SwitchDoc Labs

The SmartGarden3 Hydroponics Assembly and Test Manual

February 2022
Version 1.1

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Disclaimer **31**

Cautions when building and using The SmartGarden3

1) **Keep all water away from the electronics and power supply at all times!**
2) **The SmartGarden3 is designed for indoor use only and should be placed in a dry environment where no water or rain can reach to avoid short circuiting the electronics**
3) **Insert the moisture sensor into the CENTER of the flower pot, and keep it near the center of the plant and away from the water coming out of the holes cut in the watering pipe.**
4) **This is not a toy! Keep it out of reach of young children and pets.**
5) **SwitchDoc Labs assumes no liabilities in the use of this kit, beyond the refund of the purchase price.**

Errata

What is The SmartGarden3?

Did you ever want to build your own remote monitoring and management system for your indoor or outdoor garden? Do you want to share your garden and the weather world wide? This project is for you. You can learn the Raspberry Pi and how to connect to the real world through this easy to build **no-soldering** kit. You can measure soil moisture and then use that as feedback to provide your plant or garden just the right about of water.

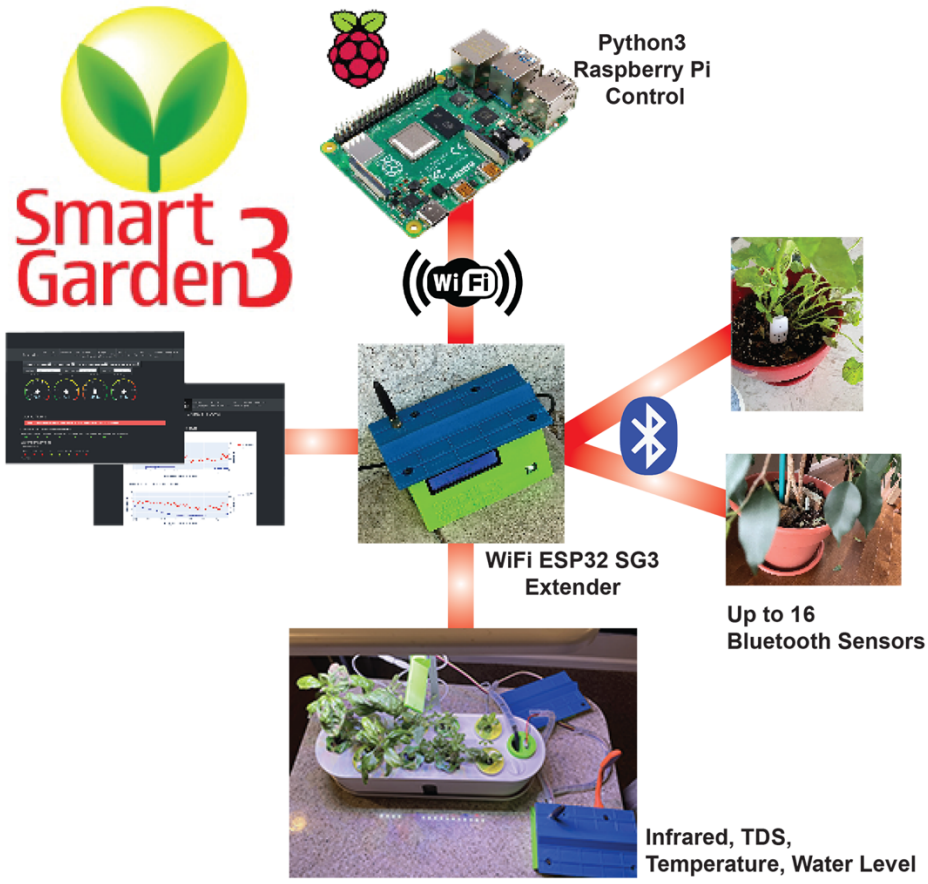
Highly expandable! You can have your Raspberry Pi Base Unit inside your house and have multiple wireless control units in your outdoor garden, greenhouse or in the upstairs bedroom. Up to 250 wireless control units can be connected up to one Raspberry Pi base unit. This allows you to control your truly MASSIVE garden. Or your small one. Either way!

