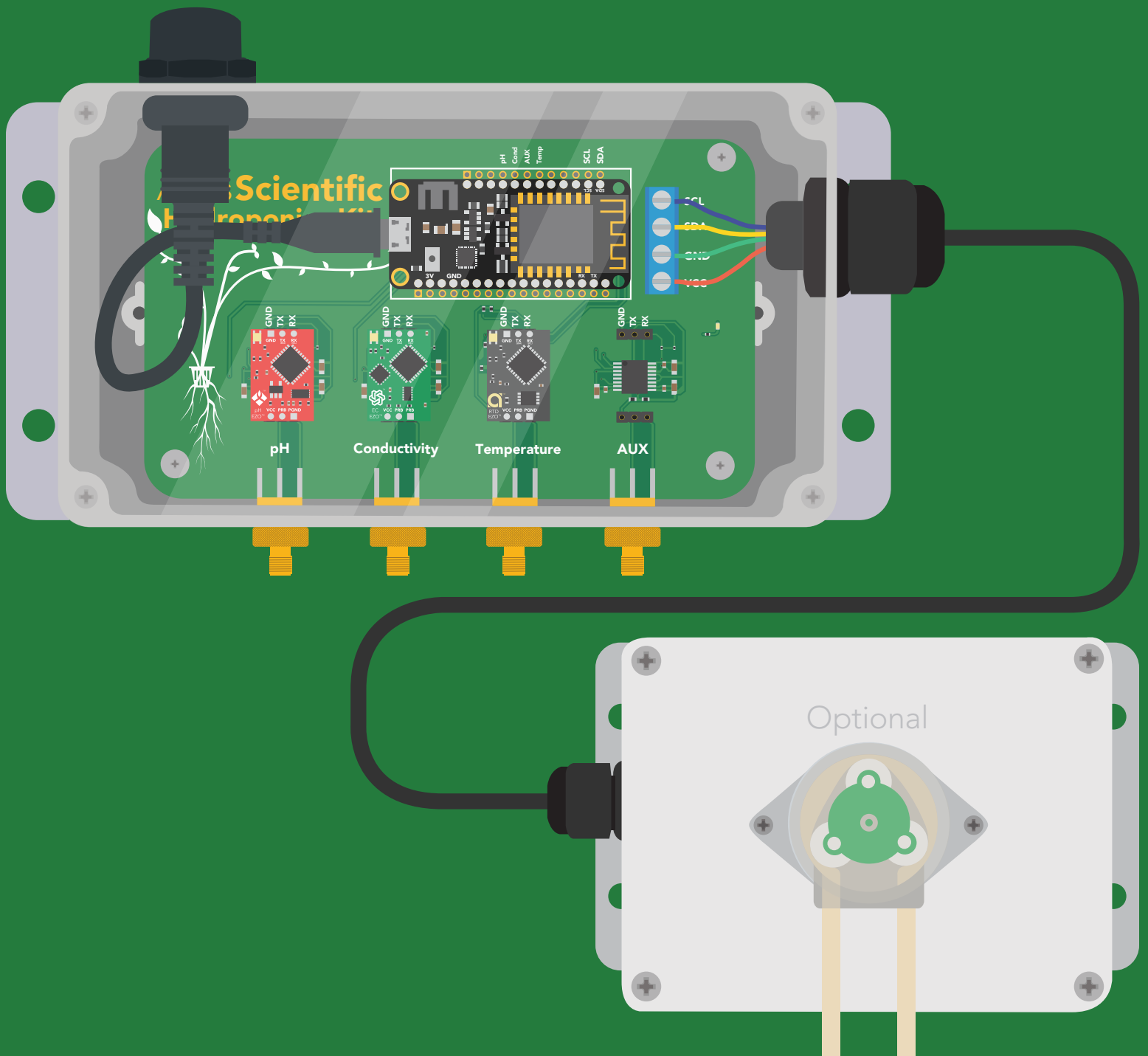


Wi-Fi Hydroponics Kit

Datasheet

V 1.5

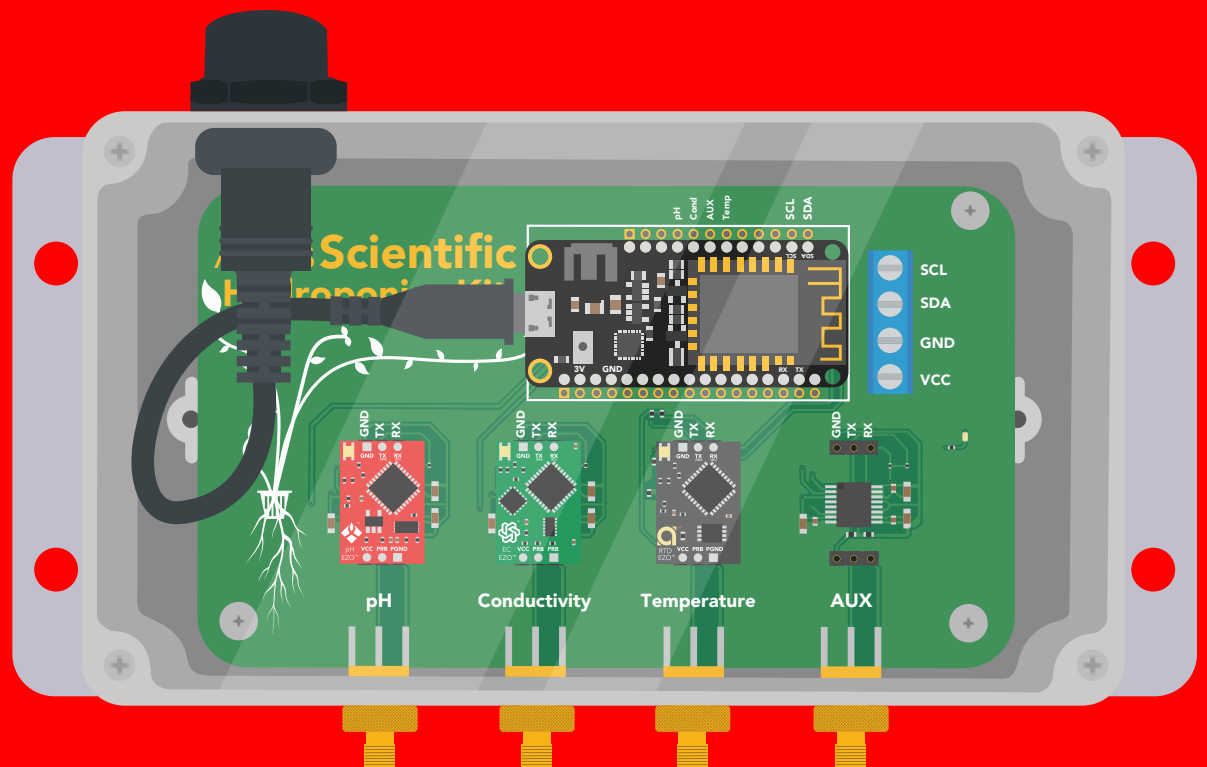


STOP

Atlas Scientific does not make consumer electronics.

This equipment is intended for electrical engineers. If you are not familiar with electrical engineering or embedded systems programming, this product may not be for you.

This device was developed and tested using a Windows computer. It was not tested on Mac, Atlas Scientific does not know if these instructions are compatible with a Mac system.



IP64

(dust and water splash proof)

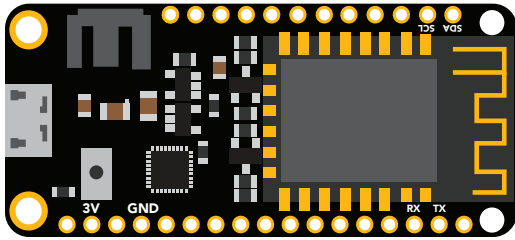
Operating principle

The Wi-Fi hydroponics kit has been designed to provide the engineer with a simple way of remotely monitoring and controlling a hydroponics system's chemistry. Sensor data is uploaded to ThingSpeak™, a free, cloud-based data acquisition and visualization platform. The Wi-Fi hydroponics kit has also been designed to be easily modified by the engineer. Feel free to change the sensors or functionality of the device to meet your specific needs.

Overview

CPU

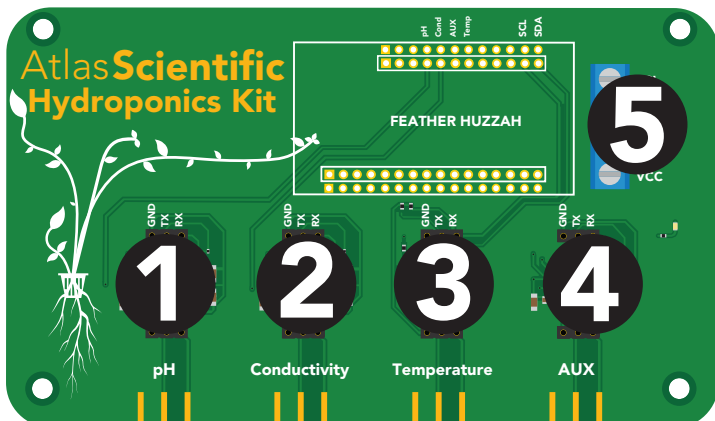
The Wi-Fi hydroponics kit is controlled using an Adafruit HUZZAH32 as its CPU. The HUZZAH is programmed using the Arduino IDE and uses an onboard ESP32 as its Wi-Fi transmitter. [Adafruit HUZZAH32 datasheet.](#)



Sensor ports

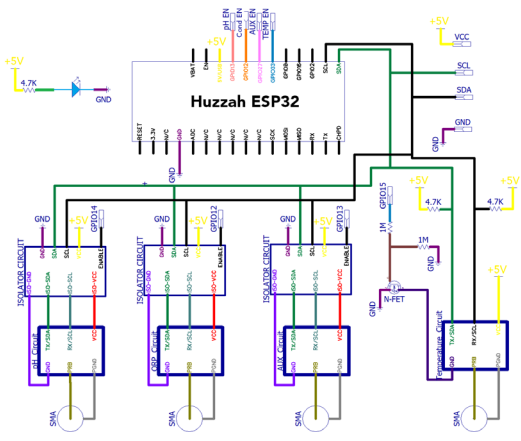
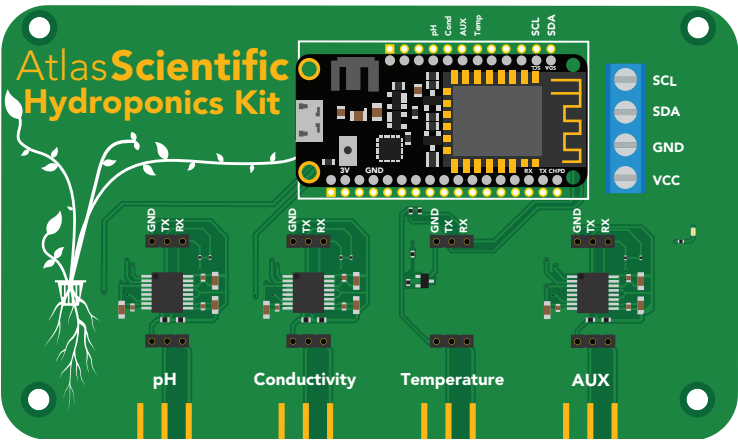
The Wi-Fi hydroponics kit PCB has 5 sensor ports. Three of the ports are electrically isolated. The isolated ports are marked pH, Conductivity, and AUX. The isolated ports are needed to take noise-free electrochemical readings. Because the sensing element of a temperature sensor is never in direct contact with the water, electrical isolation is not needed for temperature sensing.

