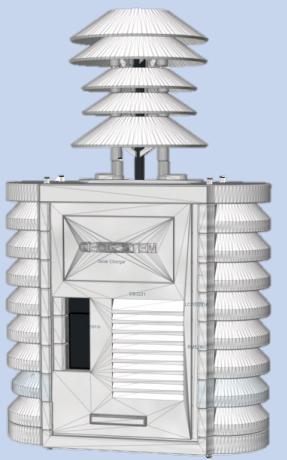




## Instruction Manual

### DIY Weather Station Ho Koon Model v2.5 (July 2024)

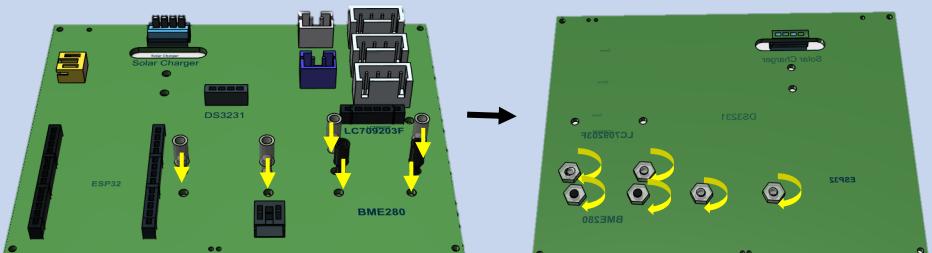


#### Circuit Board Assembly

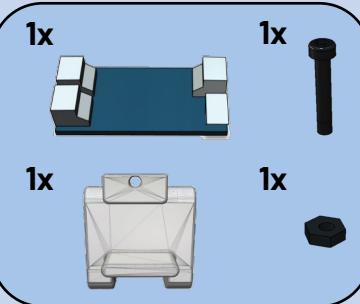
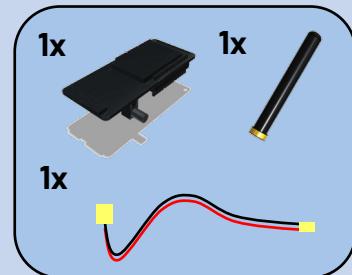
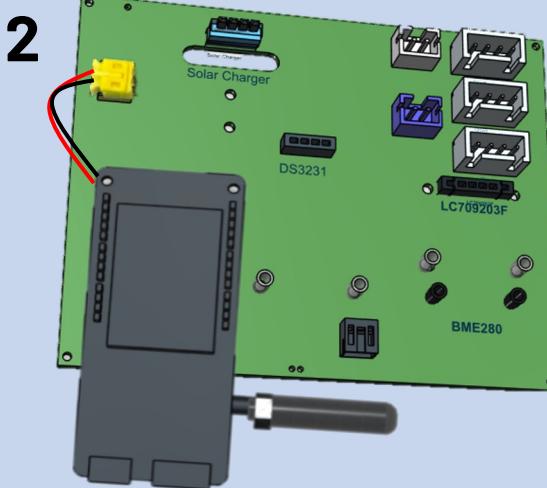