This is a perfect highly expandable project kit for kids with some help from the adults and for adults trying to learn some new things. This project has **no soldering** involved and uses Grove connectors to wire everything up! You can't reverse them and blow things up. Here is our tutorial on the Grove system.

The SmartGarden3 Features

- Control Valves, Pumps and Lights
- Measure your Soil Moisture
- Measure your Sunlight
- Show your results on the Internet and your Phone

Easy to build. Easy to learn about the IOT (Internet Of Things) and the Raspberry Pi.



Preparing and Learning your Raspberry Pi

The SmartGarden3 requires a working Raspberry Pi. You can use virtually any Raspberry Pi (3B+, 4B+, ZeroW, etc.) but you do need to set it up before starting the process of building The SmartGarden3.

Initial setup of your Raspberry Pi and connecting to it on your network is well beyond the scope of this manual. There are just too many variables in how you might set up your Raspberry Pi. Consider visiting the Raspberry Pi Foundation for suggestions.

SwitchDoc Labs provides an SD Card that has the Raspberry Pi operating system, version Buster, and all the SmartGarden3 software installed. https://shop.switchdoc.com/products/32gb-sd-card-with-stretch-smart-garden-system-groveweatherpi

The SDCard also has a provisioning system that allows easy connection to your network. See the SD Card Product page.

Once you have your Raspberry Pi setup up, running and can access a command line window (terminal) then you are ready to go with this manual.

This is the reason that we consider The SmartGarden3 an advanced beginners kit, rather than a beginners kit (like the OurWeather Weather Station).

Here are some resources to get you set up and running as quickly as possible.

Helpful Getting Started Videos:
https://www.raspberrypi.org/help/videos/

Helpful Getting Started Written Tutorial:
https://www.raspberrypi.org/wp-content/uploads/2012/12/quick-start-guide-v1.1.pdf

If you want to set up a headless (no monitor, keyboard, mouse) Raspberry Pi, it is more complicated. Here are some links to tutorials for that process.

http://www.circuitbasics.com/raspberry-pi-basics-setup-without-monitor-keyboard-headless-mode/

http://blog.self.li/post/63281257339/raspberry-pi-part-1-basic-setup-without-cables

Many, many more tutorials are available on the web.

If you have the SDL SD Card, please check the product page for directions about setting up your Pi to your network.

https://shop.switchdoc.com/products/16gb-sd-card-with-stretch-smart-garden-system-groveweatherpi

Once you have it set up, take a brief tutorial about using the terminal window and the very powerful Raspberry Pi Command Line.

https://www.raspberrypi.org/blog/learning-the-command-line/

https://www.raspberrypi.org/blog/learn-to-love-the-command-line-with-the-magpi/

You don't need to know a lot about the command line to enjoy building and running The SmartGarden3, but you do need a bit of knowledge.

What is in the SmartGarden3 Hydroponics Kit?

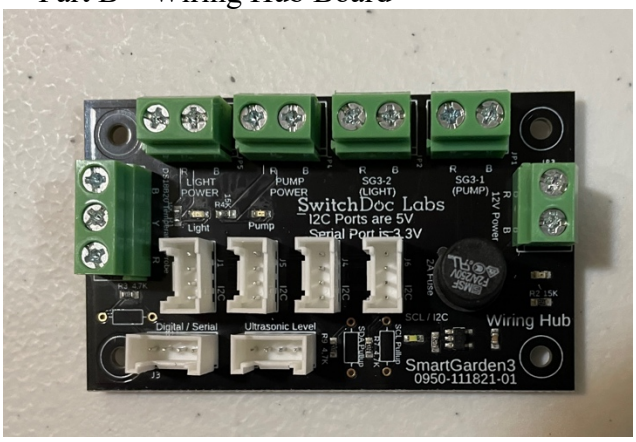
Note: You will need to add two additional things to finish your SmartGarden3 Project