The AUX port can be used to add an additional sensor of your choice. The terminal block marked Port 5 has been designed to connect one or more dosing pumps to the device. However, the port could also be used to connect a gas sensor.

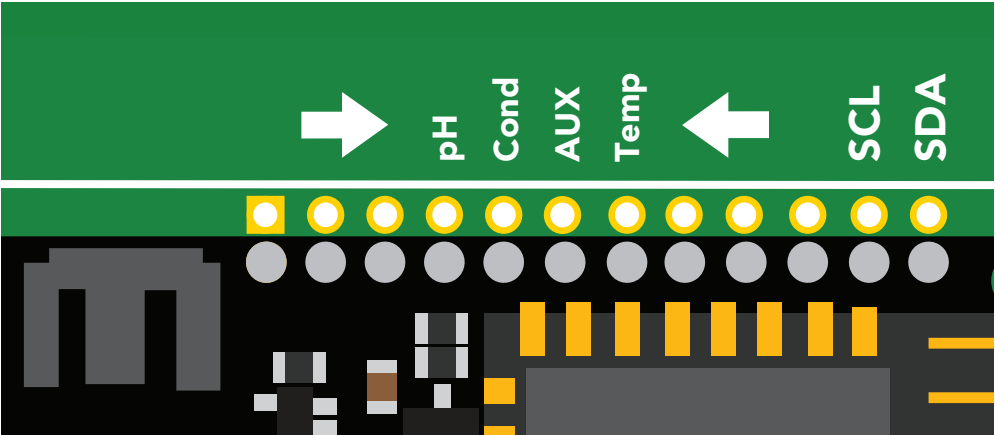


PCB

The overall design of the PCB is quite simple. The CPU is powered and programmed through the panel-mount USB connector. The CPU's USB pin supplies the board's power bus with 5V.



Each of the four main sensor ports have an enable pin, which must be set correctly to power the sensor. The enable pins are found here:



The first three pins (pH, Cond and Aux) must be set low to power on the sensor. The last pin (Temp) must be set high to power on the sensor.

Truth table

| Pin | State | Sensor Power |
|---------|-------|--------------|
| pH EN | LOW | ON |
| Cond EN | LOW | ON |
| Aux EN | LOW | ON |
| Temp EN | HIGH | ON |

Sensor port 5 (the terminal block) does not have an enable pin and can not be turned off.

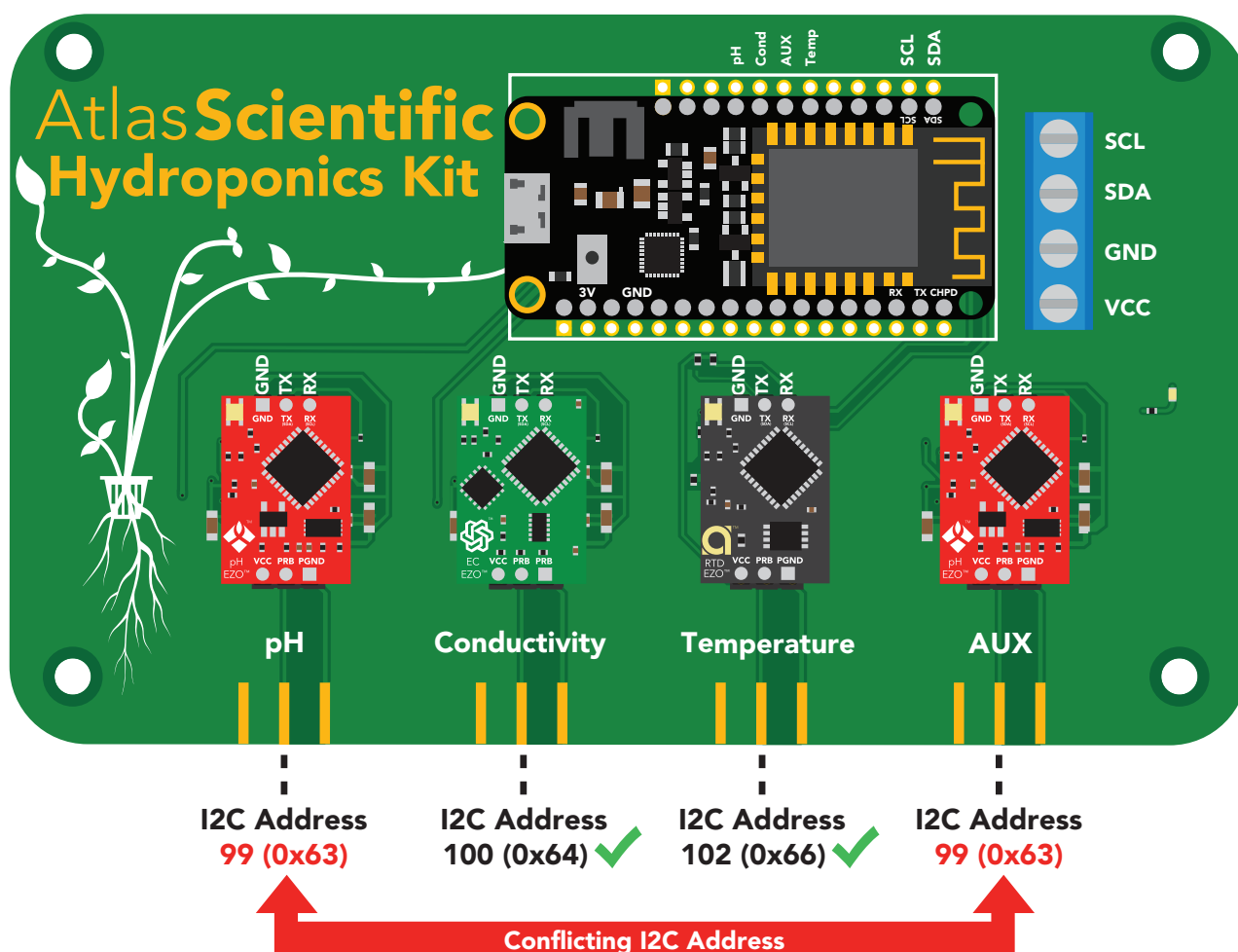
Data protocol

The CPU communicates with all peripheral sensors using the I2C data protocol. All data lines are directly connected to the CPU's I2C port. Using a different data protocol with this circuit board is not possible.

It is important to keep in mind that all Atlas Scientific components default to UART mode. When adding a new Atlas Scientific component to the kit, it must first be put into I2C mode. Refer to the component's datasheet for instructions on how to switch it over.

Adding more of the same sensor or component type

Adding additional components of the same type, such as an additional pH or conductivity sensor, is not hard to do. As mentioned above, you must set the device to I2C mode, and you must make sure that its I2C address is not the same as the already existing component.

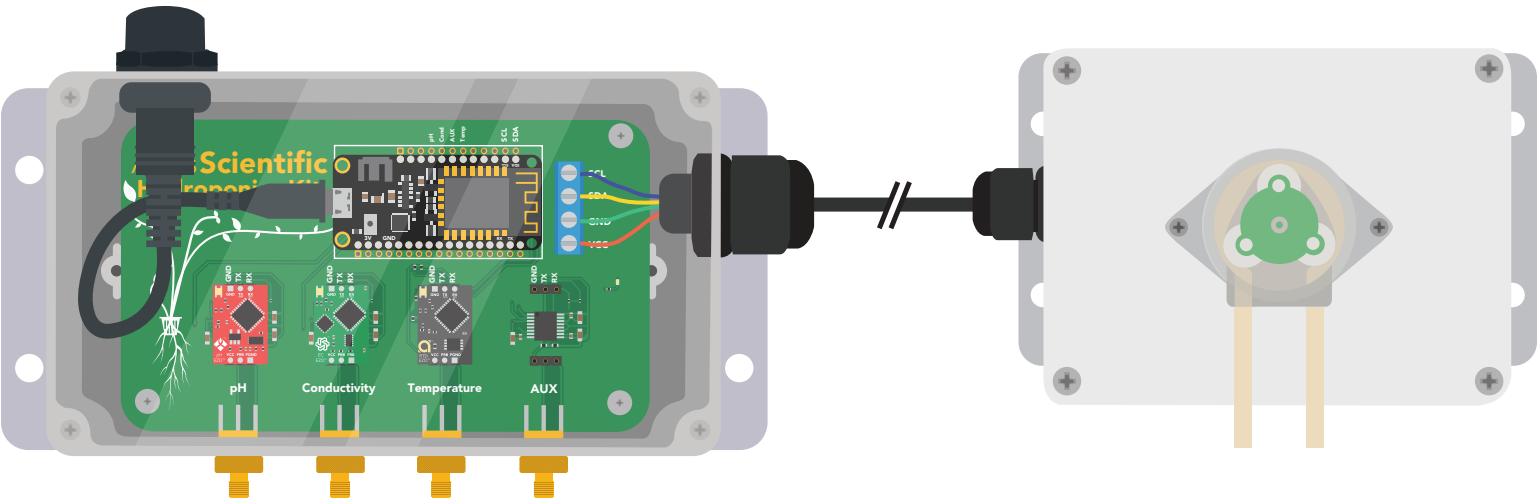


This table lists the default I2C address of components commonly added to this kit.