1

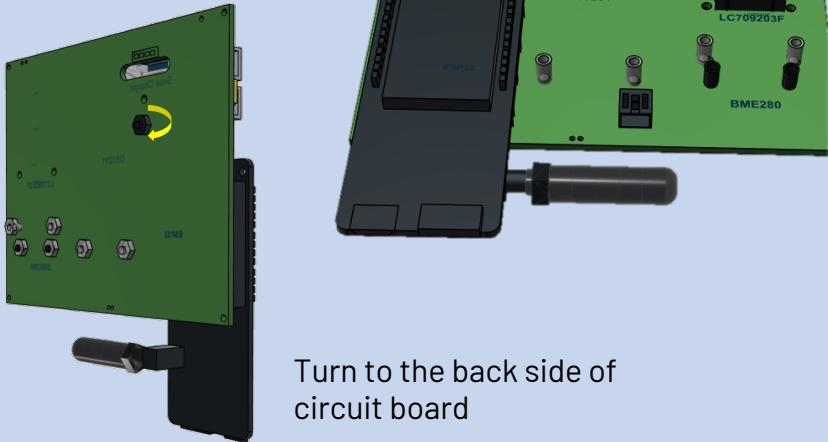
Turn to the back side of circuit board



1

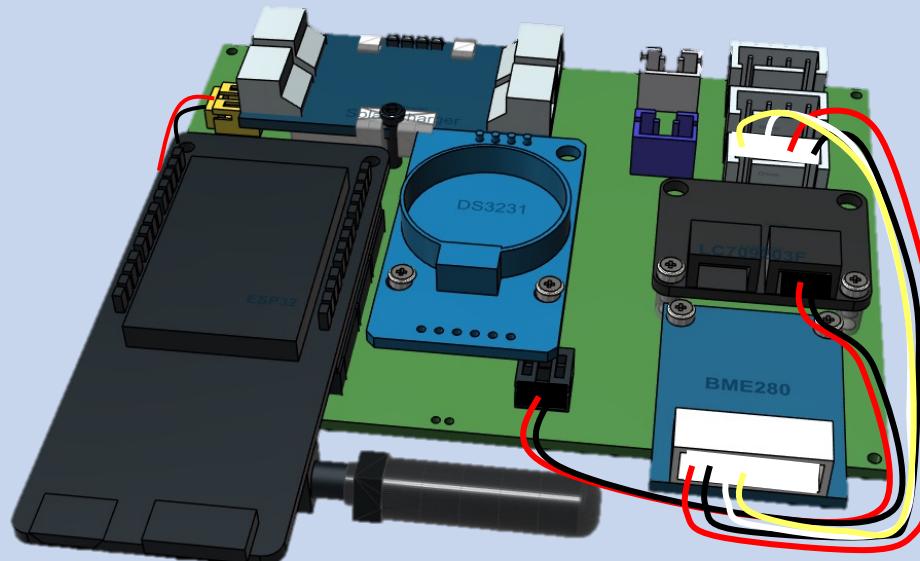
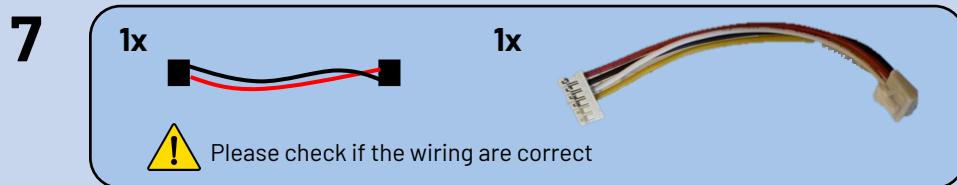
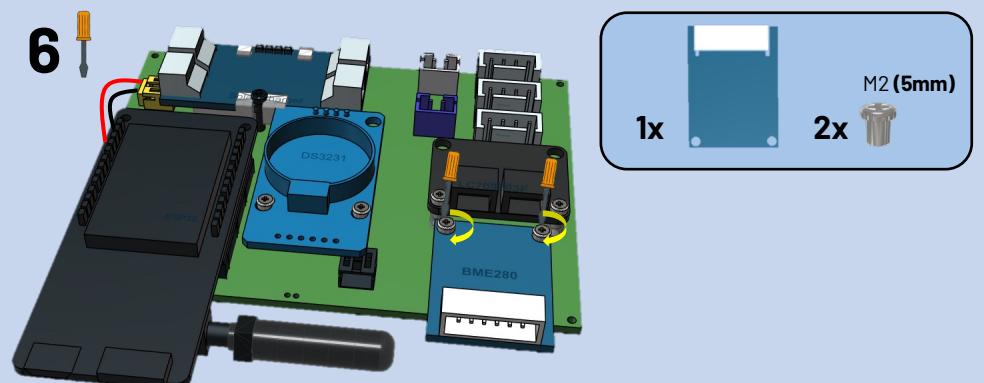
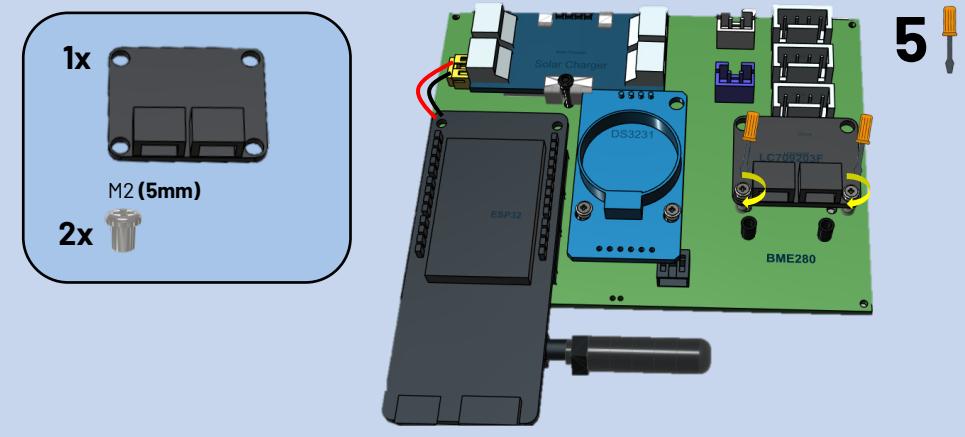
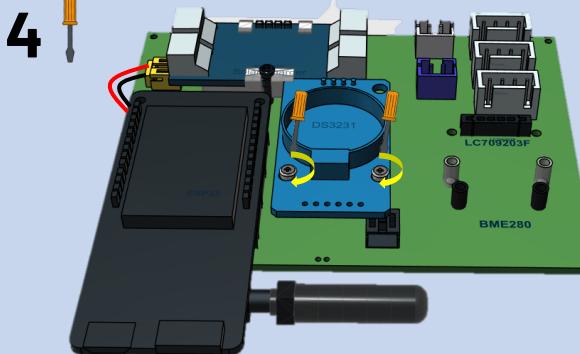


3



Turn to the back side of  
circuit board

2



**3** **4**

# Sensors Testing & Programming

## Arduino IDE and Libraries installation

### Windows Computer



Please download with link: <https://www.arduino.cc/en/software>

### Install Microcontroller Chip Driver CH9102: [https://github.com/Xinyuan-LilyGO/CH9102\\_Driver](https://github.com/Xinyuan-LilyGO/CH9102_Driver)

This is CH9102 windows driver file

CH9102\_Driver

Download  
CH9102 driver  
by clicking here

### Mac OS Computer

Arduino IDE 1.8.19

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.  
Refer to the [Arduino IDE 1.x documentation](#) for installation instructions.

SOURCE CODE  
Active development of the Arduino software is hosted by [GitHub](#). See the instructions for [building the code](#). Latest release source code archives are available [here](#). The archives are PGP-signed so they can be verified using [this gpg key](#).



Please download with link: <https://www.arduino.cc/en/software>

### Install Microcontroller Chip Driver CH34x for Mac OS: [https://github.com/WCHSoftGroup/ch34xser\\_macos](https://github.com/WCHSoftGroup/ch34xser_macos)

WCHSoftGroup / ch34xser\_macos

ch34xser\_macos Public

WCHSoftGroup Merge pull request #18 from SoldierJazz/m... 4e4c8c3 - last year

README.assets V1.8 Release 2 years ago

CH34X\_DRV\_INSTAL\_INSTRU... V1.8 Release last year

CH34xVCPDriver.dmg V1.8 Release 2 years ago

CH34xVCPDriver.pkg V1.8 Release last year

README.md Update README.md 2 years ago

HTTPS SSH GitHub CLI

Clone using the web URL.