- A Raspberry Pi
- A Box of M3 Screws
- Tubing

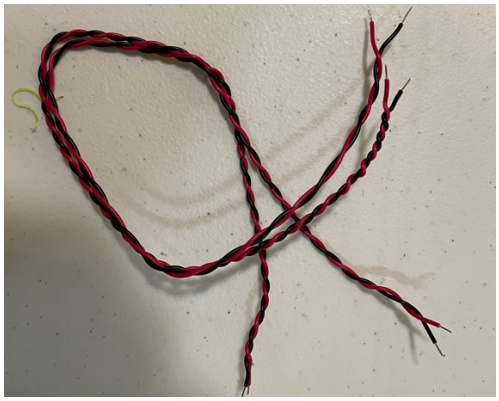
See the section immediately after the Parts List.

Part A – Hydroponics Kit

Part B – Wiring Hub Board



Part C – Two Twisted Pair Cables

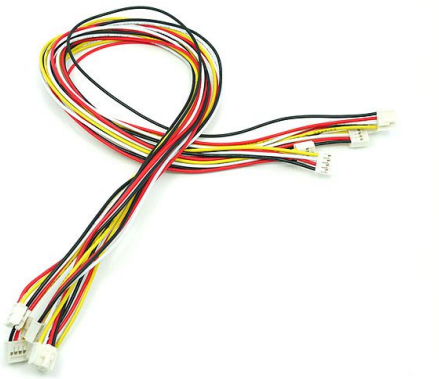


Part D – DS18B20 Waterproof Temperature Probe

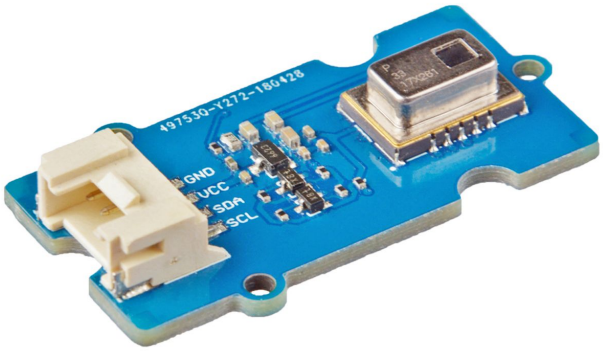
Part E – Grove TDS Board and Probe

Part F – Moisture Level Sensor and Cable

Part G – Grove 50cm Cables (4)

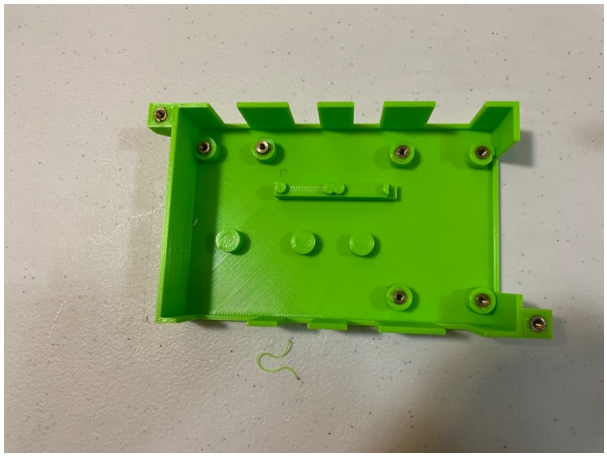


Part H – AMG8833 8x8 Infrared Thermal Sensor

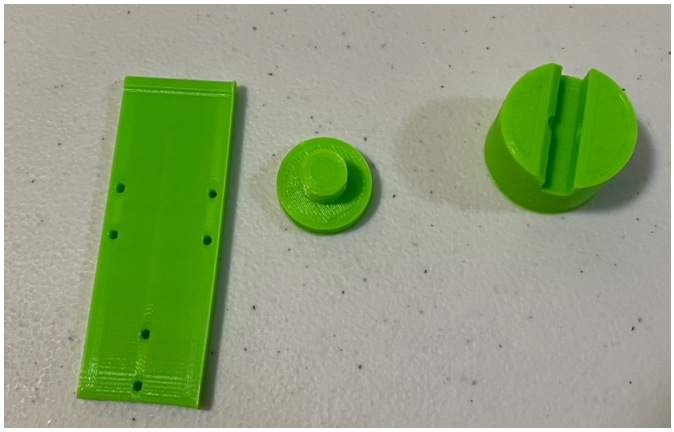


Part I – Spiral Wire Wrap

Part J – 3D Printed HydroponicsWire Hub Base (Optional)



