)

/

and put as below:

## 2.5 Show data on Application Server

Application platform provides a human friendly interface to show the sensor data, once we have sensor data in TTN V3, we can use Datacake to connect to TTN V3 and see the data in Datacake. Below are the steps:

**Step 1:** Be sure that your device is programmed and properly connected to the LoRaWAN network.

**Step 2:** Configure your Application to forward data to Datacake you will need to add integration. Go to TTN V3 Console --> Applications --> Integrations --> Add Integrations.

## Add TagoIO:

Applications > 气象站 > Webhooks > Add > Custom webhook

### Add custom webhook

#### Template information

**TagoIO**  
Integrate with TagoIO  
[About TagoIO](#) | [Documentation](#)

#### Template settings

**Webhook ID\***

**Authorization\***

TagoIO Authorization

[Create tagoio webhook](#)

## Authorization:

Name	Last Input	Last Output	Connector	Network	Active	Bucket linked	Created at
测距超声波	3 minutes ago	Never	Custom The Things Industries	LoRaWAN TT/TTN v3	Yes	测距超声波	3 months ago
LD503A_后门	22 minutes ago	Never	Custom The Things Industries	LoRaWAN TT/TTN v3	Yes	LD503A_后门	3 months ago
气象站	3 minutes ago	Never	Custom The Things Industries	LoRaWAN TT/TTN v3	Yes	气象站	3 months ago

In TagoIO console (<https://admin.tago.io/>), add WSC1-L:



### 3. Configure WSC1-L via AT Command or LoRaWAN Downlink

Use can configure WSC1-L via AT Command or LoRaWAN Downlink.

- AT Command Connection: See [FAQ](#).
- LoRaWAN Downlink instruction for different platforms:

[http://wiki.dragino.com/index.php?title=Main\\_Page#Use\\_Note\\_for\\_Server](http://wiki.dragino.com/index.php?title=Main_Page#Use_Note_for_Server)

There are two kinds of commands to configure WSC1-L, they are:

- **General Commands.**

These commands are to configure:

- ✓ General system settings like: uplink interval.
- ✓ LoRaWAN protocol & radio related command.

They are same for all Dragino Device which support DLWS-005 LoRaWAN Stack(**Note\*\***). These commands can be found on the wiki:

[http://wiki.dragino.com/index.php?title=End\\_Device\\_Downlink\\_Command](http://wiki.dragino.com/index.php?title=End_Device_Downlink_Command)

**Note\*\*:** Please check early user manual if you don't have v1.8.0 firmware.

- **Commands special design for WSC1-L**

These commands only valid for WSC1-L, as below:

#### 3.1 Set Transmit Interval Time

Feature: Change LoRaWAN End Node Transmit Interval.

##### AT Command: AT+TDC

Command Example	Function	Response
AT+TDC?	Show current transmit Interval	30000 OK the interval is 30000ms = 30s
AT+TDC=60000	Set Transmit Interval	OK Set transmit interval to 60000ms = 60 seconds

##### Downlink Command: 0x01

Format: Command Code (0x01) followed by 3 bytes time value.

If the downlink payload=0100003C, it means set the END Node's Transmit Interval to 0x00003C=60(S), while type code is 01.

- Example 1: Downlink Payload: 0100001E // Set Transmit Interval (TDC) = 30 seconds
- Example 2: Downlink Payload: 0100003C // Set Transmit Interval (TDC) = 60 seconds

### 3.2 Set Emergency Mode

Feature: In emergency mode, WSC1-L will uplink data every 1 minute.

#### AT Command:

Command Example	Function	Response
AT+ALARMMOD=1	Enter emergency mode. Uplink every 1 minute	OK
AT+ALARMMOD=0	Exit emergency mode. Uplink base on TDC time	OK

#### Downlink Command:

- ✧ 0xE101 Same as: AT+ALARMMOD=1
- ✧ 0xE100 Same as: AT+ALARMMOD=0

### 3.3 Add or Delete RS485 Sensor

Feature: User can add or delete 3<sup>rd</sup> party sensor as long they are RS485/Modbus interface, baud rate support 9600. Maximum can add 4 sensors.

#### AT Command:

AT+DYSENSOR=Type\_Code, Query\_Length, Query\_Command , Read\_Length , Valid\_Data ,has\_CRC,timeout

- Type\_Code range: A1 ~ A4
- Query\_Length: RS485 Query frame length, Value cannot be greater than **10**
- Query\_Command: RS485 Query frame data to be sent to sensor, cannot be larger than **10** bytes
- Read\_Length: RS485 response frame length supposed to receive. Max can receive
- Valid\_Data: valid data from RS485 Response, Valid Data will be added to Payload and upload via LoRaWAN.
- has\_CRC: RS485 Response crc check (0: no verification required 1: verification required). If CRC=1 and CRC error, valid data will be set to 0.
- timeout: RS485 receive timeout (uint:ms). Device will close receive window after timeout

Example:

User need to change external sensor use the type code as address code.

With a 485 sensor, after correctly changing the address code to A1, the RS485 query frame is shown in the following table:

Address Code	Function Code	Start Register		Data Length		CRC Check Low	CRC Check High
0xA1	0x03	0x00	0x00	0x00	0x01	0x9C	0xAA

The response frame of the sensor is as follows:

Address Code	Function Code	Data Length		Data		CRC Check Low	CRC Check High
0xA1	0x03	0x00	0x02	0x00	0x0A	0x7C	0xAD

Then the following parameters should be:

- Address\_Code range: A1
- Query\_Length: 8
- Query\_Command: A10300000019CAA
- Read\_Length: 8
- Valid\_Data: 24 (Indicates that the data length is 2 bytes, starting from the 4th byte)
- has\_CRC: 1
- timeout: 1500 (Fill in the test according to the actual situation)

So the input command is:

AT+DYSENSOR=A1,8,A10300000019CAA,8,24,1,1500

In every sampling, WSC1-L will auto append the sensor segment as per this structure and uplink.

Type Code	Length (Bytes)	Measured Value
A1	2	0x000A

Related commands:

AT+DYSENSOR=A1,0 → Delete 3<sup>rd</sup> party sensor A1.