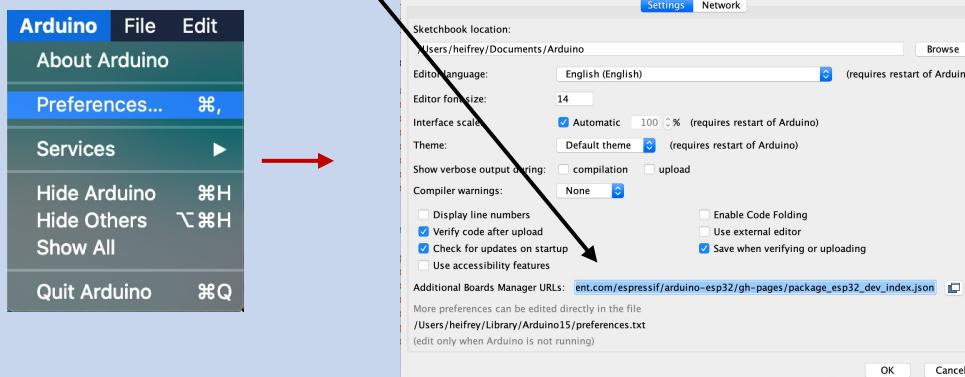
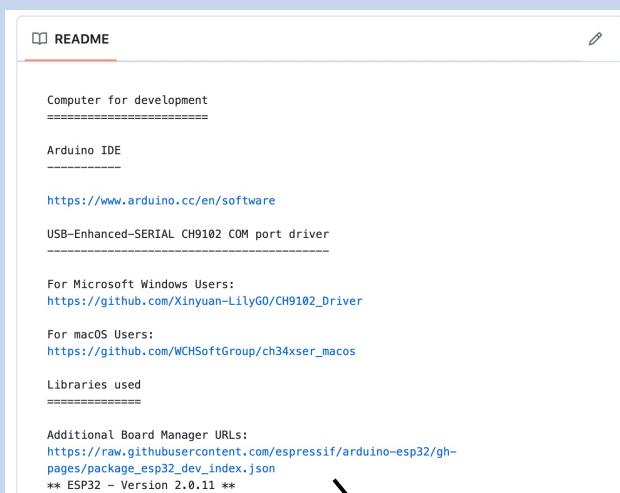
Open with GitHub Desktop

Download ZIP

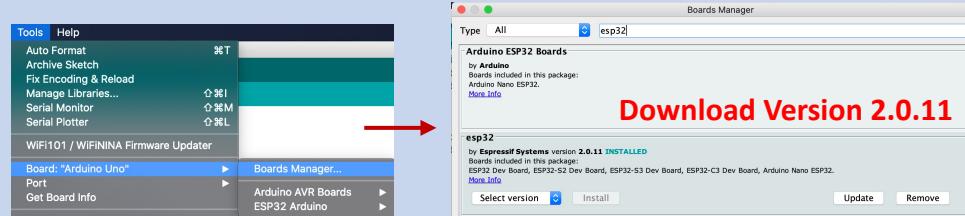
點這裡下載  
ch34x 驅動程式  
及解壓縮.zip 檔案

## 2 Install Board Libraries with refer to GeogSTEM GitHub site:

<https://github.com/GEOGSTEM/HoKoonMicroclimateWorkshop>



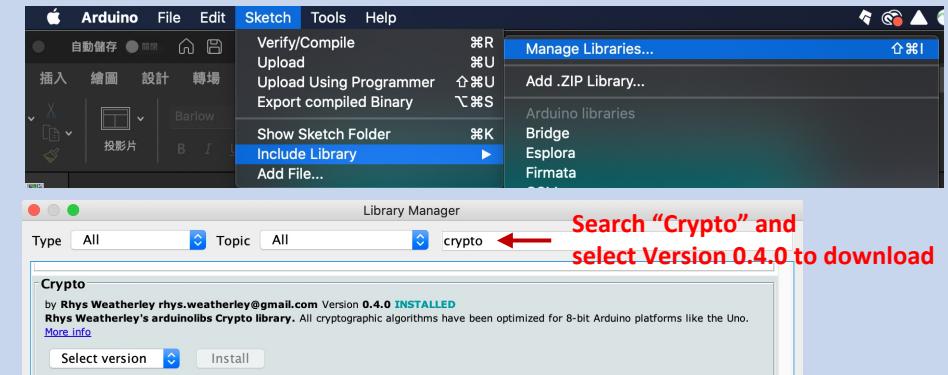
## 3 Download "ESP32" from "Boards Manager"



7

## 4 Download the sensor libraries:

Go to Sketch → Include Library → Manage Libraries



Crypto - Version 0.4.0

ESP32Time - Version 2.0.6

LoRa - Version 0.8.0

Adafruit SSD1306 - Version 2.5.10

RTCLib - Version 2.1.4

Adafruit SHT4x Library - Version 1.0.4

Adafruit BME280 Library - Version 2.2.4

Adafruit LC709203F - Version 1.3.4

NTPClient - Version 3.2.1

⚠ You can see all the imported sensor libraries under "Include Library"

8

# Programming Exercises

**HoKoonMicroclimateWorkshop** (Public)

main

Go to file + <> Code

**GEOGSTEM** Add files via upload 8a561de · now

- Mission1\_HelloWorld Rename Mission1\_HelloWorld.ino to ... last month
- Mission2\_TextDisplay Rename Mission2\_TextDisplay.ino to ... last month
- Mission3\_LoRaSensor\_HoKoon Add files via upload now
- Calibration\_Table.xlsx Add files via upload yesterday
- Readme.txt Update Readme.txt 2 days ago
- libraries.zip Add files via upload last month

## Mission 1 – Hello World

Try to code a program and print "Hello World"

Mission1\_HelloWorld | Arduino 1.8.13

```
void setup(void) {
  Serial.begin(9600, SERIAL_8N1);
}

void loop(void) {
  Serial.print("Hello, ");
  Serial.print("world! ");
  Serial.print("123");
  delay(3000);
}

// comments:

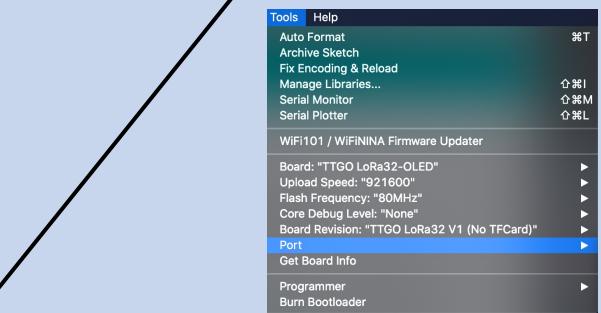
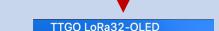
/*
void main(void) {
  setup();
  while (true) loop();
}
*/
```