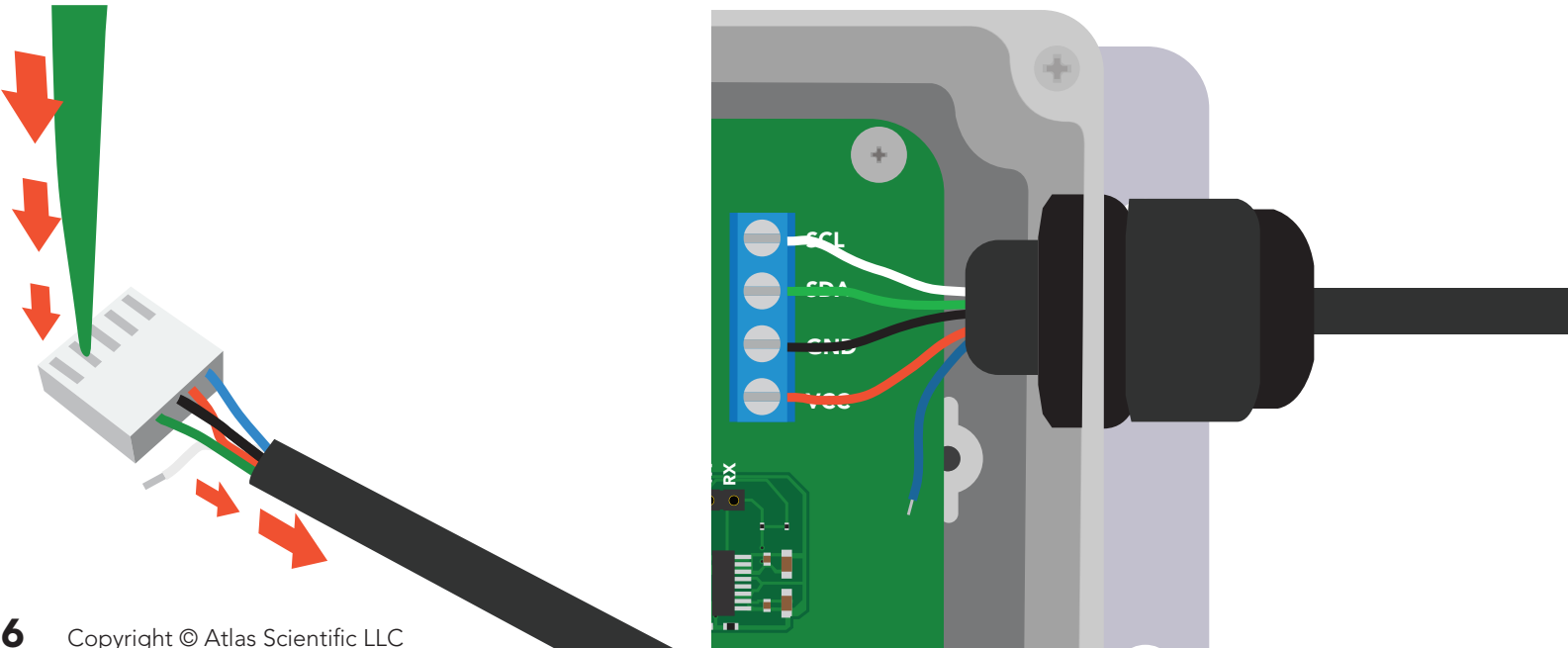
| Device | I2C Address | Device | I2C Address |
|---------|-------------|---------|-------------|
| EZO pH | 99 (0x63) | EZO EC | 100 (0x64) |
| EZO ORP | 98 (0x62) | EZO RTD | 102 (0x66) |
| EZO DO | 97 (0x61) | EZO PMP | 103 (0x67) |

Dosing pump

An optional external dosing pump can be added to the Wi-Fi hydroponics kit. Using the [EZO-PMP Advanced Kit](#) is the simplest way to add on a dosing pump.



A stand-alone EZO-PMP can be used instead of the expansion pump kit; however, you must manually put the pump in I2C mode and remove the data cable connector.



Uploading sensor data to the cloud


The Atlas-Scientific Wi-Fi hydroponics kit has been designed to upload sensor data to ThingSpeak™, a free, cloud-based data acquisition and visualization platform. You will be required to set up a free account with ThingSpeak™ to upload and visualize the data. With a free account, you can upload data once every 15 seconds. A paid account lets you upload data once per-second; look [here](#) for more info about various ThingSpeak™ services.

Atlas Scientific has no business relationship with ThingSpeak™; we just like how it works. If you want to use a different service, modify the device as you see fit.

Setting up your Wi-Fi kit

Step 1 Setup a ThingSpeak Account

Because the sensor data is stored / viewed on ThingSpeak, you will need to setup a ThingSpeak account. Create your ThingSpeak account by clicking [HERE](#).



[Channels](#)
[Apps](#)
[Support](#)

[Commercial Use](#)
[How to Buy](#)

To use ThingSpeak, you must sign in with your existing MathWorks account or create a new one.

Non-commercial users may use ThingSpeak for free. Free accounts offer limits on certain functionality. Commercial users are eligible for a time-limited free evaluation. To get full access to the MATLAB analysis features on ThingSpeak, log in to ThingSpeak using the email address associated with your university or organization.

To send data faster to ThingSpeak or to send more data from more devices, consider the [paid license options](#) for commercial, academic, home and student usage.

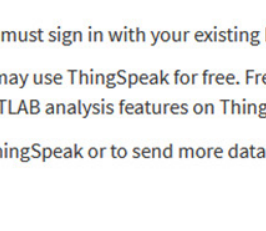


Email

No account? [Create one!](#)

By signing in you agree to our [privacy policy](#).

Next



Step 2 Create a Channel

Your data is uploaded to ThingSpeak through a 'Channel.' Select **New Channel**

ThingSpeak™

Channels ▾

Apps ▾

Support ▾

Commercial Use

How to Buy

My Channels

New Channel

Search by tag

q

Help

Collect data in a ThingSpeak channel from a device, from another channel, or from the web.

Click **New Channel** to create a new ThingSpeak channel.

Click on the column headers of the table to sort by the entries in that column or click on a tag to show channels with that tag.

ThingSpeak™

Channels ▾

Apps ▾

Support ▾

Commercial Use

How to Buy

New Channel

Name

Atlas Sensors

Description

Field 1

pH

☒

Field 2

EC (μS/cm)

☒

Field 3

Temp (°C)

☒

Help

Channels store all the data that a ThingSpeak application collects. Each channel includes eight fields that can hold any type of data, plus three fields for location data and one for status data. Once you collect data in a channel, you can use ThingSpeak apps to analyze and visualize it.

Channel Settings

- **Percentage complete:** Calculated based on data entered into the various fields of a channel. Enter the name, description, location, URL, video, and tags to complete your channel.
- **Channel Name:** Enter a unique name for the ThingSpeak channel.
- **Description:** Enter a description of the ThingSpeak channel.

Fill out the highlighted boxes. (Be sure to click on the checkboxes to enable **field 2** and **3**)
For reference, this is what we entered.

Name **Atlas Sensors**
Field 1 **pH**
Field 2 **EC (μS/cm)**
Field 3 **Temp (°C)**

Scroll to the bottom of the page and click **Save Channel**.

Step 3

Get ThingSpeak API keys

After you saved your channel settings, you will be redirected to your channel page. Click on **API keys**.

ThingSpeak™

Channels ▾ Apps ▾ Support ▾

Commercial Use How to Buy

My Channels

New Channel

Search by tag

| Name | Created | Updated |
|--|------------|------------------|
| <div><div>Atlas Sensors</div><div>Private Public Settings Sharing API Keys Data Import / Export</div></div> | 2020-02-14 | 2020-05-11 23:04 |

Help

Collect data in a ThingSpeak channel from a device, from another channel, or from the web.

Click **New Channel** to create a new ThingSpeak channel.

Click on the column headers of the table to sort by the entries in that column or click on a tag to show channels with that tag.

Learn to [create channels](#), explore and transform data.

Learn more about [ThingSpeak Channels](#).

ThingSpeak™

Channels ▾ Apps ▾ Support ▾

Commercial Use How to Buy

Atlas Sensors

Channel ID: xxxxxxx

Author:

Access: Private

Private View Public View Channel Settings Sharing **API Keys** Data Import / Export

Write API Key

Key

Generate New Write API Key

Help

API keys enable you to write data to a channel or read data from a private channel. API keys are auto-generated when you create a new channel.

API Keys Settings

- **Write API Key:** Use this key to write data to a channel. If you feel your key has been compromised, click **Generate New Write API Key**.
- **Read API Keys:** Use this key to allow other people to view your private channel