AT+DYSENSOR --> List All 3<sup>rd</sup> Party Sensor. Like below:

#### Downlink Command:

##### delete custom sensor A1:

✧ 0xE5A1 Same as: AT+DYSENSOR=A1,0

##### Remove all custom sensors

✧ 0xE5FF

### 3.4 RS485 Test Command

#### AT Command:

Command Example	Function	Response
AT+RSWRITE=xxxxxx	Send command to 485 sensor Range : no more than 10 bytes	OK

Eg: Send command **01 03 00 00 00 01 84 0A** to 485 sensor

AT+RSWRITE=0103000001840A

#### Downlink Command:

✧ 0xE20103000001840A Same as: AT+RSWRITE=0103000001840A

### 3.5 RS485 response timeout

Feature: Set or get extended time to receive 485 sensor data.

#### AT Command:

Command Example	Function	Response
AT+DTR=1000	Set response timeout to: Range : 0~10000	OK

#### Downlink Command:

Format: Command Code (0xE0) followed by 3 bytes time value.

If the downlink payload=E0000005, it means set the END Node's Transmit Interval to 0x000005=5(S), while type code is E0.

- Example 1: Downlink Payload: E0000005 // Set Transmit Interval (DTR) = 5 seconds
- Example 2: Downlink Payload: E000000A // Set Transmit Interval (DTR) = 10 seconds

### 3.6 Set Sensor Type

Feature: Set sensor in used. If there are 6 sensors, user can set to only send 5 sensors values.

See [definition](#) for the sensor type.

Byte3	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
		A4	A3	A2	A1			
Byte2	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8
			Solar Radiation	PAR	PM10	PM2.5	Rain Gauge	Air Pressure
Byte1	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	Humidity	Temperature	CO2	Rain/Snow Detect	illuminance	Wind Direction	Wind Speed	BAT

#### AT Command:

Command Example	Function	Response
AT+STYPE=80221	Set sensor types	OK

Eg: The setting command **AT+STYPE=802212** means:

Byte3	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
	0	0	0	0	1	0	0	0
Byte2	Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8
	0	0	0	0	0	0	1	0
Byte1	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	0	0	1	0	0	0	0	1

So wsc1-L will upload the following data: Custom Sensor A1, Rain Gauge,CO2,BAT.

#### Downlink Command:

✧ 0xE400802212 Same as: AT+STYPE=80221

#### Note:

1. The sensor type will not be saved to flash, and the value will be updated every time the sensor is restarted or rescanned



## **4. Power consumption and battery**

### **4.1 Total Power Consumption**

Dragino Weather Station serial products include the main process unit ( WSC1-L ) and various sensors. The total power consumption equal total power of all above units. The power consumption for main process unit WSC1-L is 18ma @ 12v. and the power consumption of each sensor can be found on the Sensors chapter.

### **4.2 Reduce power consumption**

The main process unit WSC1-L is set to LoRaWAN Class C by default. If user want to reduce the power consumption of this unit, user can set it to run in Class A. In Class A mode, WSC1-L will not be to get real-time downlink command from IoT Server.

### **4.3 Battery**

All sensors are only power by external power source. If external power source is off. All sensor won't work.

Main Process Unit WSC1-L is powered by both external power source and internal 1000mAh rechargeable battery. If external power source is off, WSC1-L still runs and can send periodically uplinks, but the sensors value will become invalid. External power source can recharge the 1000mAh rechargeable battery.

## 5. Main Process Unit WSC1-L

### 5.1 Features

- ✓ Wall Attachable.
- ✓ LoRaWAN v1.0.3 Class A protocol.
- ✓ RS485 / Modbus protocol
- ✓ Frequency Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915
- ✓ AT Commands to change parameters
- ✓ Remote configure parameters via LoRaWAN Downlink
- ✓ Firmware upgradable via program port
- ✓ Powered by external 12v battery
- ✓ Back up rechargeable 1000mAh battery
- ✓ IP Rating: IP65
- ✓ Support default sensors or 3rd party RS485 sensors