1. TTGO LoRa32-OLED, TTGO LoRa32 V2.1 (1.6.1), 80MHz, 921600, None, Disabled on /dev/cu.wchusbserial1568B0043481

1. Edit the word "Hello" to "Group X" & "world" to "YOUR GROUP NAME"

2. Compile the code again and load into the microcontroller

## Select your board "TTGO LoRa32-OLED" under Tools



Select the right USB port and connect the wire between Arduino and computer

Click to compile and upload script to Arduino board

## Mission 2 – Text Display

Try to print out some text on OLED monitor

Mission2\_TextDisplay | Arduino 1.8.13

```
#include <Adafruit_SSD1306.h>

Adafruit_SSD1306 SSD1306(128, 64);

void setup(void) {
  pinMode(LED_BUILTIN, OUTPUT);

  SSD1306.begin(SSD1306_SWITCHCAPVCC, 0x3C);
  SSD1306.setRotation(2);
  SSD1306.setTextSize(1);
  SSD1306.setTextColor(SSD1306_WHITE, SSD1306_BLACK);
  SSD1306.invertDisplay(false);
  SSD1306.clearDisplay();
  SSD1306.display();
}

bool light = false;
unsigned int y = 0;

void loop(void) {
  if (light)
    digitalWrite(LED_BUILTIN, HIGH);
  else
    digitalWrite(LED_BUILTIN, LOW);
}
```

1. TTGO LoRa32-OLED, TTGO LoRa32 V2.1 (1.6.1), 80MHz, 921600, None, Disabled on /dev/cu.wchusbserial1568B0043481

Problem:

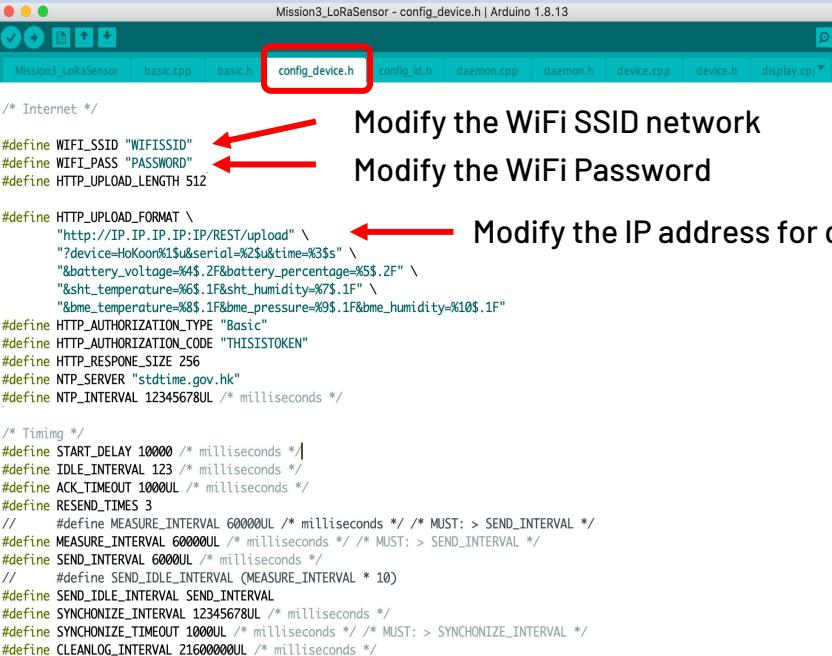
- (1) Print your group name on OLED monitor
- (2) Choose 1 student from your group, and find his date of birth and multiply the MM(Month) and DD(Day) together

i.e. Birthday: 12<sup>th</sup> November  
→ 11 x 12 = 132

- (3) Loop the program and when y = THE VALUE, turn on the LIGHT

## Mission 3 – LoRaSensor\_HoKoon

Loading programme into the Arduino Microcontroller



```
/* Internet */
#define WIFI_SSID "WIFISSID"
#define WIFI_PASS "PASSWORD"
#define HTTP_UPLOAD_LENGTH 512

#define HTTP_UPLOAD_FORMAT \
"HTTP://IP.IP.IP:IP/REST/upload" \
"?device=HoKoon&serial=%2$&time=%3$&" \
"&battery_voltage=%4$.2F&battery_percentage=%5$.2F" \
"&sh_temperature=%6$.1F&ht_humidity=%7$.1F" \
"&bme_temperature=%8$.1F&bme_pressure=%9$.1F&bme_humidity=%10$.1F"

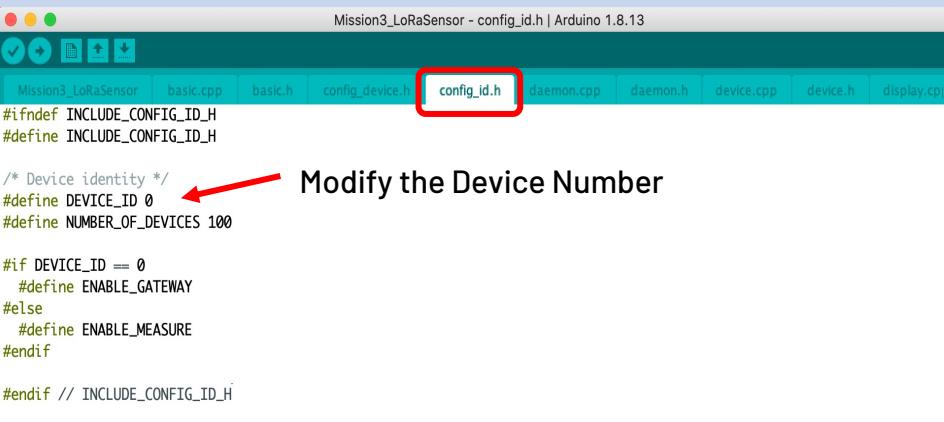
#define HTTP_AUTHORIZATION_TYPE "Basic"
#define HTTP_AUTHORIZATION_CODE "THISISTOKEN"
#define HTTP_RESPONSE_SIZE 256
#define NTP_SERVER "stdtime.gov.hk"
#define NTP_INTERVAL 12345678UL /* milliseconds */

/* Timing */
#define START_DELAY 10000 /* milliseconds */
#define IDLE_INTERVAL 123 /* milliseconds */
#define ACK_TIMEOUT 1000UL /* milliseconds */
#define RESEND_TIMES 3
// #define MEASURE_INTERVAL 60000UL /* milliseconds */ /* MUST: > SEND_INTERVAL */
#define MEASURE_INTERVAL 60000UL /* milliseconds */ /* MUST: > SEND_INTERVAL */
#define SEND_INTERVAL 6000UL /* milliseconds */
// #define SEND_IDLE_INTERVAL (MEASURE_INTERVAL * 10)
#define SEND_IDLE_INTERVAL SEND_INTERVAL
#define SYNCHONIZE_INTERVAL 12345678UL /* milliseconds */
#define SYNCHONIZE_TIMEOUT 1000UL /* milliseconds */ /* MUST: > SYNCHONIZE_INTERVAL */
#define CLEANLOG_INTERVAL 21600000UL /* milliseconds */
```