Part K – 3D Printed Infrared Mount (Optional)



Part L – 3D Printed Hydroponics Hub Top (Optional)

Part M – 3D Printed Hydroponics Sensor Mount

Parts Not Included

For your convenience, we have a SG3 Hardware Kit that has the M3 and M2 screws and brass inserts necessary for assembly of the SG3 Hydroponics Wireless Hub.

Brass Inserts (to assemble the 3D Prints):
https://amzn.to/3AwvgNV

You will need a box of M3 screws (to assemble the 3D Prints) and nuts such as this (on Amazon or shop.switchdoc.com):
https://amzn.to/3FSgNNp

You will also need a box M2 plastic screws to mount the Infrared Sensor to the mount. Alternatively, you can glue the sensor to the mount. (on Amazon: https://amzn.to/3gqg1wH)

Step by Step Assembly

Cautions: Keep your static charge to a minimum during your assembly and operation. Touch metal before handling parts. Avoid shuffling your feet. Before starting assembly, layout all the parts above and familiarize yourself with the various parts.

NOTE: There is no water anywhere in the system while you assemble it. Do not fill they hydroponics tank until the end of the assembly instructions.

What are we doing here?

We are assembling the Hydroponics unit and the SmartGarden3 Hydroponics wiring hub and connecting it up with the SmartGarden3 wireless extender.

While we recommend you buy or print a 3D enclosure, you can also use a Tupperware or other plastic enclosure to protect the SmartGarden3 Hydroponics Hub from water.

Assembling the SmartGarden3 Hydroponics Unit

Step 1) Assemble and test the SmartGarden3 Wireless Extender unit as shown in the "Step-By-Step Assembly and Test Manual for SmartGarden3". You must complete this manual and procedure before continuing.

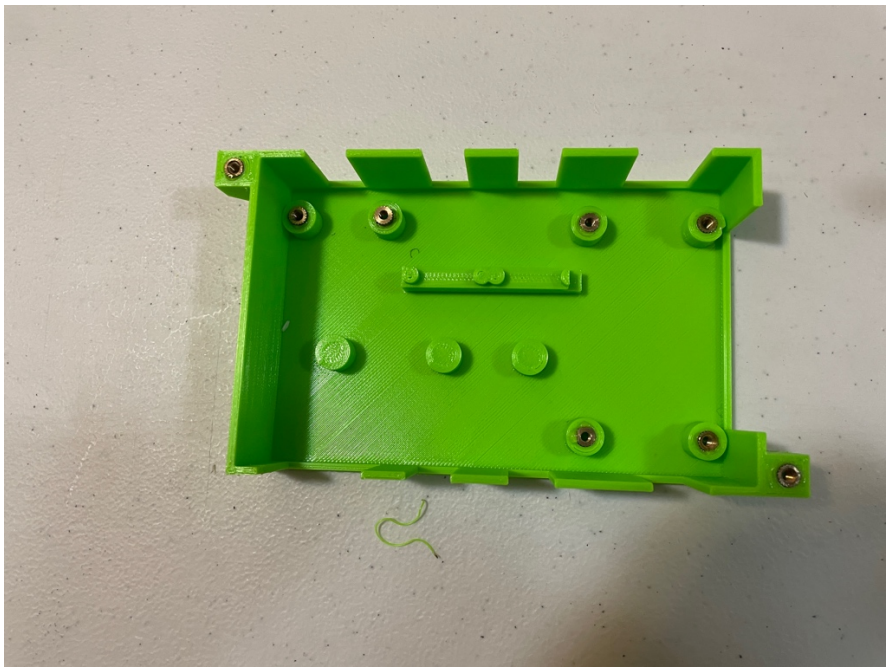
Step 2) Assemble the Indoor Hydroponics Unit (Part A) as shown in the included instructions in the box. Note: There is no button control unit in the hydroponics unit and the power, light and pump wires have screw down terminals attached for use in the SmartGarden3 Hydroponics Wiring Hub (Part B).