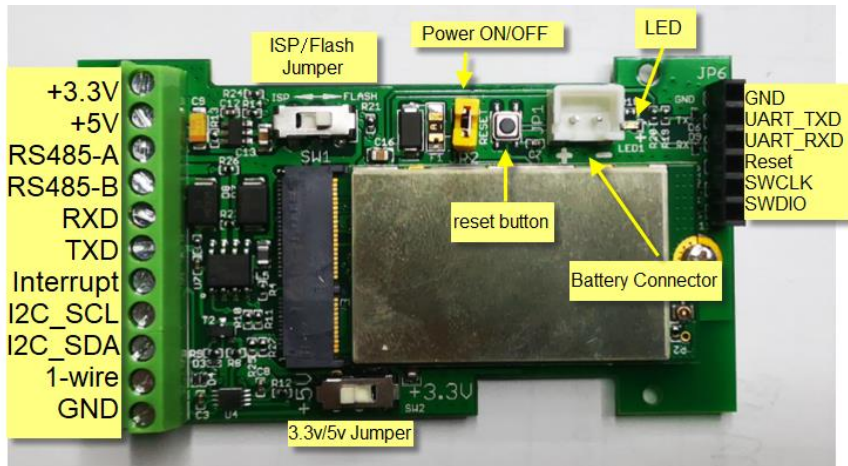
### 5.2 Power Consumption

WSC1-L (without external sensor): Idle: 4mA, Transmit: max 40mA

### 5.3 Storage & Operation Temperature

-20°C to +60°C

### 5.4 Pin Mapping



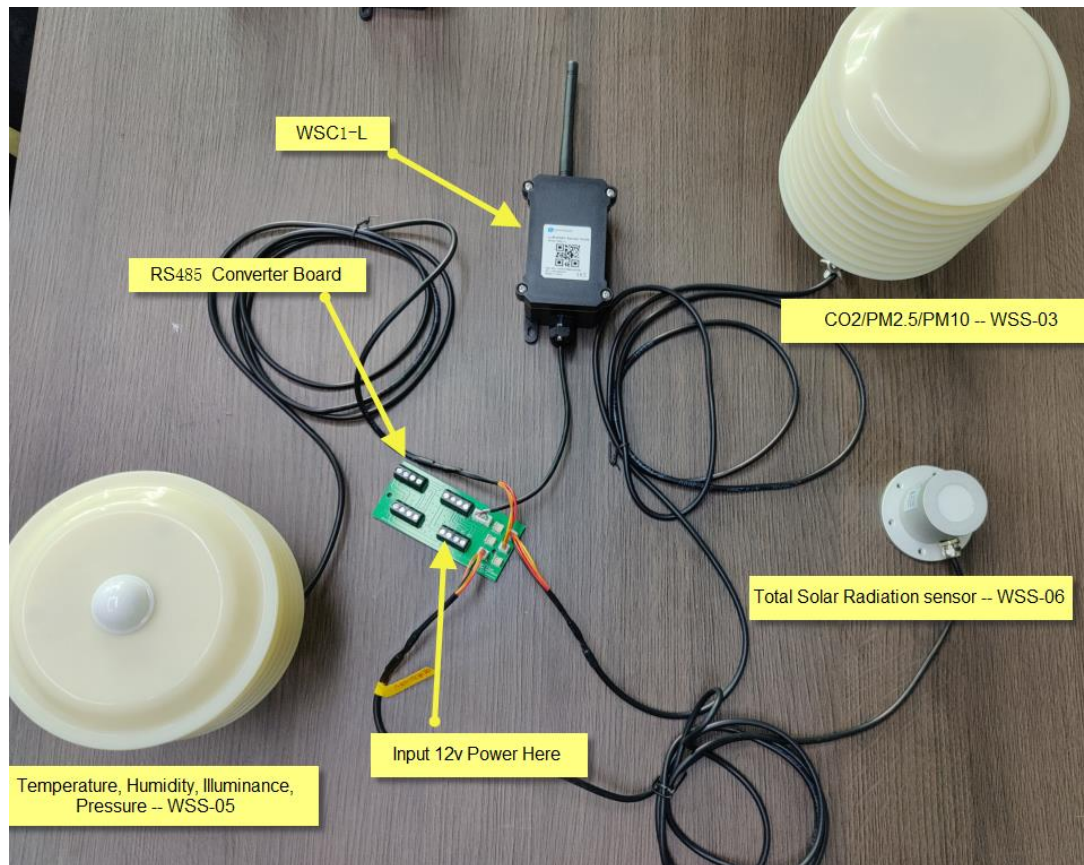
### 5.5 Mechanical

Refer LSn50v2 enclosure drawing in:

[https://www.dragino.com/downloads/index.php?dir=LSN50-LoRaST/Mechanical\\_Drawing/](https://www.dragino.com/downloads/index.php?dir=LSN50-LoRaST/Mechanical_Drawing/)

## 5.6 Connect to RS485 Sensors

WSC1-L includes a RS485 converter PCB. Which help it easy to connect multiply RS485 sensors.  
Below is the photo for reference.



Hardware Design for the Converter Board please see:

[https://www.dragino.com/downloads/index.php?dir=LoRa\\_End\\_Node/Weather\\_Station/RS485\\_Converter\\_Board/](https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/Weather_Station/RS485_Converter_Board/)

## 6. Weather Sensors

### 6.1 Rain Gauge -- WSS-01

WSS-01 RS485 Rain Gauge is used in meteorology and hydrology to gather and measure the amount of liquid precipitation (mainly rainfall) over an area.

WSS-01 uses a tipping bucket to detect rainfall. The tipping bucket use 3D streamline shape to make sure it works smoothly and is easy to clean.

WSS-01 is designed to support the Dragino Weather station solution.

Users only need to connect WSS-01 RS485 interface to WSC1-L. The weather station main processor WSC1-L can detect and upload the rainfall to the IoT Server via wireless LoRaWAN protocol

The tipping bucket of WSS-01 is adjusted to the best angle. When installation, user only needs to screw up and adjust the bottom horizontally.

WSS-01 package includes screw which can be installed to ground. If user want to install WSS-01 on pole, they can purchase WS-K2 bracket kit.

#### 6.1.1 Feature

- RS485 Rain Gauge
- Small dimension, easy to install
- Vents under funnel, avoid leaf or other things to avoid rain flow.
- ABS enclosure.
- Horizontal adjustable.

#### 6.1.2 Specification

- Resolution: 0.2mm
- Accuracy:  $\pm 3\%$
- Rainfall strength: 0mm~4mm/min (max 8mm/min)
- Input Power: DC 5~24v
- Interface: RS485
- Working Temperature: 0°C~70°C ( incorrect below 0 degree, because water become ICE)
- Working Humidity: <100% (no dewing)
- Power Consumption: 4mA @ 12v.

### 6.1.3 Dimension



### 6.1.4 Pin Mapping



### 6.1.5 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.

Installation Photo as reference:

#### Install on Ground:

WSS-01 Rain Gauge include screws so can install in ground directly .

#### Install on pole:

If user want to install on pole, they can purchase the **WS-K2 : Bracket Kit for Pole installation**, and install as below:



WS-K2: Bracket Kit for Pole installation:



WSSC-K2 dimension document, please see:

[https://www.dragino.com/downloads/index.php?dir=LoRa\\_End\\_Node/Weather\\_Station/](https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/Weather_Station/)

## 6.2 Wind Speed/Direction -- WSS-02



WSS-02 is a RS485 wind speed and wind direction monitor designed for weather station solution.

WSS-02 shell is made of polycarbonate composite material, which has good anti-corrosion and anti-corrosion characteristics, and ensure the long-term use of the sensor without rust. At the same time, it cooperates with the internal smooth bearing system to ensure the stability of information collection

Users only need to connect WSS-02 RS485 interface to WSC1-L. The weather station main processor WSC1-L can detect and upload the wind speed and direction to the IoT Server via wireless LoRaWAN protocol.

### 6.2.1 Feature

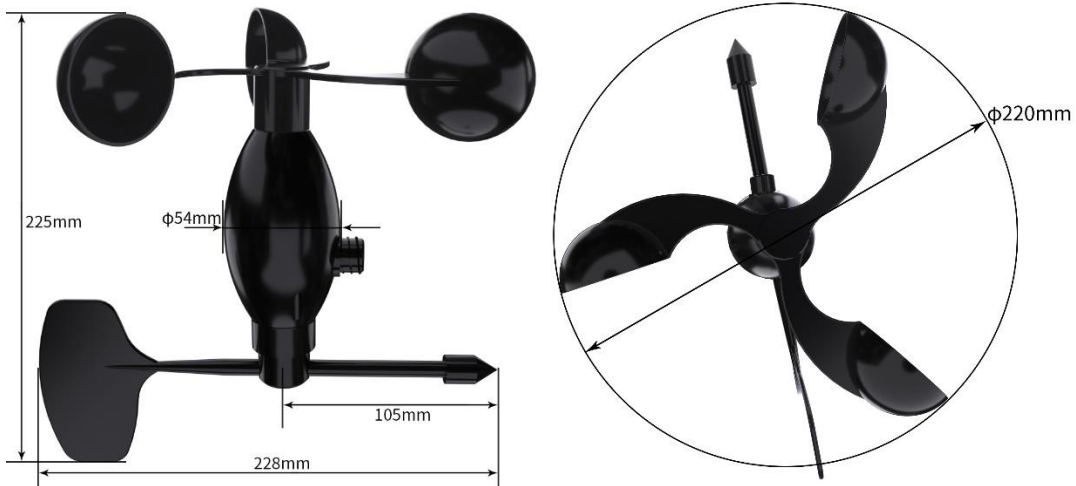
- RS485 wind speed / direction sensor
- PC enclosure, resist corrosion