Modify the WiFi SSID network

Modify the WiFi Password

Modify the IP address for data upload



```
#ifndef INCLUDE_CONFIG_ID_H
#define INCLUDE_CONFIG_ID_H

/* Device identity */
#define DEVICE_ID 0
#define NUMBER_OF_DEVICES 100

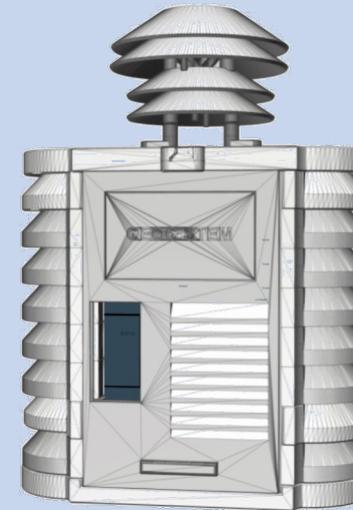
#if DEVICE_ID == 0
#define ENABLE_GATEWAY
#else
#define ENABLE_MEASURE
#endif

#endif // INCLUDE_CONFIG_ID_H
```

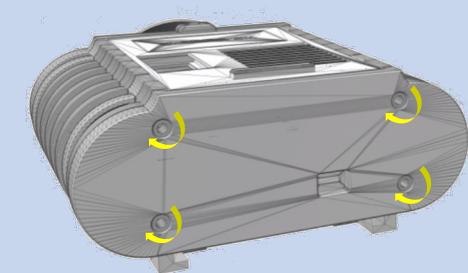
Modify the Device Number

## Devices Operation

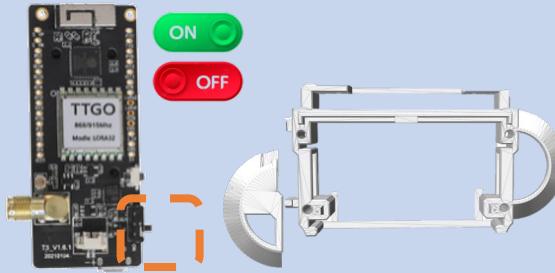
### Sensors



For outdoor measurement,  
please remove the sensor  
cover to enable more wind  
ventilation to the sensor



To turn on/off the sensor,  
please kindly remove the  
hemispheric cover and  
switch the button on the  
microcontroller board

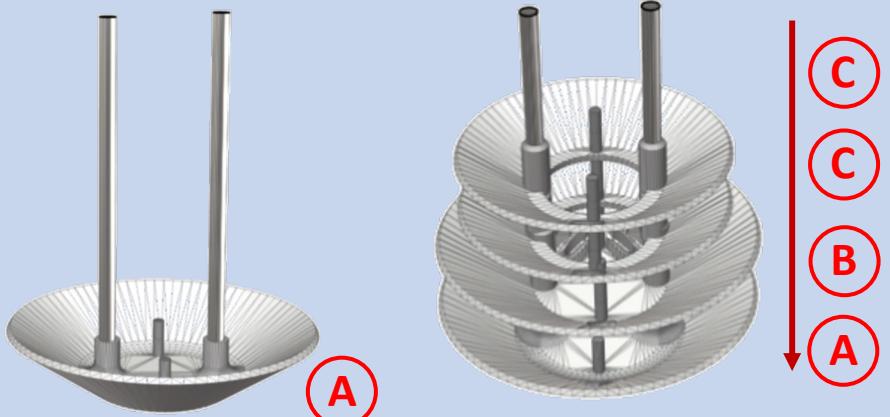
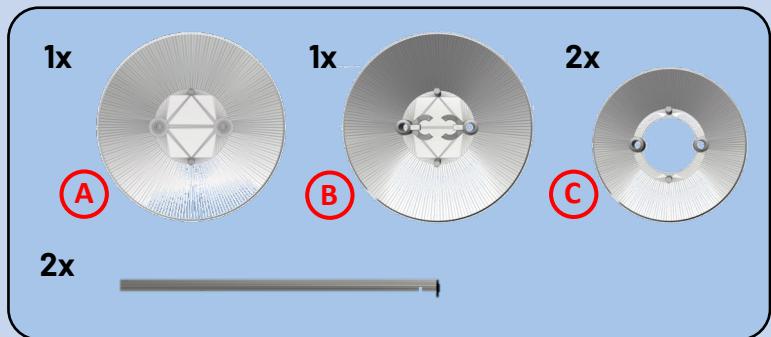


You can charge the sensors directly  
by plugging in the micro-USB  
cable to the sensor