Step 3) **NOTE:** These instructions are written for use with the 3D Prints which you can print yourself from the STL files or buy optionally from SwitchDoc Labs.

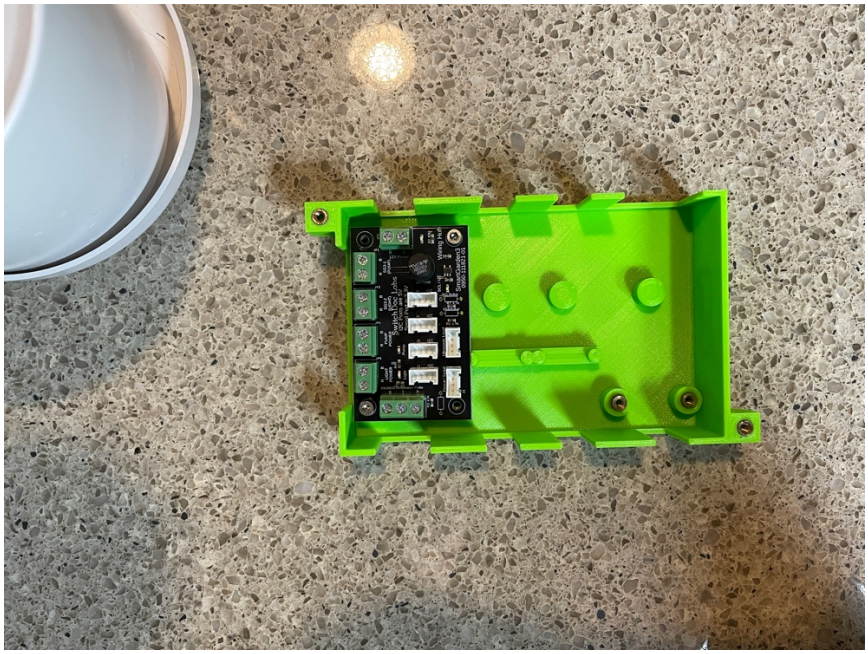
STL Files: https://github.com/switchdoclabs/SDL_STL_SmartGarden3

3D Prints: https://shop.switchdoc.com/products/3d-print-for-smart-garden-hydroponics