### 6.2.2 Specification

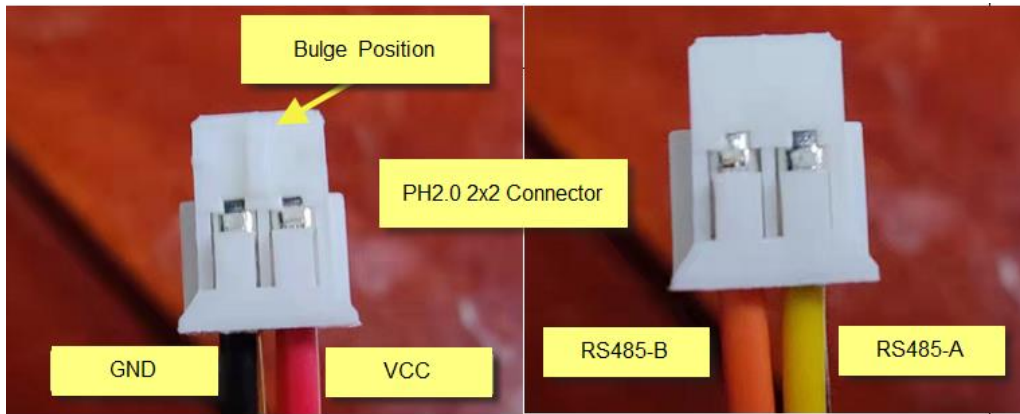
- Wind speed range: 0 ~ 30m/s, (always show 30m/s for higher speed)
- Wind direction range: 0 ~ 360°
- Start wind speed:  $\leq 0.3$ m/s
- Accuracy:  $\pm (0.3 + 0.03V)$  m/s ,  $\pm 1^\circ$
- Input Power: DC 5~24v
- Interface: RS485
- Working Temperature:  $-30^\circ\text{C} \sim 70^\circ\text{C}$
- Working Humidity: <100% (no dewing)
- Power Consumption: 13mA ~ 12v.
- Cable Length: 2 meters

### 6.2.3 Dimension

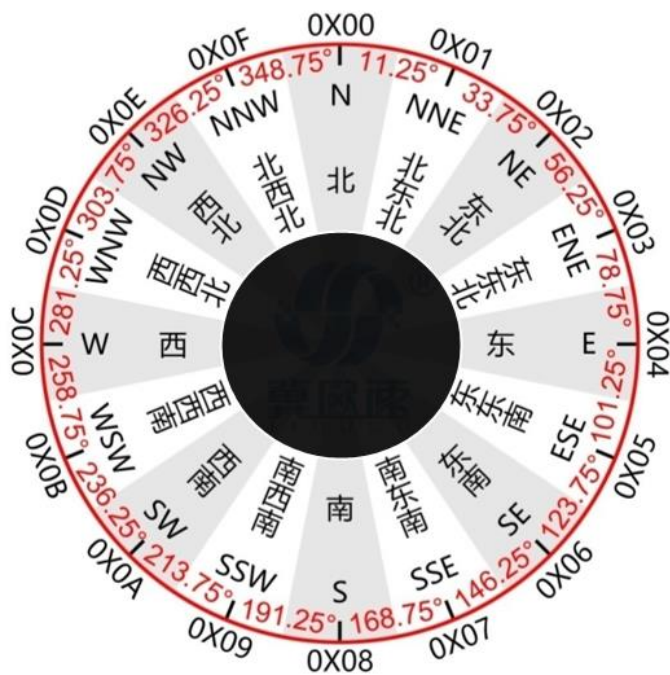




### 6.2.4 Pin Mapping



### 6.2.5 Angle Mapping



### 6.2.6 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.

The sensor must be installed with below direction, towards North.



### 6.3 CO<sub>2</sub>/PM<sub>2.5</sub>/PM<sub>10</sub> -- WSS-03

WSS-03 is a RS485 Air Quality sensor. It can monitor CO<sub>2</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> at the same time.

WSS-03 uses weather proof shield which can make sure the sensors are well protected against UV & radiation.

WSS-03 is designed to support the Dragino Weather station solution.

Users only need to connect WSS-03 RS485 interface to WSC1-L. The weather station main processor WSC1-L can detect and upload the environment CO<sub>2</sub>, PM<sub>2.5</sub> and PM<sub>10</sub> to the IoT Server via wireless LoRaWAN protocol.

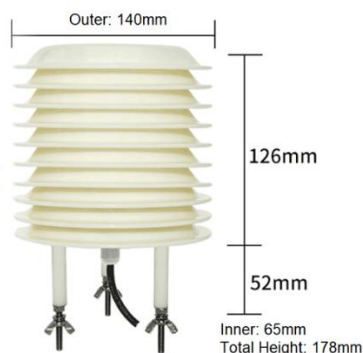
#### 6.3.1 Feature

- RS485 CO<sub>2</sub>, PM<sub>2.5</sub>, PM<sub>10</sub> sensor
- NDIR to measure CO<sub>2</sub> with Internal Temperature Compensation
- Laser Beam Scattering to PM<sub>2.5</sub> and PM<sub>10</sub>