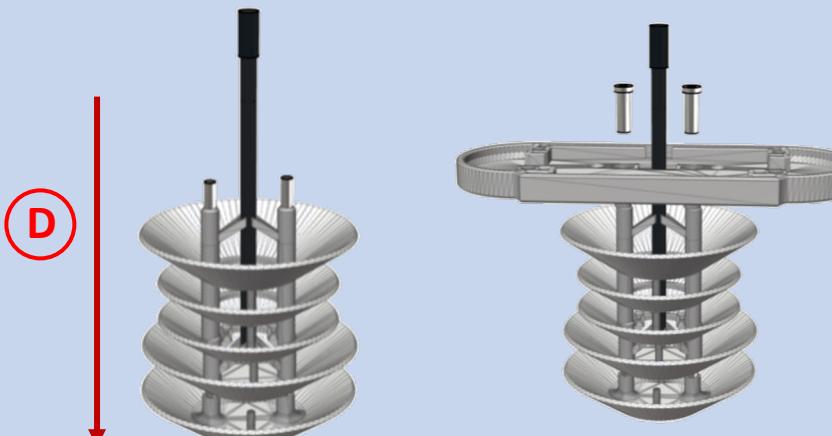


## Enclosure Building

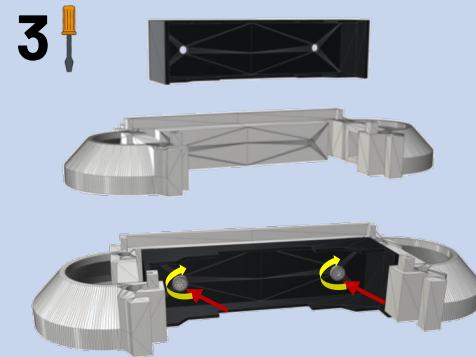
1



2

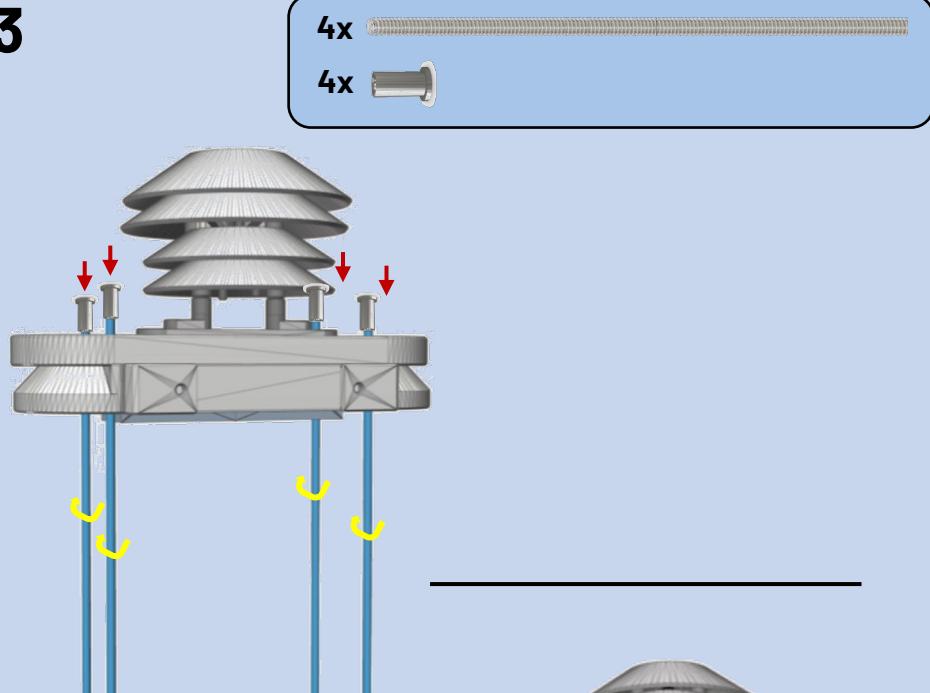
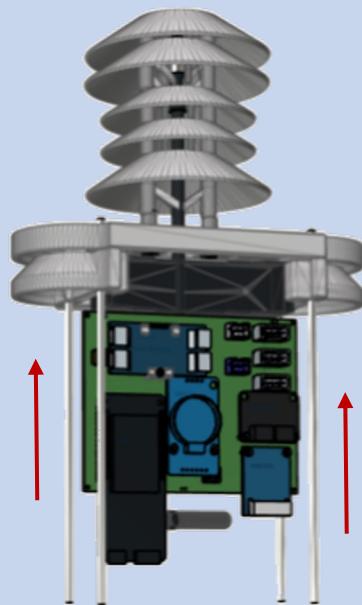
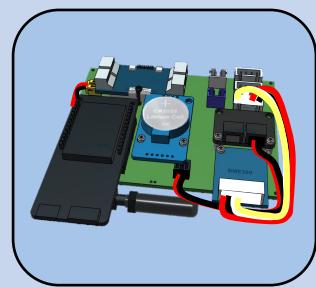


3

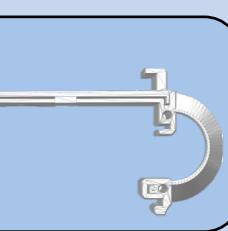
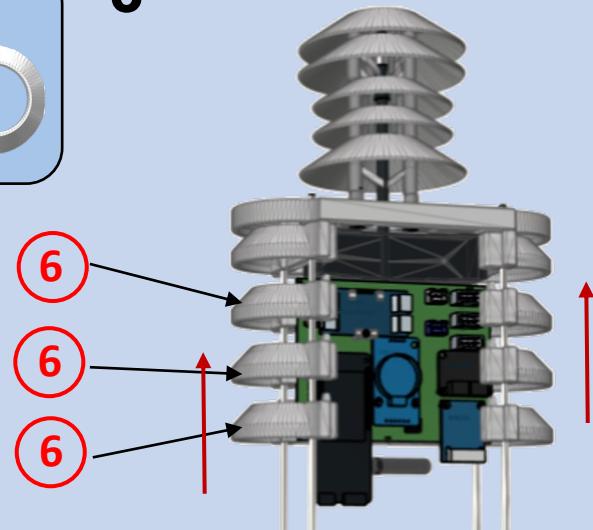
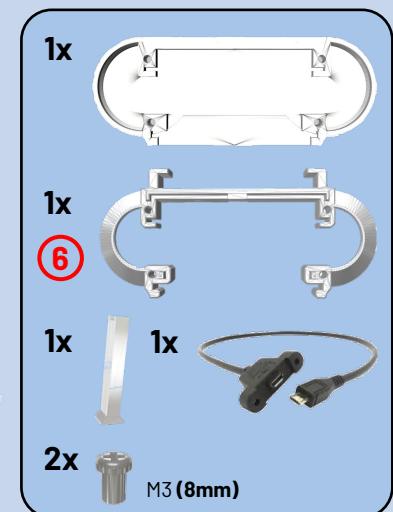
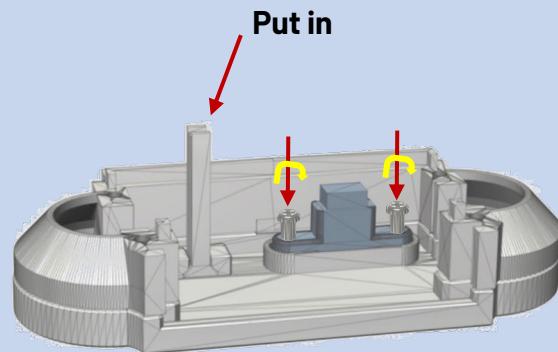