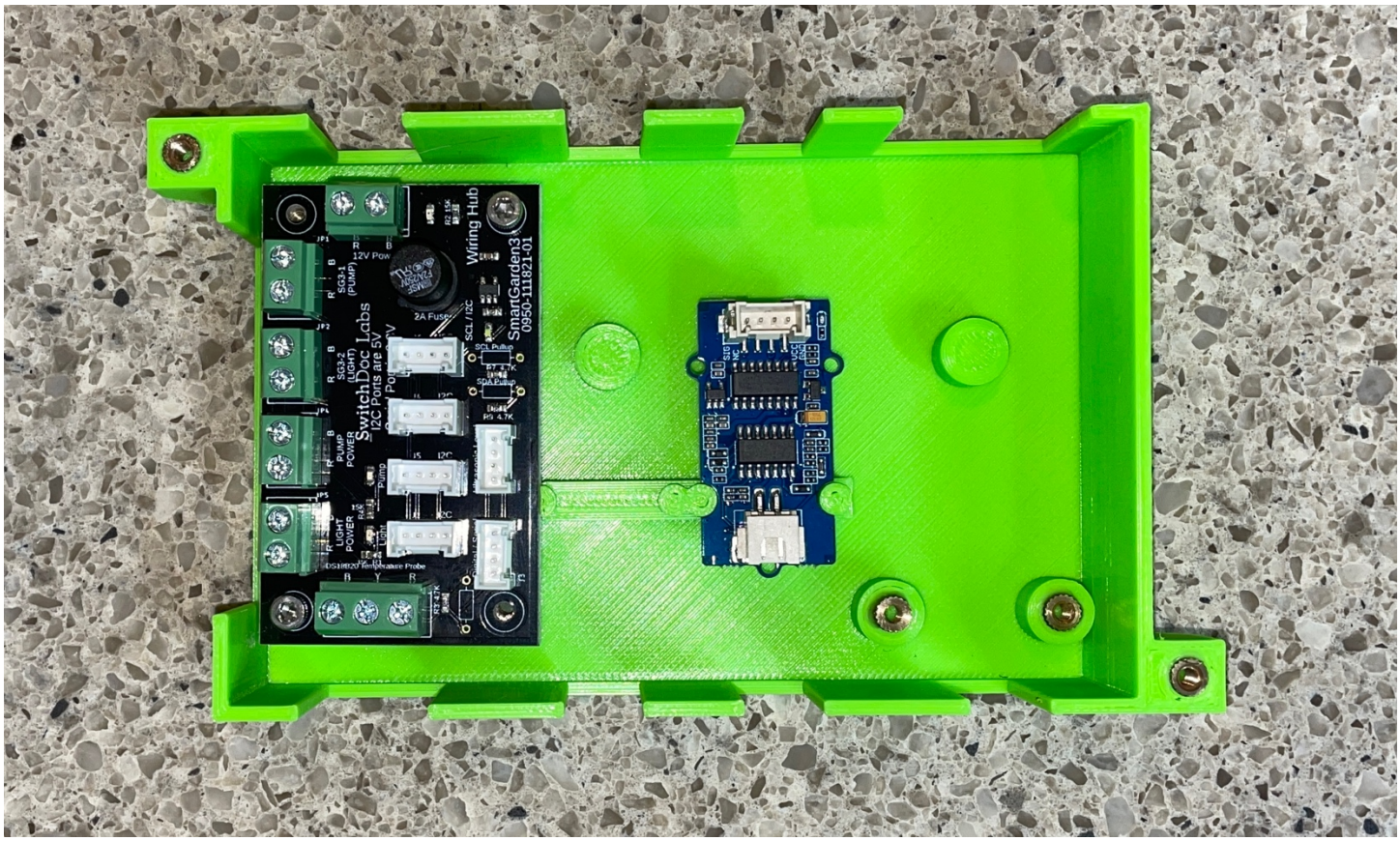
Step 4) Insert the Brass Inserts in all 8 holes on the SG3 Extender Base (Part J). Use one of the screws to hold the inserts as you put a small amount of super glue around the outside. Don't get any of the super glue on the screw! Let the box dry for about an hour.



Step 5) Install the Wiring Hub Board (Part B) into the 3D Printed Hydroponics Wire Hub Base (Part J) using two M3 screws. Note the holes on the Wiring Hub Board (Part B) are self tapping so start them in the board first before placing the board in the 3D Printed housing.

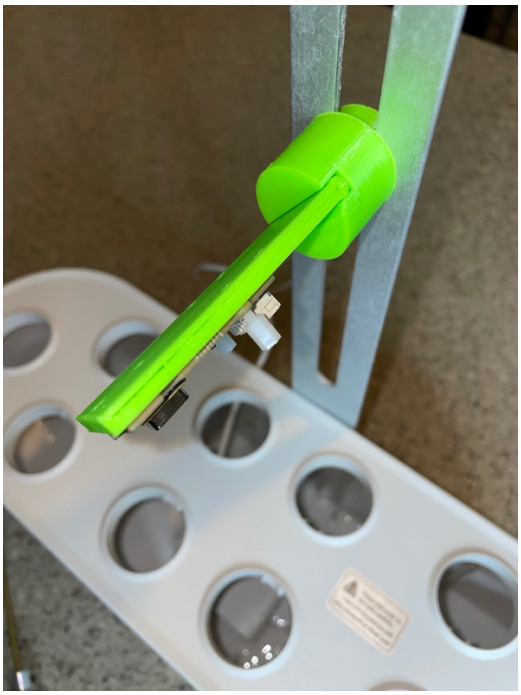


Step 6) Install the Grove TDS Board (Part E) into the 3D Printed Hydroponics Wire Hub Base (Part J) as shown. If it doesn't snap fit, then use a small amount of glue on the back to hold it on the upper post.