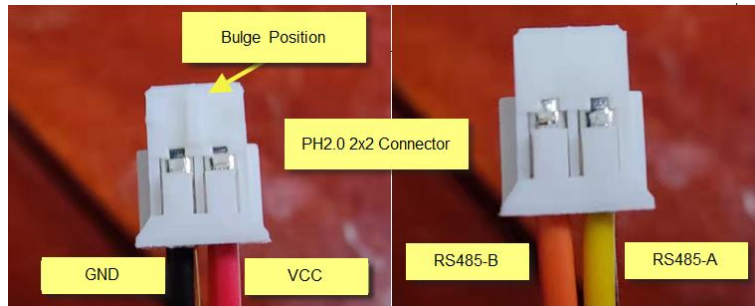
#### 6.3.2 Specification

- CO<sub>2</sub> Range: 0~5000ppm, accuracy:  $\pm 3\%F \cdot S$  (25°C)
- CO<sub>2</sub> resolution: 1ppm
- PM<sub>2.5</sub>/PM<sub>10</sub> Range: 0~1000 $\mu\text{g}/\text{m}^3$ , accuracy  $\pm 3\%F \cdot S$  (25°C)
- PM<sub>2.5</sub>/PM<sub>10</sub> resolution: 1 $\mu\text{g}/\text{m}^3$
- Input Power: DC 7 ~ 24v
- Preheat time: 3min
- Interface: RS485
- Working Temperature:
  - ✧ CO<sub>2</sub>: 0°C ~ 50°C;
  - ✧ PM<sub>2.5</sub>/PM<sub>10</sub>: -30 ~ 50°C
- Working Humidity:
  - ✧ PM<sub>2.5</sub>/PM<sub>10</sub>: 15~80%RH (no dewing)
  - ✧ CO<sub>2</sub>: 0~95%RH
- Power Consumption: 50mA@ 12v.

#### 6.3.3 Dimension

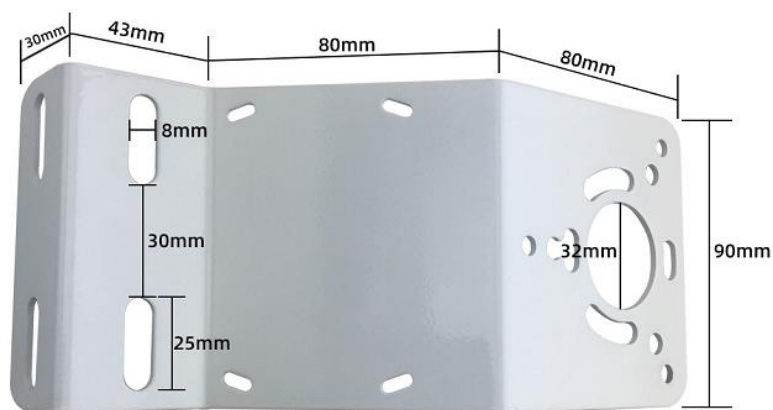


### 6.3.4 Pin Mapping



### 6.3.5 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.



## 6.4 Rain/Snow Detect -- WSS-04

WSS-04 is a RS485 rain / snow detect sensor. It can monitor Rain or Snow event.

WSS-04 has auto heating feature, this ensures measurement more reliable.

WSS-04 is designed to support the Dragino Weather station solution.

Users only need to connect WSS-04 RS485 interface to WSC1-L. The weather station main processor WSC1-L can detect and upload the SNOW/Rain Event to the IoT Server via wireless LoRaWAN protocol.

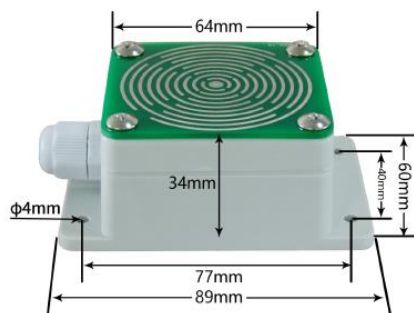
### 6.4.1 Feature

- RS485 Rain/Snow detect sensor
- Surface heating to dry
- grid electrode uses Electroless Nickel/Immersion Gold design for resist corrosion

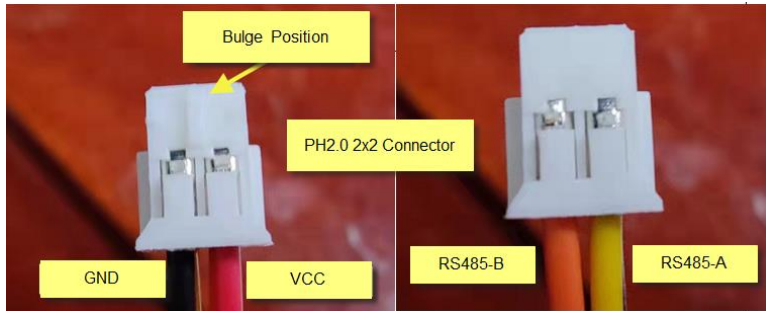
### 6.4.2 Specification

- Detect if there is rain or snow
- Input Power: DC 12 ~ 24v
- Interface: RS485
- Working Temperature:  $-30^{\circ}\text{C} \sim 70^{\circ}\text{C}$
- Working Humidity: 10~90%RH
- Power Consumption:
  - ✧ No heating: 12mA @ 12v,
  - ✧ heating: 94ma @ 12v.

### 6.4.3 Dimension



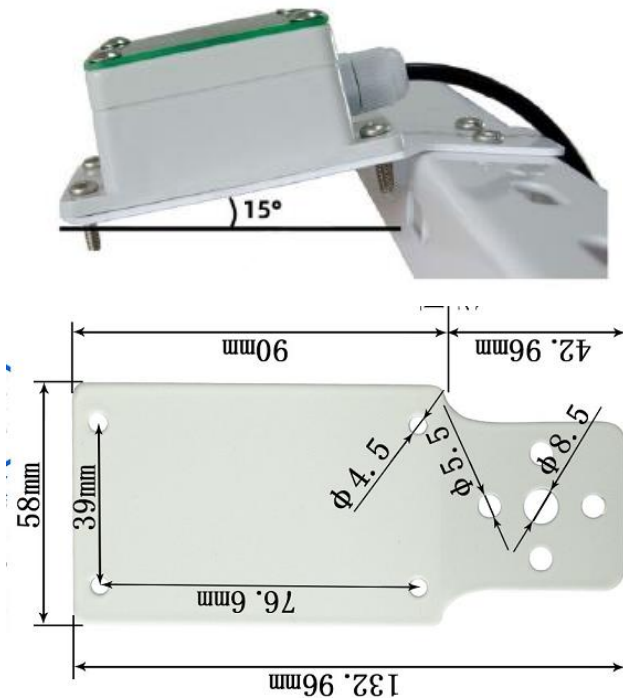
### 6.4.4 Pin Mapping



### 6.4.5 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.

Install with 15° degree.