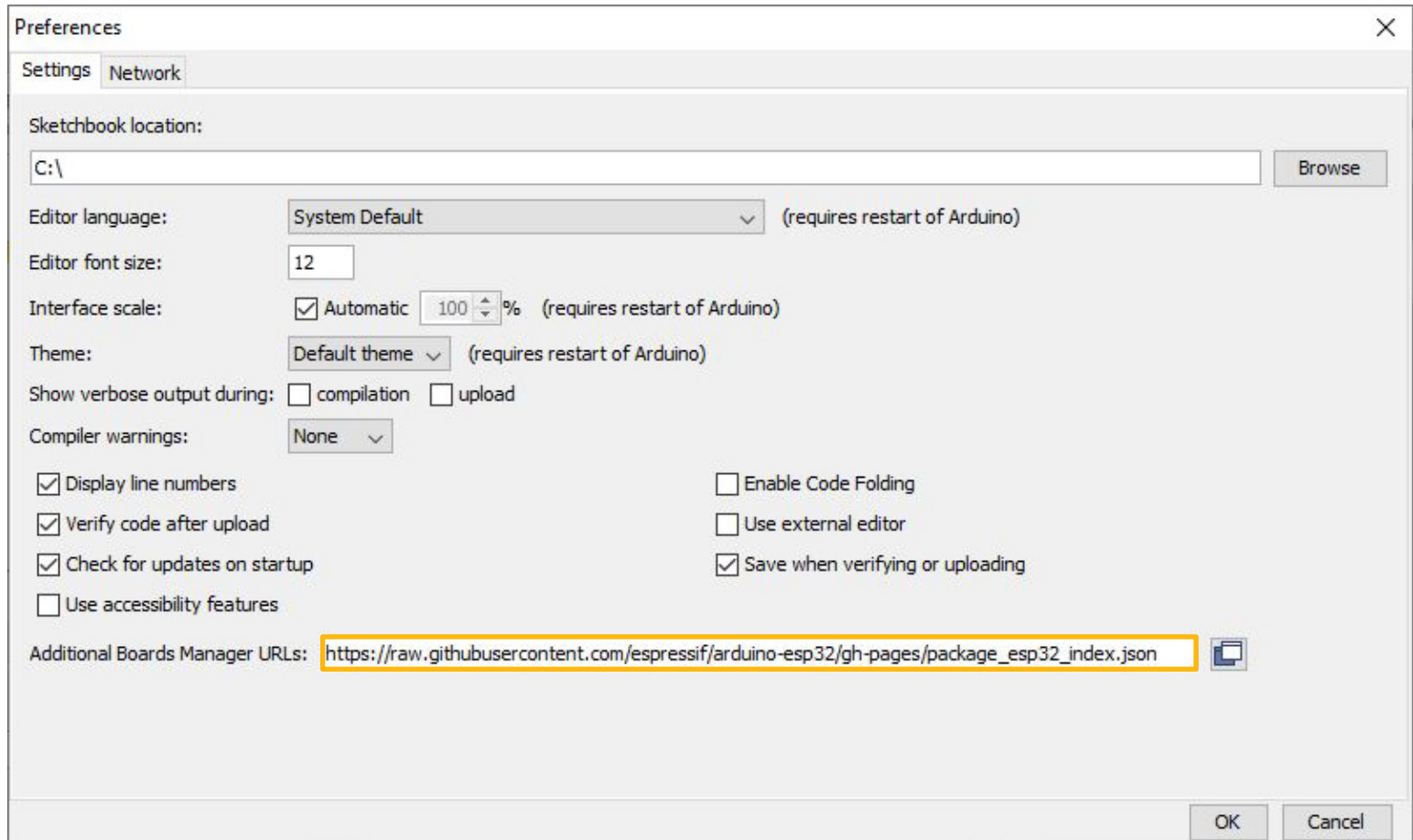
Be sure to save your **Channel ID** and **Write API Key** we are going to need these, in the next few steps.

Step 4 Make sure your Arduino IDE libraries are up to date

A Make sure you have the correct path for the Esp32 Library

In the IDE, go to **File > Preferences**

Locate the **Additional Boards Manager URLs** text box.



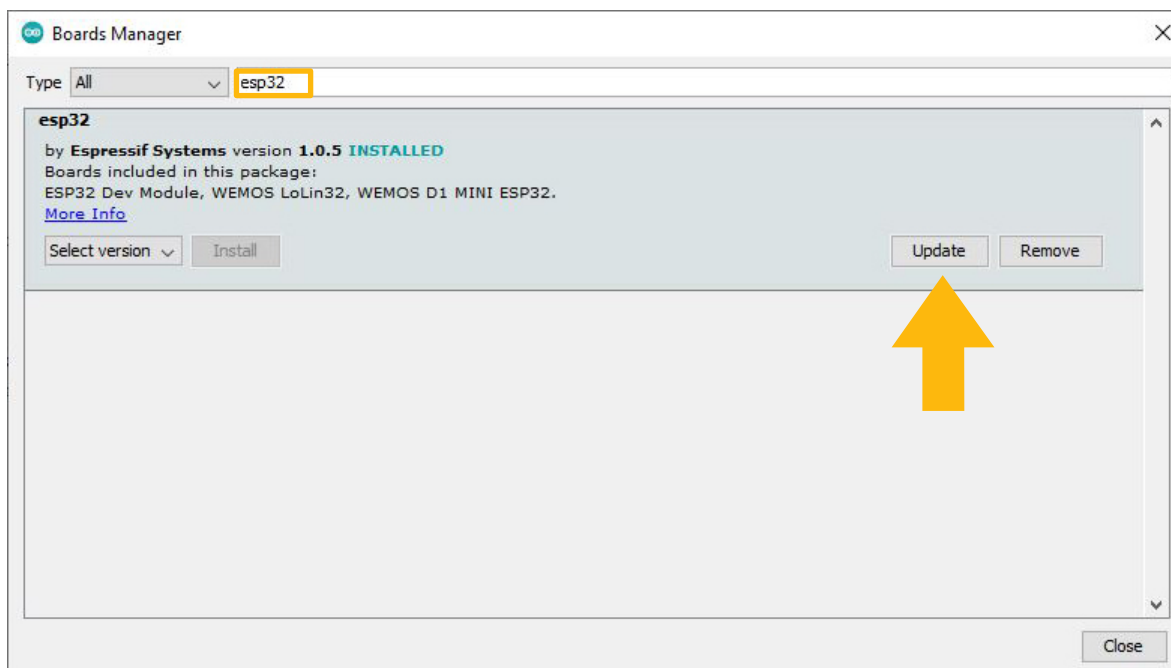
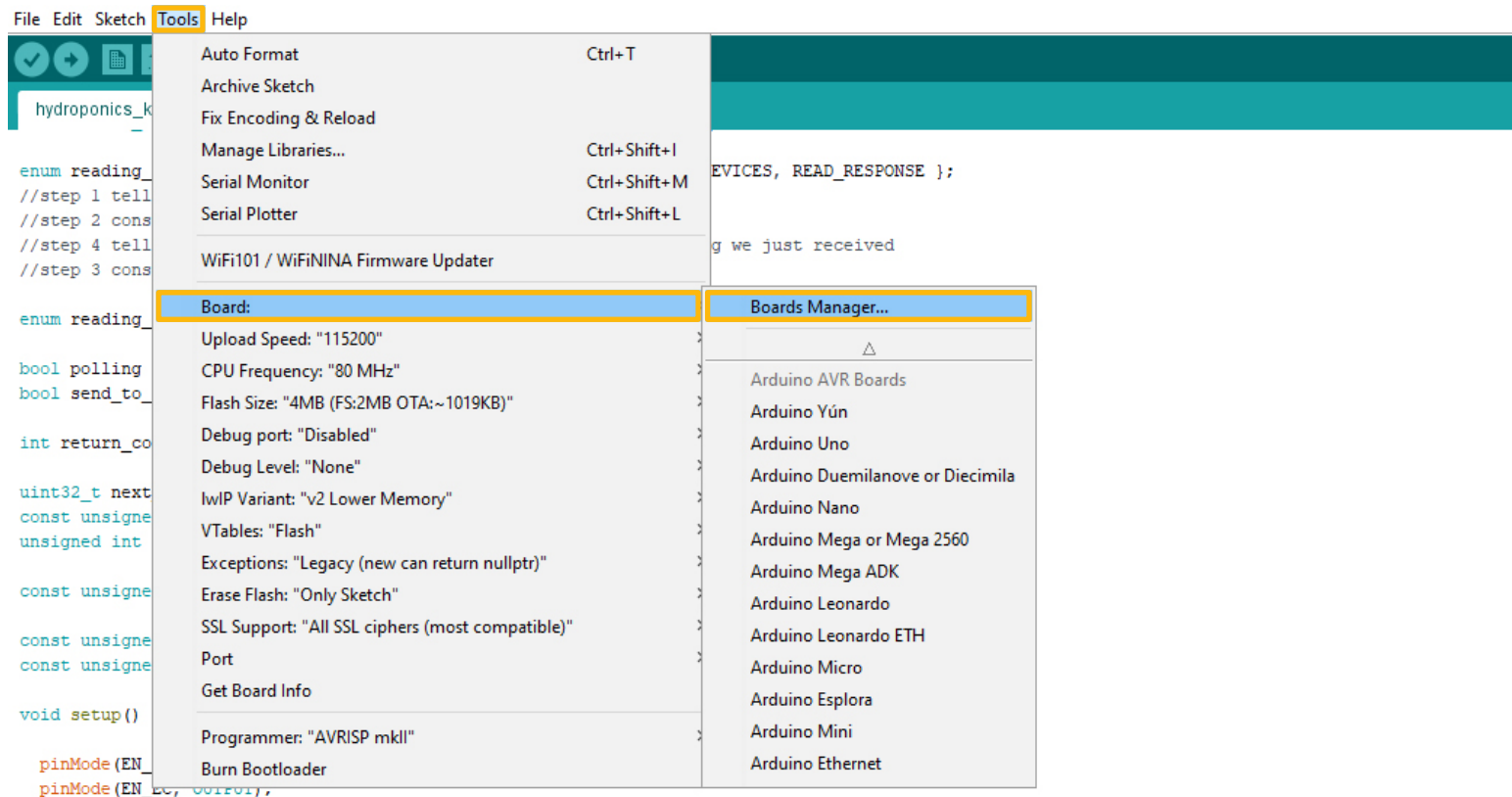
Make sure this URL is in the textbox

https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json

Click **OK**.

B Update the esp32 board

In the IDE, go to **Tools > Board > Boards Manager**



In the search bar of the Boards Manager, lookup **esp32**.
Update to the most recent version if you don't already have it.