13

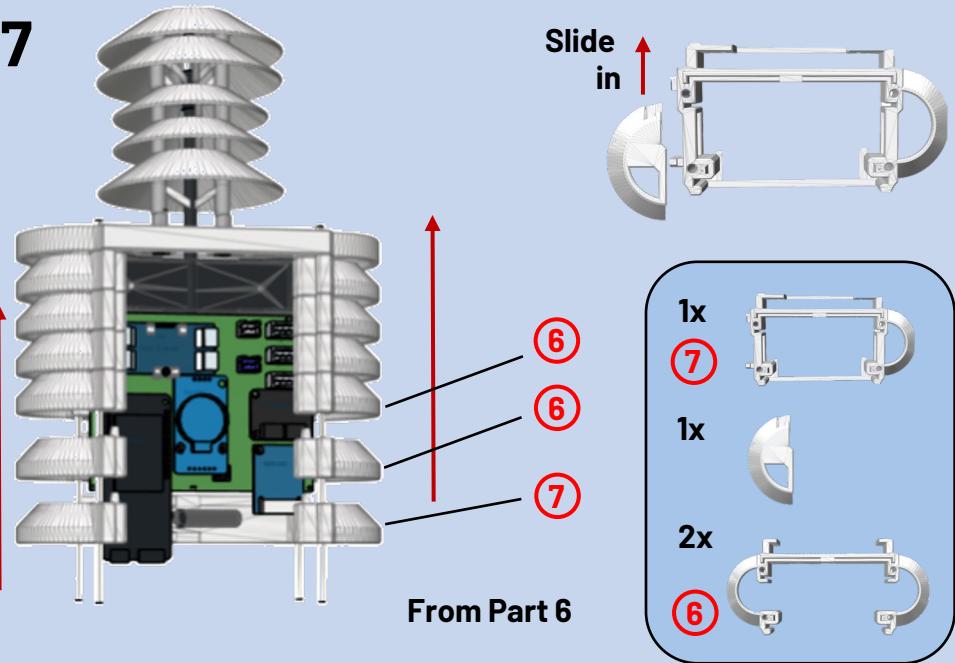
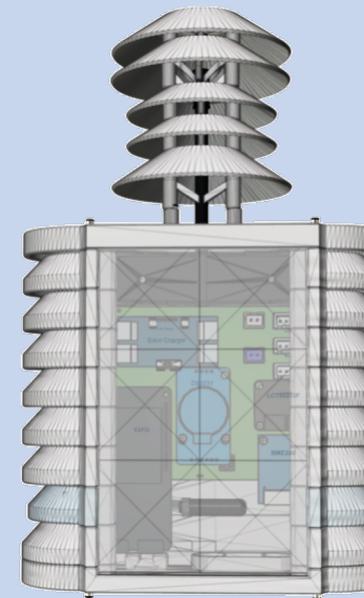
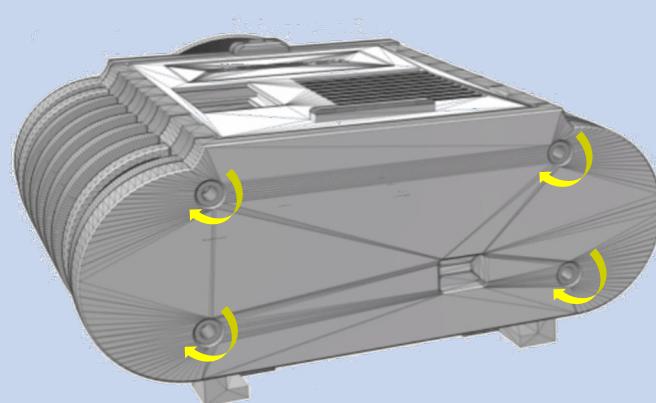
14

**3****4**

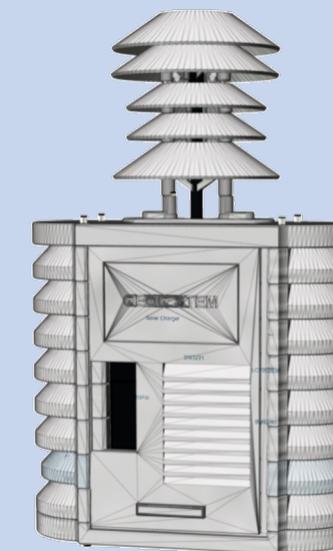
15

**5****6**

16

**7****Clear Glass Version****8**

17

**Radiation Shield Version**

18

# Sensors Calibration

## 1 Co-location Measurement



Detect and log air temperature, relative humidity and air pressure with 5 GeogSTEM Sensor & Professional Sensor (i.e. Kestrel / HOBO / Davis , etc.)

## 2 Linear Regression

Use Professional Sensor as reference, as:

$y$  = GeogSTEM Sensor Measured Values

$x$  = Professional Sensor Measured Values

Use Excel to plot a x-y plot on GeogSTEM Sensor and Professional Sensor's readings

## 3 Find equations for each sensor

$y$  = calibrated value of GeogSTEM sensor

$x$  = raw value of GeogSTEM sensor

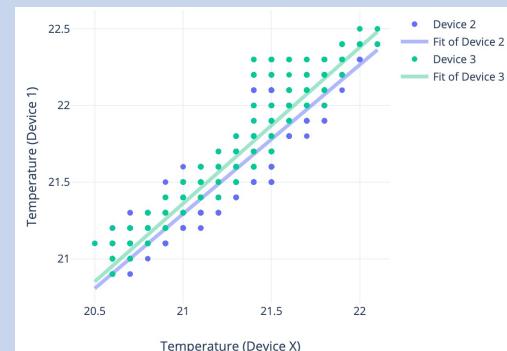
$m$  = slope found from x-y plot

$c$  = intercept from x-y plot

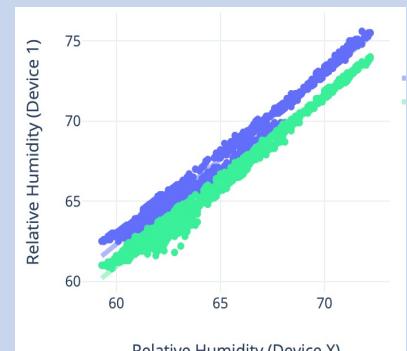
## 4 Data Post-processing

After fieldwork studies, you may use Excel Equation to easily adjust the measured data