### 6.4.6 Heating

WSS-04 supports auto-heat feature. When the temperature is below the heat start temperature 15°C, WSS-04 starts to heat and stop at stop temperature (default is 25°C).

## 6.5 Temperature, Humidity, Illuminance, Pressure -- WSS-05

WSS-05 is a 4 in 1 RS485 sensor which can monitor Temperature, Humidity, Illuminance and Pressure at the same time.

WSS-05 is designed to support the Dragino Weather station solution.

Users only need to connect WSS-05 RS485 interface to WSC1-L. The weather station main processor WSC1-L can detect and upload environment Temperature, Humidity, Illuminance, Pressure to the IoT Server via wireless LoRaWAN protocol.

### 6.5.1 Feature

- RS485 Temperature, Humidity, Illuminance, Pressure sensor

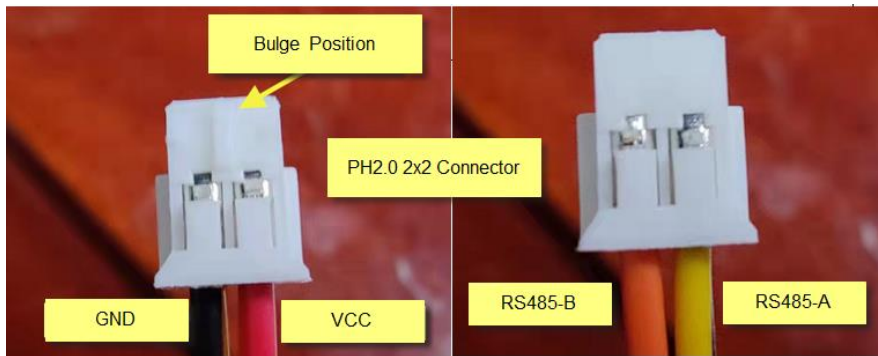
### 6.5.2 Specification

- Input Power: DC 12 ~ 24v
- Interface: RS485
- Temperature Sensor Spec:
  - ✧ Range: -30 ~ 70°C
  - ✧ resolution 0.1°C
  - ✧ Accuracy:  $\pm 0.5^\circ\text{C}$
- Humidity Sensor Spec:
  - ✧ Range: 0 ~ 100% RH
  - ✧ resolution 0.1 %RH
  - ✧ Accuracy: 3% RH
- Pressure Sensor Spec:
  - ✧ Range: 10~1100hPa
  - ✧ Resolution: 0.1hPa
  - ✧ Accuracy:  $\pm 0.1\text{hPa}$
- Illuminate sensor:
  - ✧ Range: 0~2/20/200kLux
  - ✧ Resolution: 10 Lux
  - ✧ Accuracy:  $\pm 3\%FS$
- Working Temperature: -30°C ~ 70°C
- Working Humidity: 10~90%RH
- Power Consumption: 4mA @ 12v

### 6.5.3 Dimension

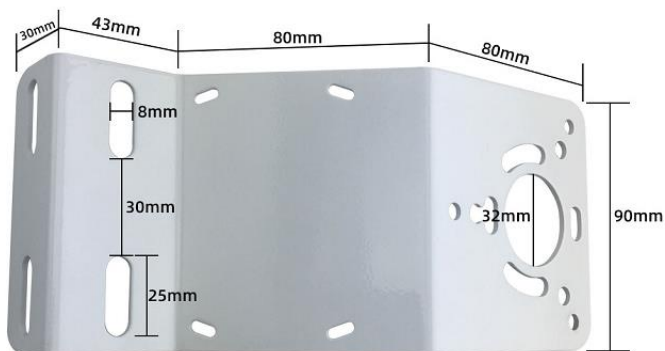


### 6.5.4 Pin Mapping



### 6.5.5 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.





## 6.6 Total Solar Radiation sensor -- WSS-06

WSS-06 is Total Radiation Sensor can be used to measure the total solar radiation in the spectral range of 0.3 to 3  $\mu\text{m}$  (300 to 3000 nm). If the sensor face is down, the reflected radiation can be measured, and the shading ring can also be used to measure the scattered radiation.

The core device of the radiation sensor is a high-precision photosensitive element, which has good stability and high precision; at the same time, a precision-machined PTTE radiation cover is installed outside the sensing element, which effectively prevents environmental factors from affecting its performance

WSS-06 is designed to support the Dragino Weather station solution.

Users only need to connect WSS-06 RS485 interface to WSC1-L. The weather station main processor WSC1-L can detect and upload Total Solar Radiation to the IoT Server via wireless LoRaWAN protocol.

### 6.6.1 Feature

- RS485 Total Solar Radiation sensor
- Measure Total Radiation between 0.3~3  $\mu\text{m}$  (300~3000nm)
- Measure Reflected Radiation if sense area towards ground.

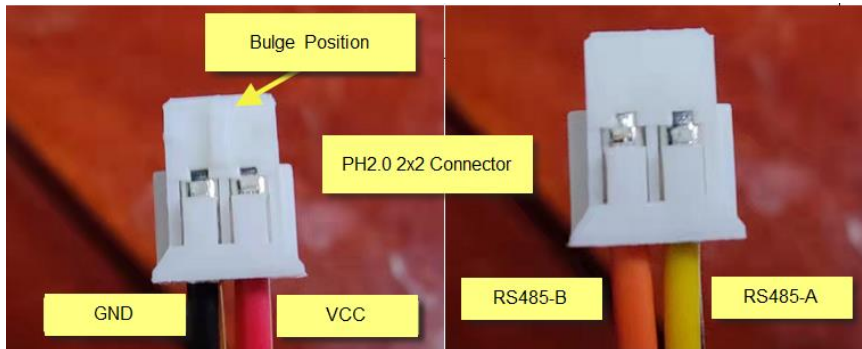
### 6.6.2 Specification

- Input Power: DC 5 ~ 24v
- Interface: RS485
- Detect spectrum: 0.3~3 $\mu\text{m}$  (300~3000nm)
- Measure strength range: 0~2000W/m<sup>2</sup>
- Resolution: 0.1W/m<sup>2</sup>
- Accuracy:  $\pm 3\%$
- Yearly Stability:  $\leq \pm 2\%$
- Cosine response:  $\leq 7\%$  (@ Sun angle 10° )
- Temperature Effect:  $\pm 2\%$  ( -10°C ~ 40°C )
- Working Temperature: -40°C ~ 70°C
- Working Humidity: 10~90%RH
- Power Consumption: 4mA @ 12v