(Version 1.0.5 in not the most recent version)

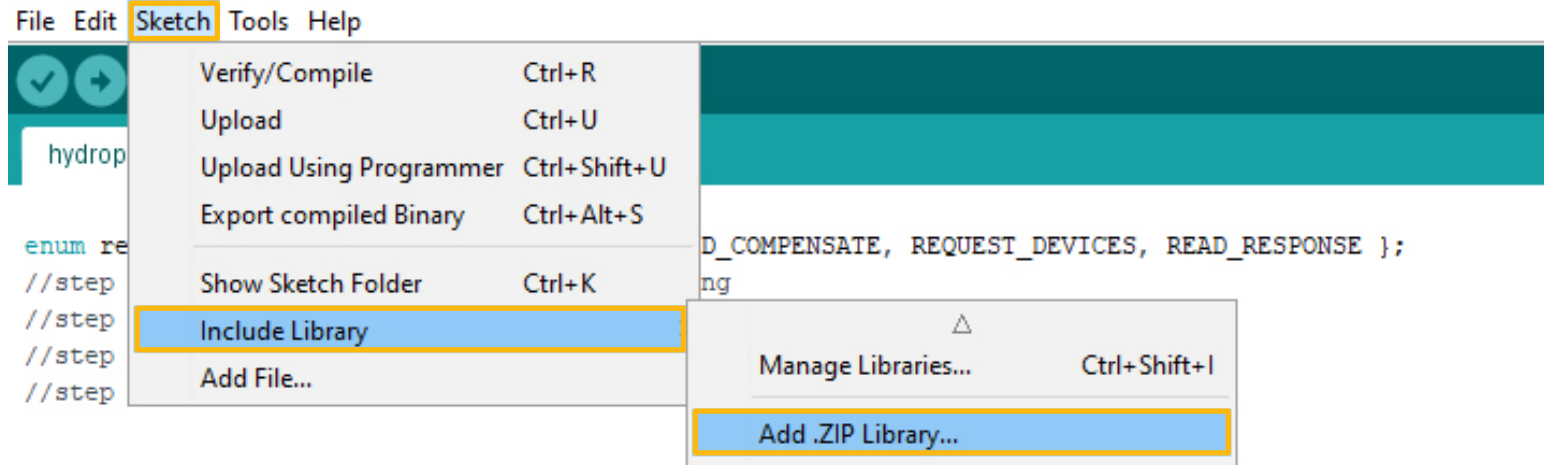
C Download the ThingSpeak library for Arduino

Click [HERE](#) to download the latest version of the ThingSpeak library.

Don't unzip it!

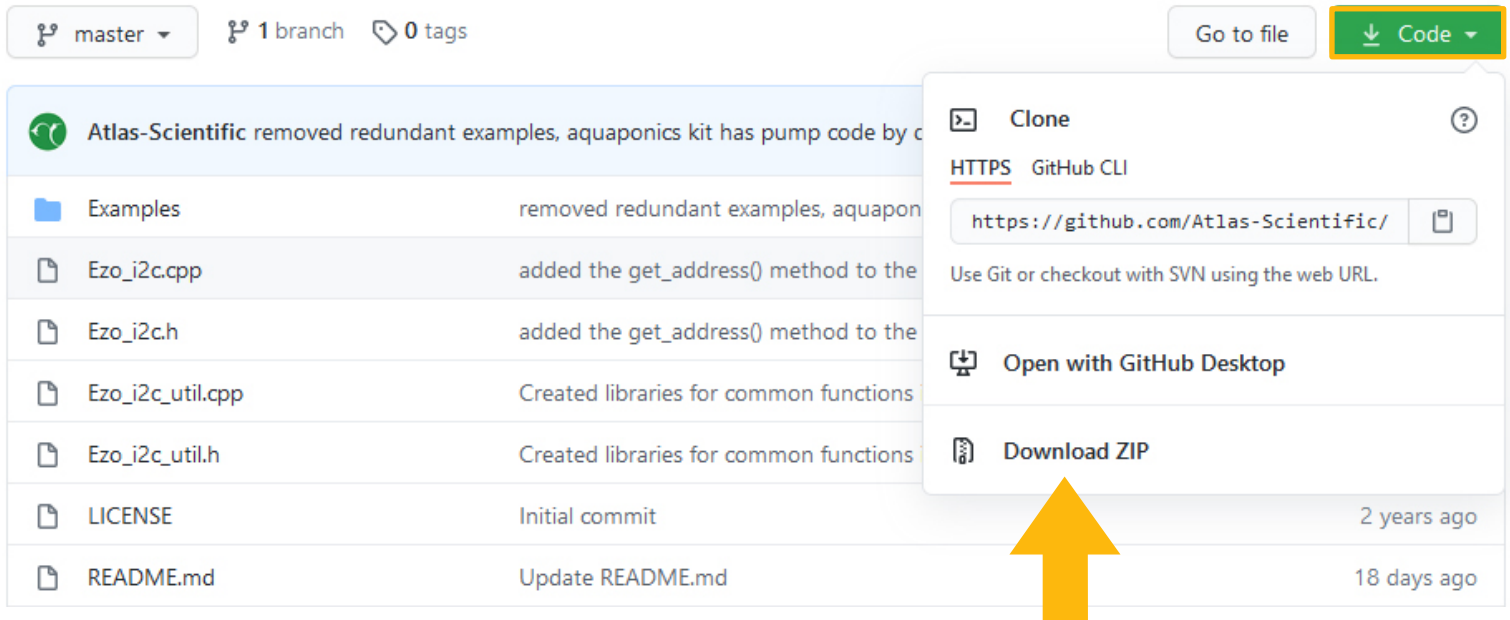
Import the .ZIP file into your Arduino IDE.

To import the .ZIP file go to **Sketch > Include Library > Add .ZIP Library**



D Add the EZO I2C Library

To download the Ezo_I2c library file, click [HERE](#).



Don't unzip it!

Import the .ZIP file to your Arduino IDE.

To import the .ZIP file go to **Sketch > Include Library > Add .ZIP Library**

Step 5

Flash the Hydroponics meter with the correct code

A Select, open and adjust the code you want to use for your Wi-Fi Kit

File> Examples> EZO_I2C_lib-master> Examples> IOT_kits> hydroponics_kit

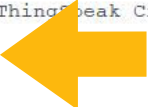
The screenshot shows the Arduino IDE interface. The File menu is open, and the path File > Examples > EZO_I2C_lib-master > Examples > IOT_kits > hydroponics_kit is being navigated. The code editor displays the hydroponics_kit.ino file, which includes comments and code for connecting to a Wi-Fi network and sending data to a Thingspeak channel. The code includes comments for the Wi-Fi network name and password, and the Thingspeak channel number and API key. The code also includes comments for the circuit board address and name, and an array of boards used for sending commands.

```
11 //wifi hydroponics kit that uses the Adafruit huzzah32 as its computer.
12 #include <WiFi.h>
13 #include <Thingspeak.h>
14 //include wifi library
15 //include thingspeak library
16 //imports a 4 function sequencer
17 //imports a 1 function sequencer
18 //brings in common print statements
19 #include <Ezo_I2c_lib.h>
20 //C library from https://github.com/Atlas-Scientific/Ezo_I2c_lib
21 //I2c library
22 //declare that this device connects to a Wi-Fi network
23 //Thingspeak Credentials-----
24 //The name of the Wi-Fi network you are connecting to
25 //Your Wi-Fi network password
26 //Your Thingspeak channel number
27 //Your ThingSpeak Write API Key
28 //-----
29 //create a PH circuit object, who's address is 99 and name is "PH"
30 //create an EC circuit object who's address is 100 and name is "EC"
31 //create an RTD circuit object who's address is 102 and name is "RTD"
32 //create an PMP circuit object who's address is 103 and name is "PMP"
33 //an array of boards used for sending commands to all or specific boards
34 //-----
35 //get the length of the array
36 const uint8_t devCount = sizeof(devices) / sizeof(device_t);
```


B Fill in your Wi-Fi / ThingSpeak credentials

Fill in your Wi-Fi name and Password, along with the Channel ID and Write API Key to the code. (see step 3)

```
3 #include <iot_cmd.h>
4 #include <WiFi.h> //include wifi library
5 #include "ThingSpeak.h" //include thingspeak library
6 #include <sequencer4.h> //imports a 4 function sequencer
7 #include <sequencer1.h> //imports a 1 function sequencer
8 #include <Ezo_i2c_util.h> //brings in common print statements
9 #include <Ezo_i2c.h> //include the EZO I2C library from https://github.com/Atlas-Scientific/Ezo\_I2c\_lib
10 #include <Wire.h> //include arduinos i2c library
11
12 WiFiClient client; //declare that this device connects to a Wi-Fi network,c
13
14 //-----Fill in your Wi-Fi / ThingSpeak Credentials-----
15 const String ssid = "Wifi Name"; //The name of the Wi-Fi network you are connecting to
16 const String pass = "Wifi Password"; //Your WiFi network password
17 const long myChannelNumber = 1234566; //Your Thingspeak channel number
18 const char * myWriteAPIKey = "XXXXXXXXXXXXXXXXXX"; //Your ThingSpeak Write API Key
19 //-----
```



C Setting up your pump

If you do not have a pump attached, you can just skip this part. The code is rather self explanatory. You set what parameters will trigger the pump to engage.