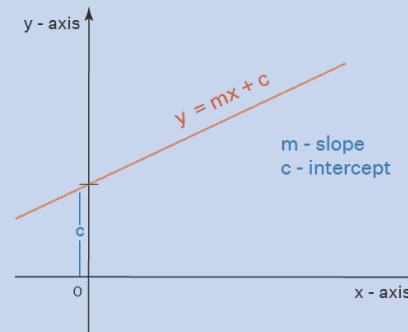
Air Temperature



Relative Humidity

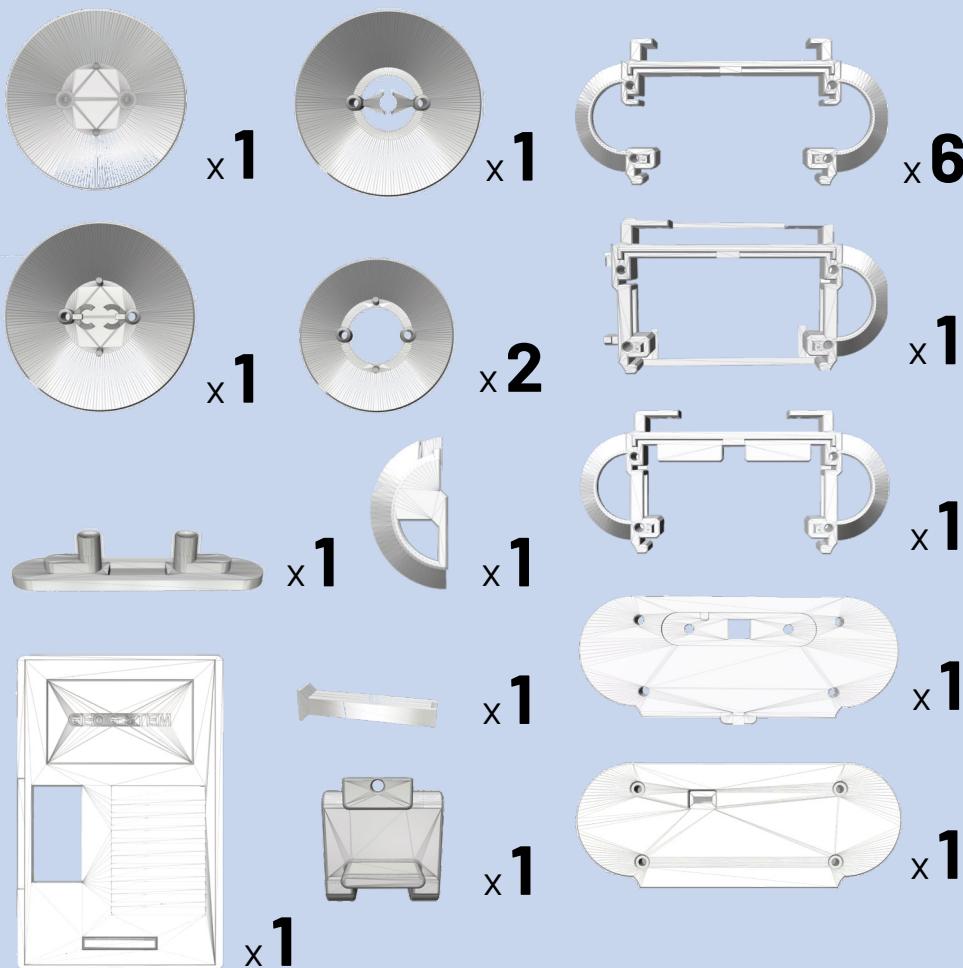


Slope Intercept Form:  $y = mx + c$

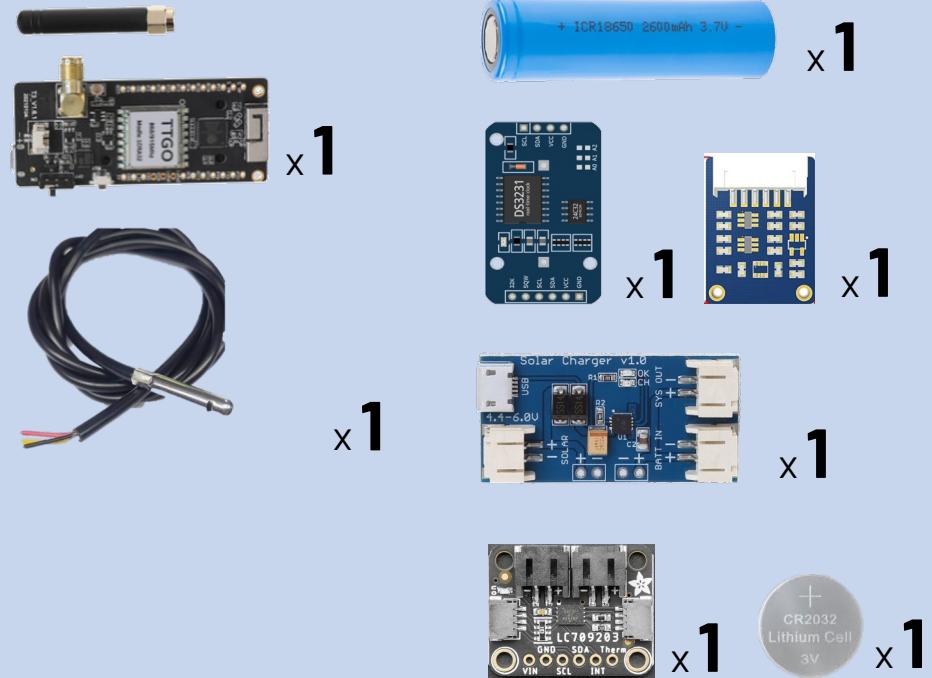




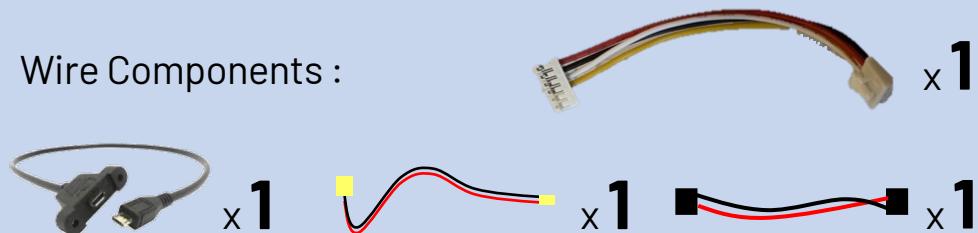
### Plastic Components:



### Electronic Components :



### Wire Components :



### Screw Components :