### 6.6.3 Dimension

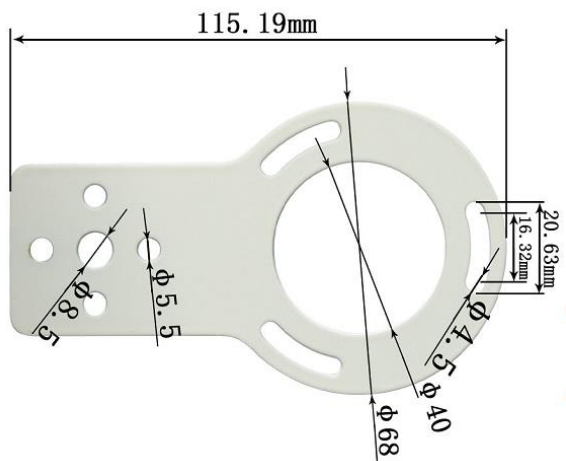


### 6.6.4 Pin Mapping



### 6.6.5 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.



## 6.7 PAR (Photosynthetically Available Radiation) -- WSS-07

WSS-07 photosynthetically active radiation sensor is mainly used to measure the photosynthetically active radiation of natural light in the wavelength range of 400-700nm.

WSS-07 use precision optical detectors and has an optical filter of 400-700nm, when natural light is irradiated, a voltage signal proportional to the intensity of the incident radiation is generated, and its luminous flux density is proportional to the cosine of the direct angle of the incident light.

WSS-07 is designed to support the Dragino Weather station solution.

Users only need to connect WSS-07 RS485 interface to WSC1-L. The weather station main processor WSC1-L can detect and upload Photosynthetically Available Radiation to the IoT Server via wireless LoRaWAN protocol.

### 6.7.1 Feature

PAR (Photosynthetically Available Radiation) sensor measure 400 ~ 700nm wavelength nature light's Photosynthetically Available Radiation.

When nature light shine on the sense area, it will generate a signal base on the incidence radiation strength.

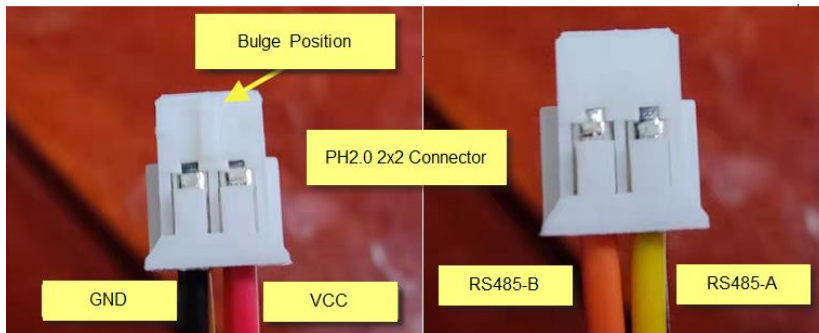
### 6.7.2 Specification

- Input Power: DC 5 ~ 24v
- Interface: RS485
- Response Spectrum: 400~700nm
- Measure range: 0~2500 $\mu$ mol/m<sup>2</sup>•s
- Resolution: 1 $\mu$ mol/m<sup>2</sup>•s
- Accuracy:  $\pm$ 2%
- Yearly Stability:  $\leq$   $\pm$ 2%
- Working Temperature: -30 $^{\circ}$ C ~ 75 $^{\circ}$ C
- Working Humidity: 10~90%RH
- Power Consumption: 3mA @ 12v

### 6.7.3 Dimension

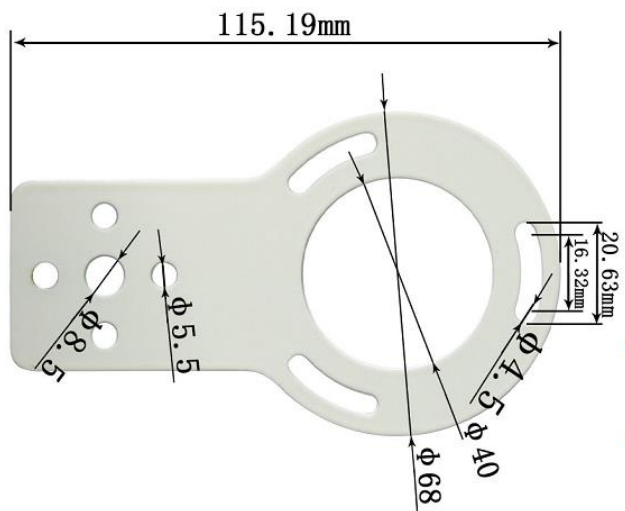


### 6.7.4 Pin Mapping



### 6.7.5 Installation Notice

Do not power on while connect the cables. Double check the wiring before power on.