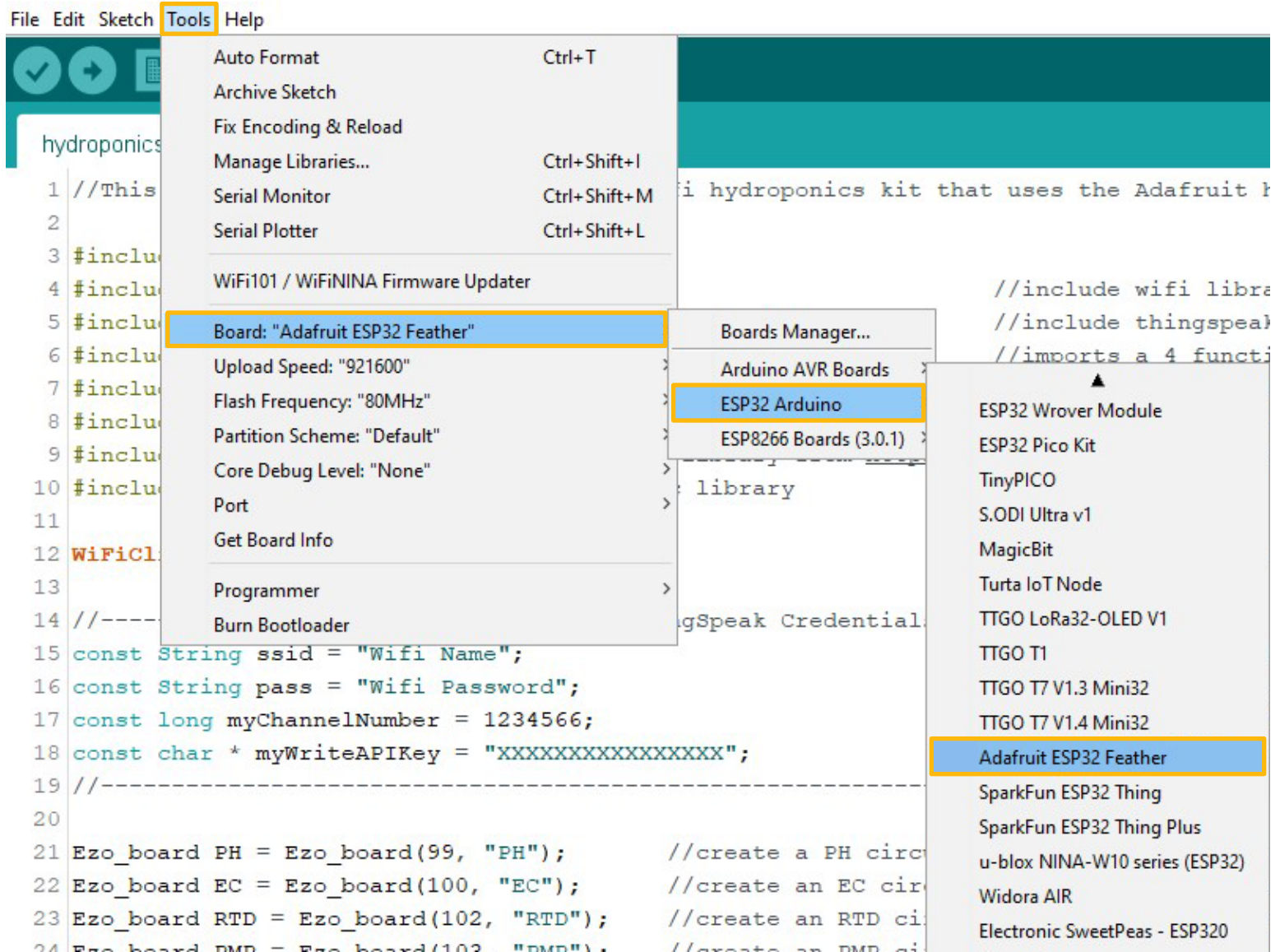
```
48
49 //parameters for setting the pump output
50 #define PUMP_BOARD PMP //the pump that will do the output (if theres more than one)
51 #define PUMP_DOSE -0.5 //the dose that the pump will dispense in milliliters
52 #define EZO_BOARD EC //the circuit that will be the target of comparison
53 #define IS_GREATER_THAN true //true means the circuit's reading has to be greater than the comparison value,
54 #define COMPARISON_VALUE 1000 //the threshold above or below which the pump is activated
55
```

Step 6

Setting up the HUZZAH board

A Set the target CPU to flash

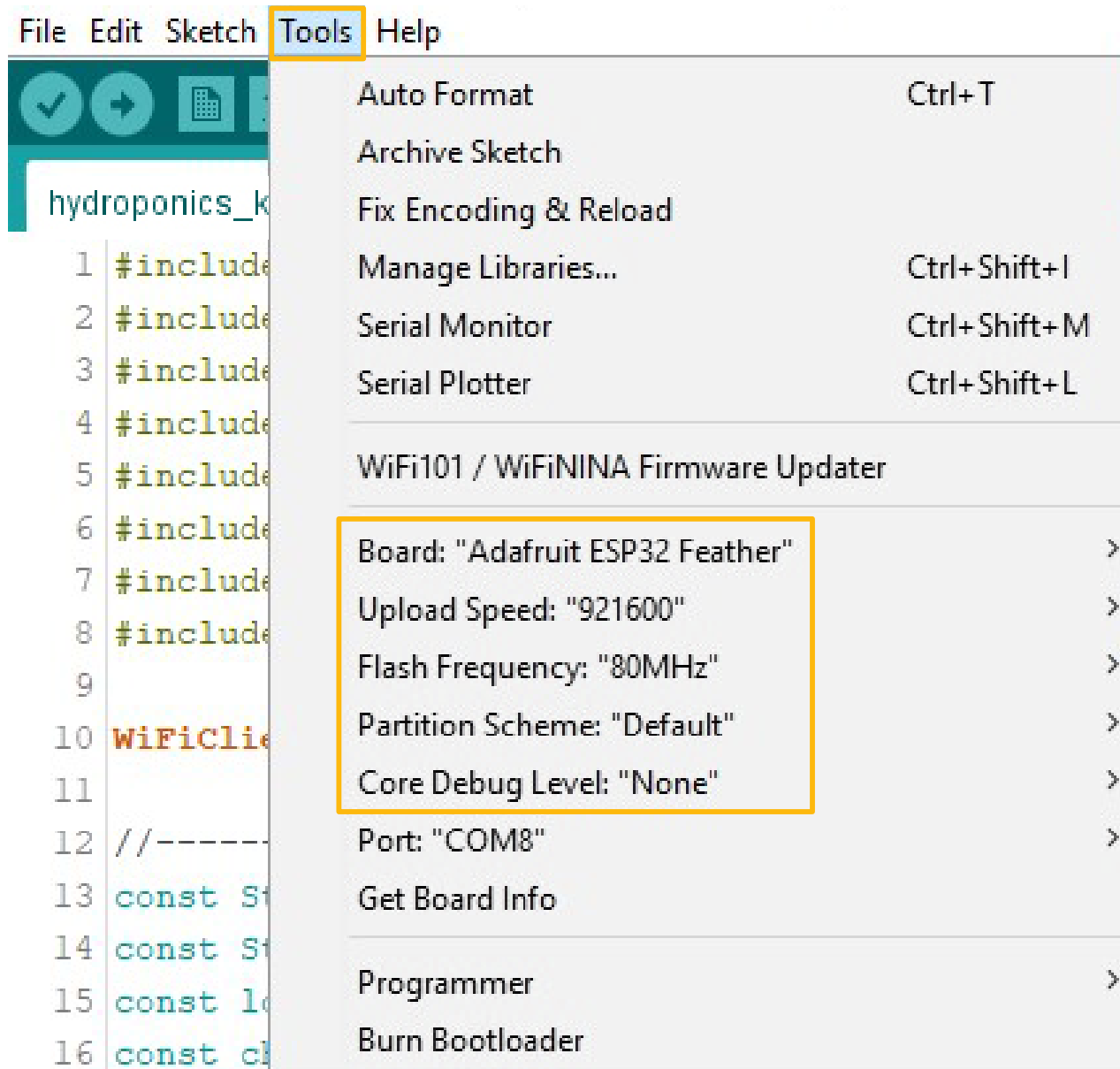
Tools> Board> ESP32 Arduino > Adafruit ESP32 Feather



B Adjust CPU Settings

Make sure the CPU settings on the Adafruit HUZZAH32 are correct.
To adjust the CPU settings, click **Tools**.

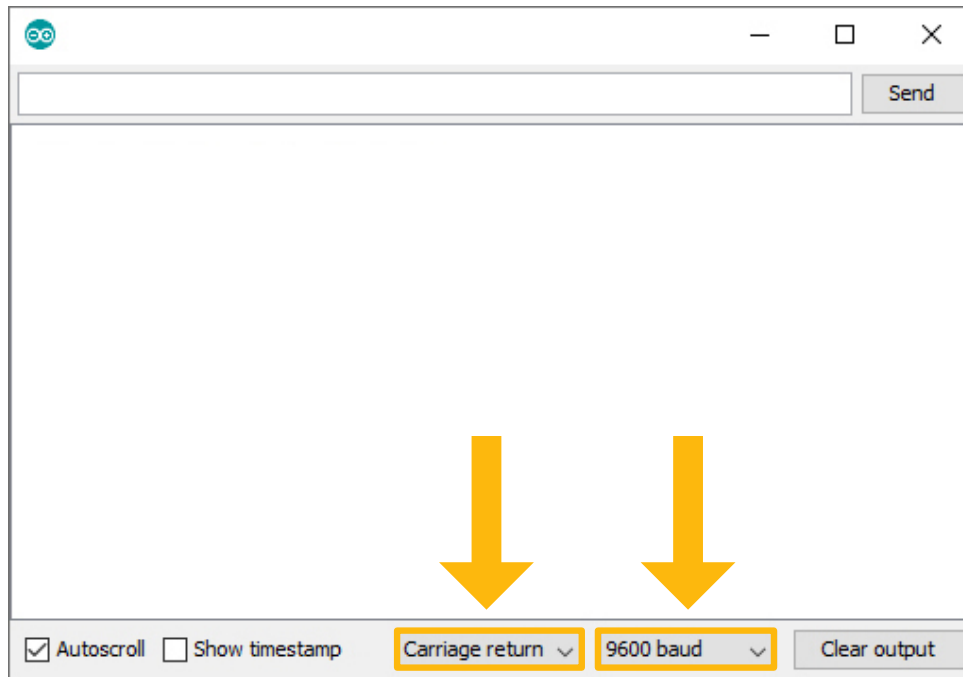
For reference, this is what Atlas Scientific set the CPU settings to.
(your options may not be exactly the same, just try and match them as closely as possible.)



Step 7 See the readings

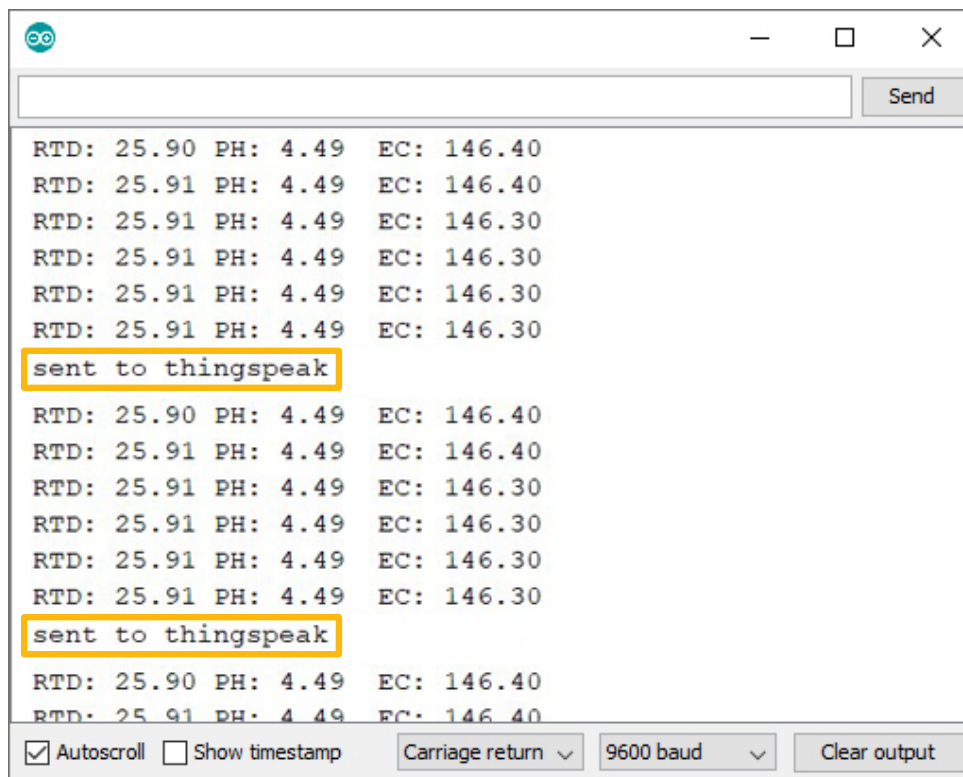
Open your Arduino serial monitor.