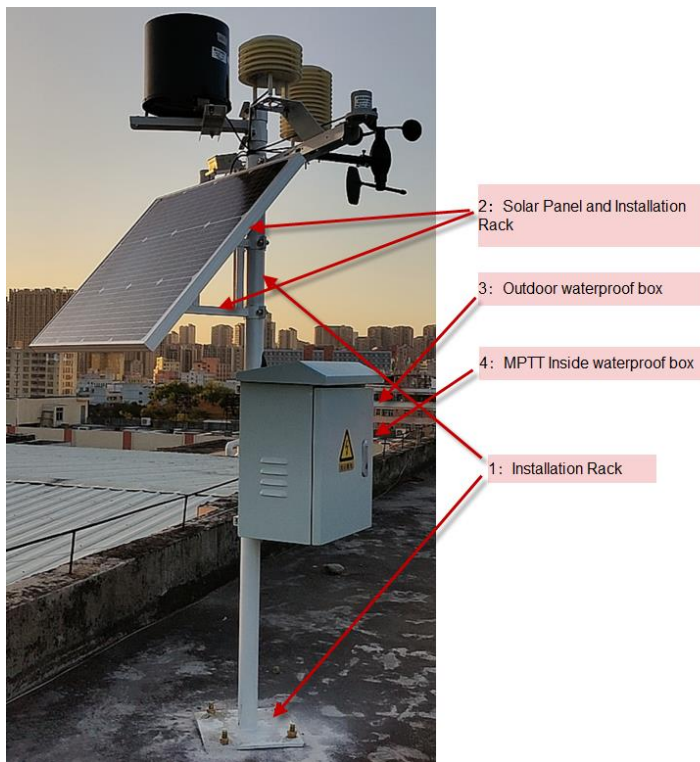
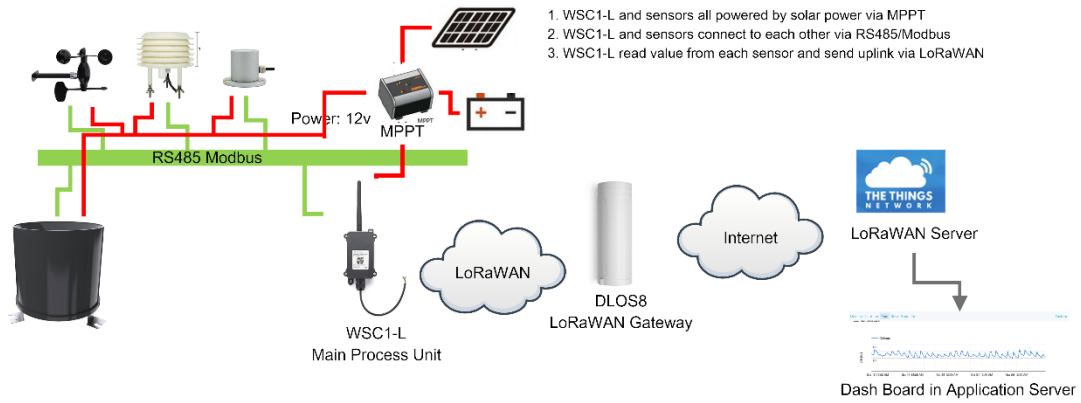


## 7. FAQ

### 7.1 What else do I need to purchase to build Weather Station?

Below is the installation photo and structure:

WSC1-L Weather Station Installation Diagram



## 7.2 How to upgrade firmware for WSC1-L?

Firmware Location & Change log:

[https://www.dragino.com/downloads/index.php?dir=LoRa\\_End\\_Node/WSC1-L/](https://www.dragino.com/downloads/index.php?dir=LoRa_End_Node/WSC1-L/)

Firmware Upgrade instruction:

[https://wiki.dragino.com/index.php?title=Firmware Upgrade Instruction for STM32 base products#Hardware Upgrade Method Support List](https://wiki.dragino.com/index.php?title=Firmware_Upgrade_Instruction_for_STM32_base_products#Hardware_Upgrade_Method_Support_List)

## 7.3 How to change the LoRa Frequency Bands/Region?

User can follow the introduction for how to upgrade image. When download the images, choose the required image file for download.

## 7.4 Can I add my weather sensors?

Yes, connect the sensor to RS485 bus and see instruction: [add sensors](#).

## 8. Trouble Shooting

## 9. Order Info

### 9.1 Main Process Unit

Part Number: **WSC1-L-XX**

**XX**: The default frequency band

- ✓ **AS923**: LoRaWAN AS923 band
- ✓ **AU915**: LoRaWAN AU915 band
- ✓ **EU433**: LoRaWAN EU433 band
- ✓ **EU868**: LoRaWAN EU868 band
- ✓ **KR920**: LoRaWAN KR920 band
- ✓ **US915**: LoRaWAN US915 band
- ✓ **IN865**: LoRaWAN IN865 band
- ✓ **CN470**: LoRaWAN CN470 band

### 9.2 Sensors

Sensor Model	Part Number
Rain Gauge	WSS-01
Rain Gauge installation Bracket for Pole	WS-K2
Wind Speed Direction 2 in 1 Sensor	WSS-02
CO2/PM2.5/PM10 3 in 1 Sensor	WSS-03
Rain/Snow Detect Sensor	WSS-04
Temperature, Humidity, illuminance and Pressure 4 in 1 sensor	WSS-05
Total Solar Radiation Sensor	WSS-06
PAR (Photosynthetically Available Radiation)	WSS-07

## 10. Support

- Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be 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

[support@dragino.com](mailto:support@dragino.com)

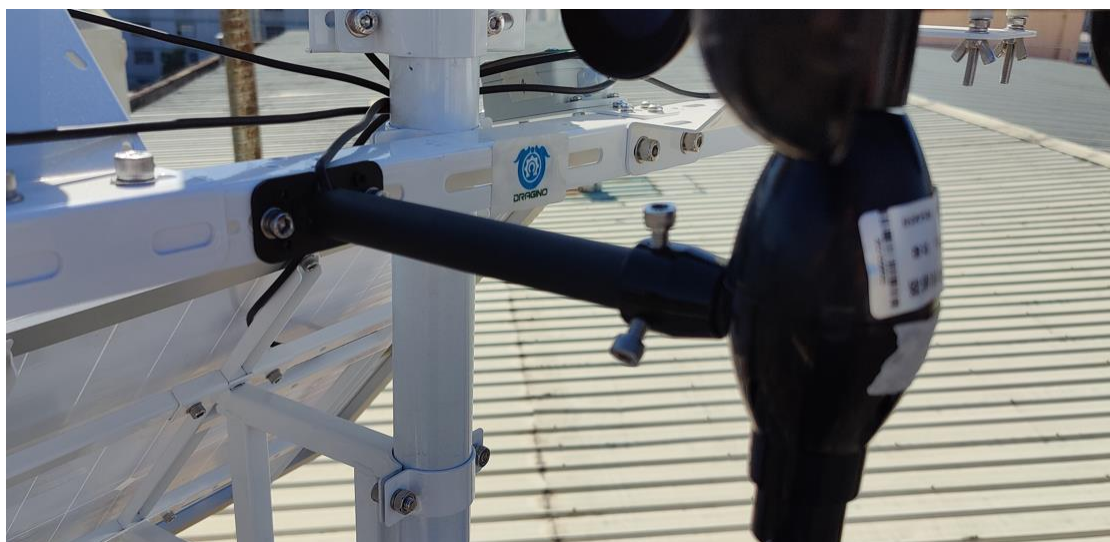


### 11. Appendix I: Field Installation Photo



**Storage Battery:** 12v,12AH li battery

Wind Speed/Direction.



Dragino LoRaWAN Weather Station



Total Solar Radiation sensor



PAR Sensor



CO2/PM2.5/PM10 3 in 1 sensor