(You must have the serial monitor set to the com port from the Adafruit HUZZAH32)

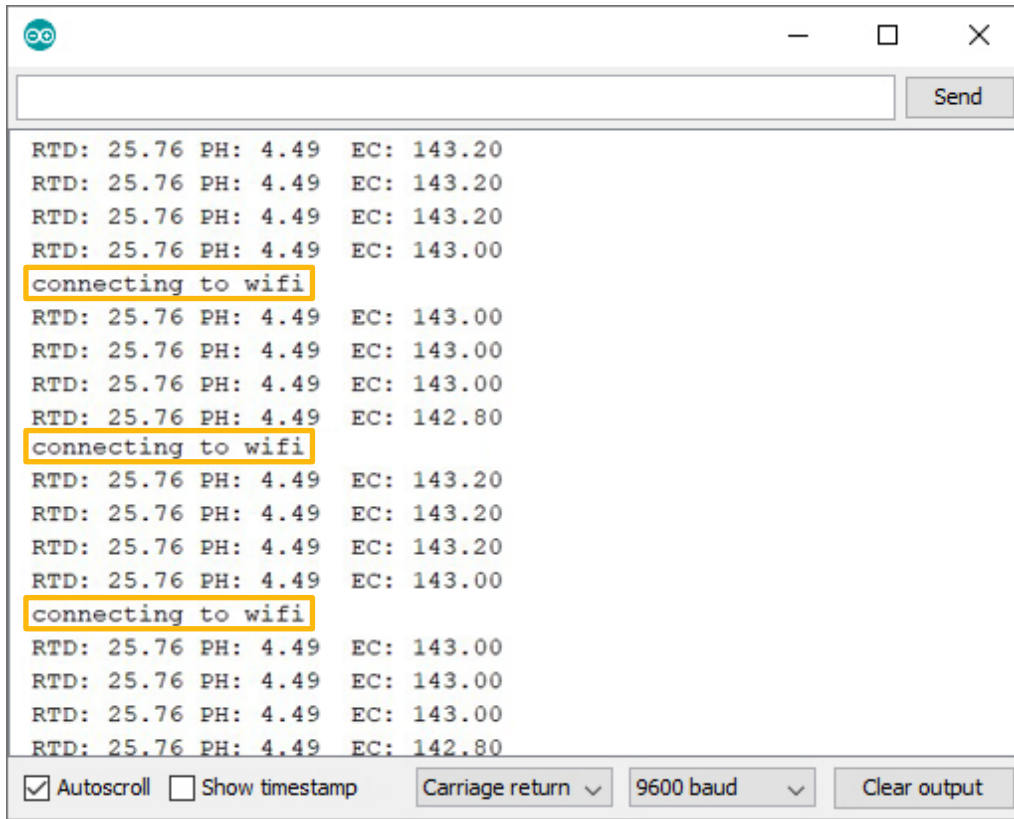


Set to **carriage return** and **9600 baud**.

The Wi-Fi Hydroponics Meter will always attempt to connect to ThingSpeak on bootup.



If it cannot connect to your Wi-Fi you will see this:



The screenshot shows a terminal window with a title bar containing a logo, a minus sign, a maximize button, and a close button. Below the title bar is a text input field and a 'Send' button. The main area of the terminal displays a series of sensor readings: 'RTD: 25.76 PH: 4.49 EC: 143.20' repeated four times, followed by 'connecting to wifi' (highlighted with a yellow box), then 'RTD: 25.76 PH: 4.49 EC: 143.00' repeated three times, followed by 'connecting to wifi' (highlighted with a yellow box), then 'RTD: 25.76 PH: 4.49 EC: 143.20' repeated three times, followed by 'connecting to wifi' (highlighted with a yellow box), and finally 'RTD: 25.76 PH: 4.49 EC: 142.80'. At the bottom of the terminal window, there are four controls: a checked checkbox for 'Autoscroll', an unchecked checkbox for 'Show timestamp', a dropdown menu for 'Carriage return' showing a downward arrow, a dropdown menu for '9600 baud' showing a downward arrow, and a 'Clear output' button.

```
RTD: 25.76 PH: 4.49 EC: 143.20
RTD: 25.76 PH: 4.49 EC: 143.20
RTD: 25.76 PH: 4.49 EC: 143.20
RTD: 25.76 PH: 4.49 EC: 143.00
connecting to wifi
RTD: 25.76 PH: 4.49 EC: 143.00
RTD: 25.76 PH: 4.49 EC: 143.00
RTD: 25.76 PH: 4.49 EC: 143.00
RTD: 25.76 PH: 4.49 EC: 142.80
connecting to wifi
RTD: 25.76 PH: 4.49 EC: 143.20
RTD: 25.76 PH: 4.49 EC: 143.20
RTD: 25.76 PH: 4.49 EC: 143.20
RTD: 25.76 PH: 4.49 EC: 143.00
connecting to wifi
RTD: 25.76 PH: 4.49 EC: 143.00
RTD: 25.76 PH: 4.49 EC: 143.00
RTD: 25.76 PH: 4.49 EC: 143.00
RTD: 25.76 PH: 4.49 EC: 142.80
```

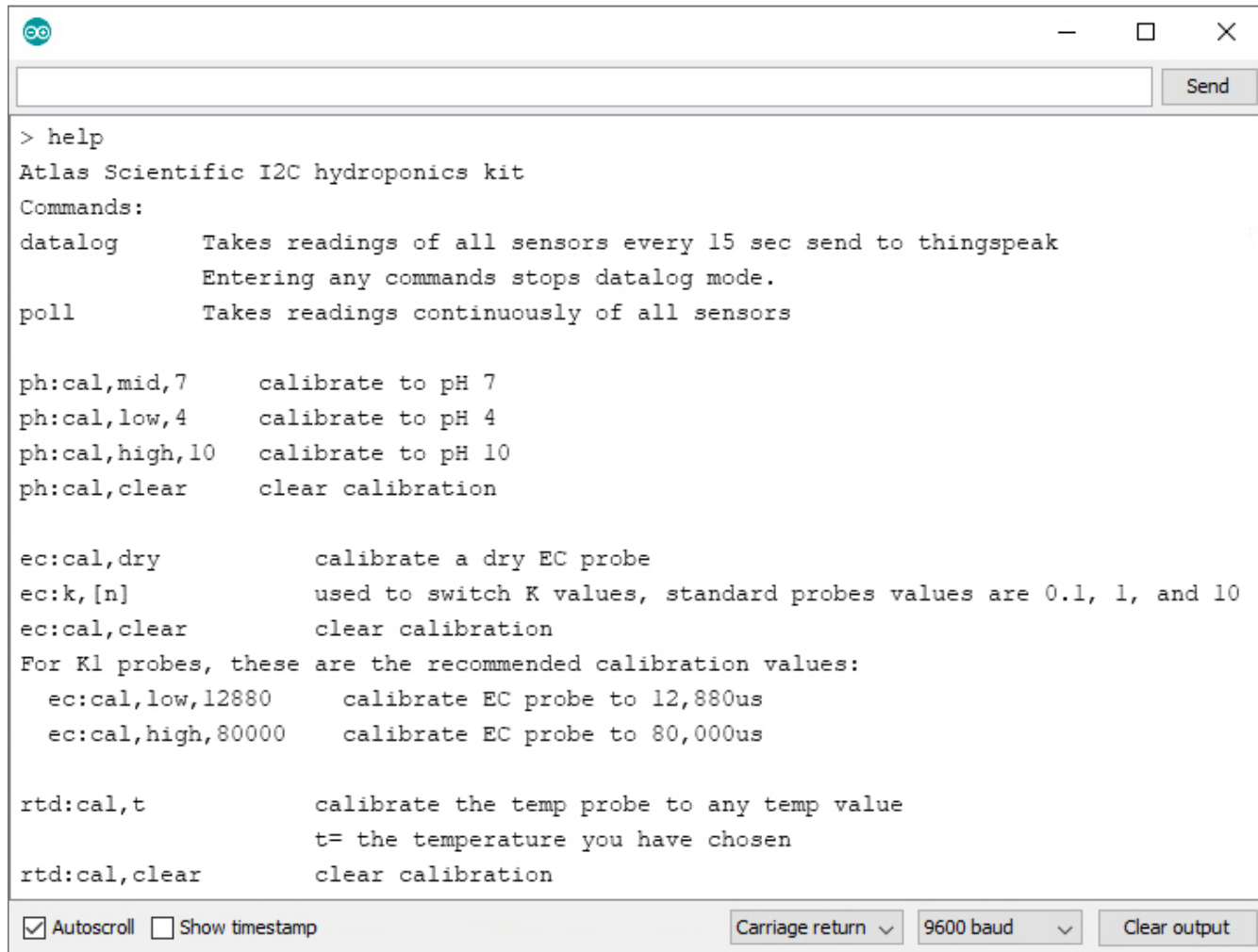
☒ Autoscroll ☐ Show timestamp Carriage return 9600 baud Clear output

Entering the **poll** command will stop the Wi-Fi Hydroponics Meter from uploading the readings to thingspeak, while you debug your Wifi problems.

Step 8

Sensor Calibration

Atlas Scientific created a list of calibration commands that are built into the library. Type in **help** to see a list of commands.



```
> help
Atlas Scientific I2C hydroponics kit
Commands:
datalog      Takes readings of all sensors every 15 sec send to thingspeak
              Entering any commands stops datalog mode.
poll         Takes readings continuously of all sensors

ph:cal,mid,7   calibrate to pH 7
ph:cal,low,4   calibrate to pH 4
ph:cal,high,10 calibrate to pH 10
ph:cal,clear   clear calibration

ec:cal,dry     calibrate a dry EC probe
ec:k,[n]       used to switch K values, standard probes values are 0.1, 1, and 10
ec:cal,clear   clear calibration
For K1 probes, these are the recommended calibration values:
  ec:cal,low,12880   calibrate EC probe to 12,880us
  ec:cal,high,80000  calibrate EC probe to 80,000us

rtd:cal,t      calibrate the temp probe to any temp value
                t= the temperature you have chosen
rtd:cal,clear  clear calibration
```

☒ Autoscroll ☐ Show timestamp Carriage return ▾ 9600 baud ▾ Clear output

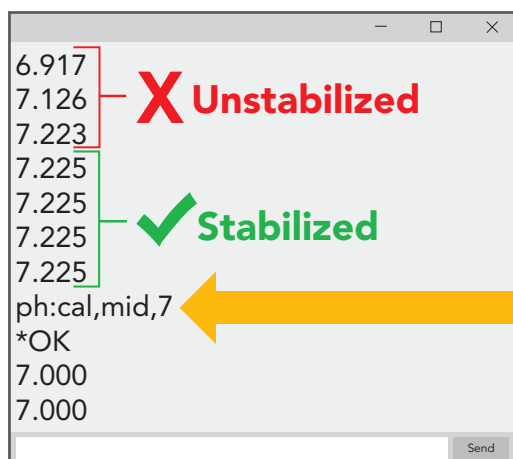
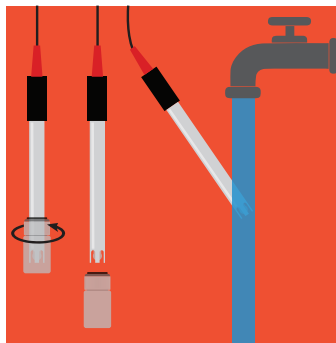
A The poll command

Send the command **poll**; This will let you see the readings once per second and it will stop uploading to ThingSpeak while you calibrate.

B Calibrate pH

When calibrating pH, you must always calibrate to pH 7 first.

Remove the soaker bottle and rinse off the pH probe. Remove the top of the pH 7.00 calibration solution pouch. Place the pH probe inside the pouch and let the probe sit in the calibration solution until the readings stabilize. This will take about 1 – 2 mins.



Once the readings have stabilized, issue the Mid point calibration command. **ph:cal,mid,7**

Rinse off the probe and repeat this process for both **pH 4.00** and **pH 10.00**.

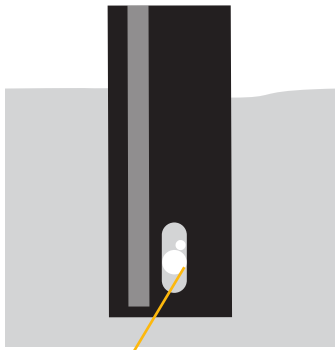
C Calibrate Conductivity

When calibrating Conductivity, you must always calibrate a dry probe first.

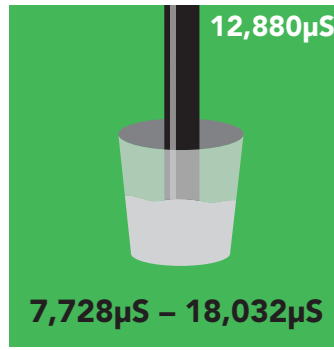


Make sure that the probe is dry before issuing this command, **ec:cal,dry**

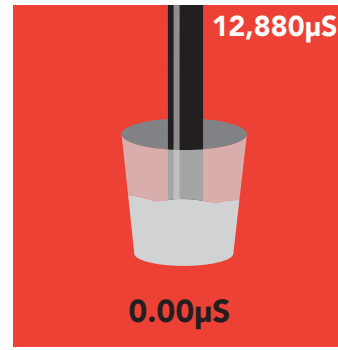
Once the dry calibration has been completed, place the probe into a small cup of the 12,880 μ S calibration solution. Shake the probe to make sure you do not have trapped air bubbles in the sensing area. You should see readings that are off by **1 – 40%** from the stated value of the calibration solution. Wait for readings to stabilize.



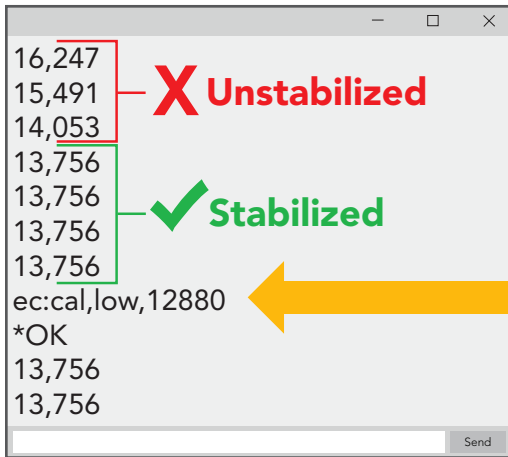
Trapped air in sensing area (shake to remove)



+/- 40%

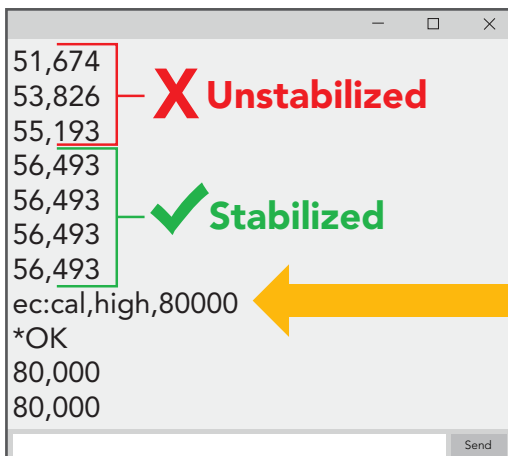


check probe connection,
you cannot calibrate to 0.



Once the readings stabilize, issue the low point calibration command. **ec:cal,low,12880**
(Readings will **NOT** change)

Rinse off the probe before calibrating to the high point. Pour a small amount of the 80,000 μ S calibration solution into a cup. Shake the probe to remove trapped air. Again, the readings may be off by **1 – 40%** Wait for readings to stabilize.

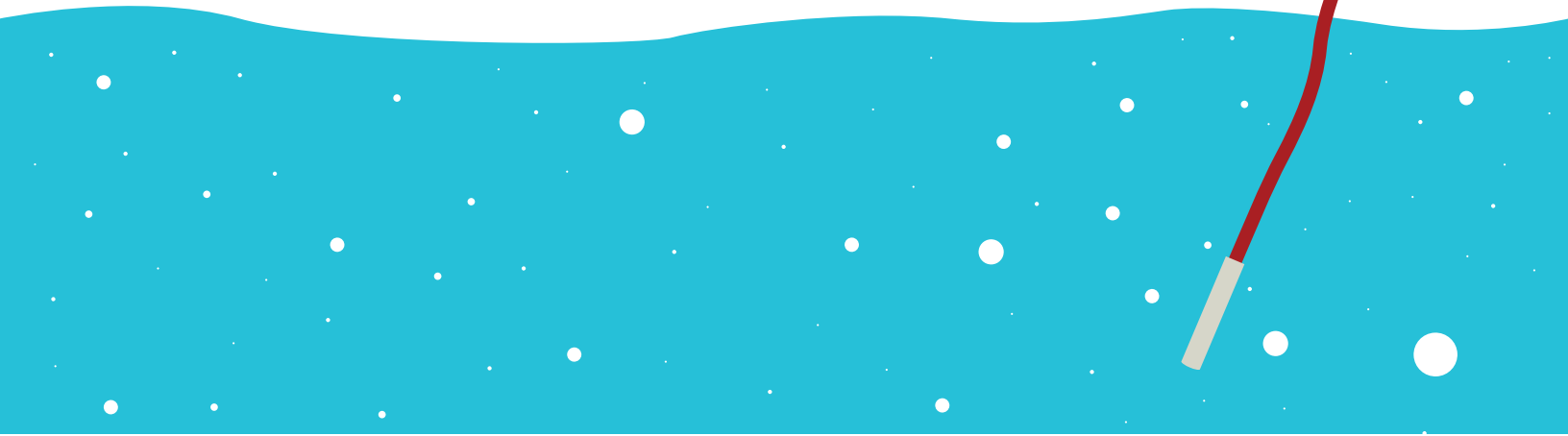


Once the readings stabilize, issue the high point calibration command. **ec:cal,high,80000**
(Readings **will** change, calibration complete).

D Calibrate Temperature

Calibrating the PT-1000 temperature probe is not required. However, if you want to, a simple method to calibrate the probe is to place the PT-1000 into boiling water. Then issue command **rtd:cal,t**

100 °C

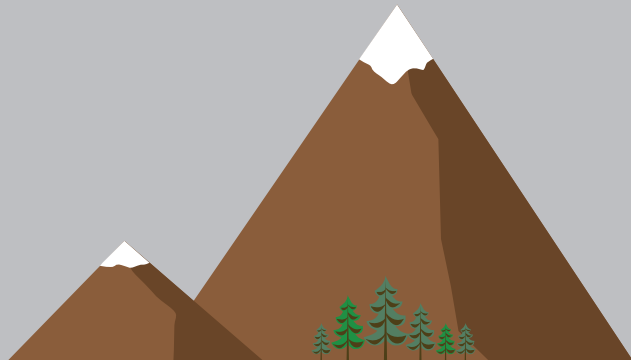


Elevation in meters

305
229
152
76
0
-76
-152

Boiling point

98.9 °C
99.2 °C
99.5 °C
99.7 °C
100 °C
100.3 °C
100.5 °C



Calibration Complete

Step 9 **Almost done!**

Once you are finished with calibration, issue the **datalog** command to resume taking a reading every 15 seconds and uploading it to thingspeak.

To see the data on your phone, download the ThingSpeak app.



Setup Complete!