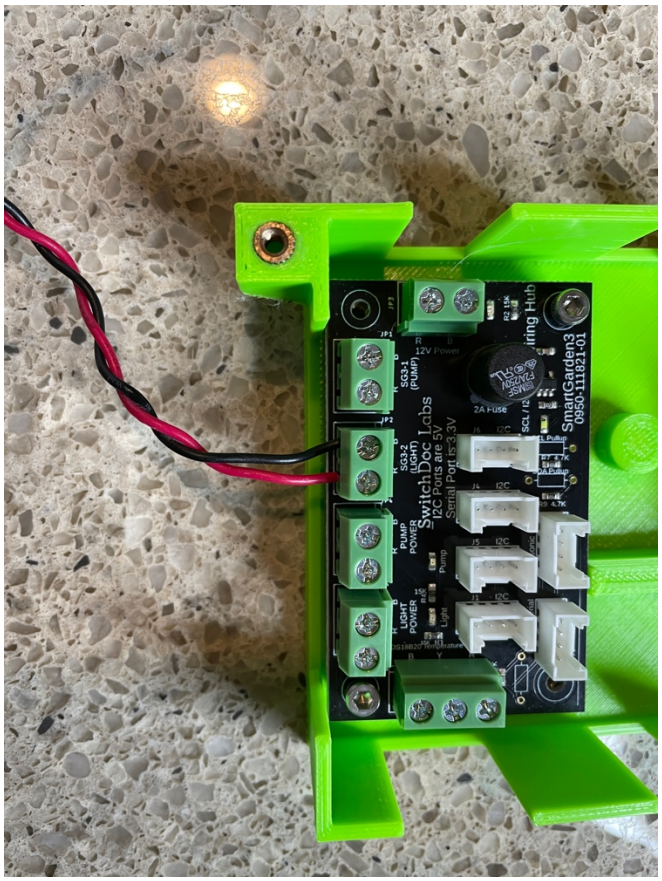


Step 7) Install the AMG8833 8x8 Infrared Thermal Sensor (Part H) on the 3D Printed Infrared Mount (Part K) as shown. If you don't have M2 screws, then use glue to hold the board to the mount as shown.

Step 8) Slide the Mount into the Mount Base (Part K) and screw it to the Hydroponics Light Holder (Part A) as shown. If the AMG8833 Mount is not tight, use a M3 set screw to hold it in position by threading it into the hole on the Mount Base.

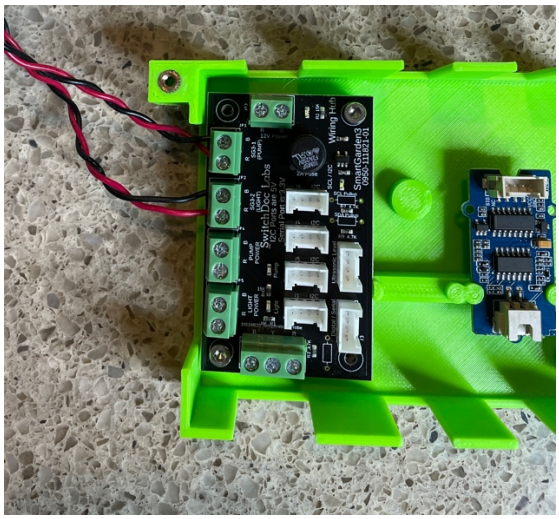


Step 9) Take one of the two Twisted Pair Wires (Part C) and screw them into the terminal as shown. Connected Red to “R” and Black to “B”. This is for the SmartGarden3 to control the Light.

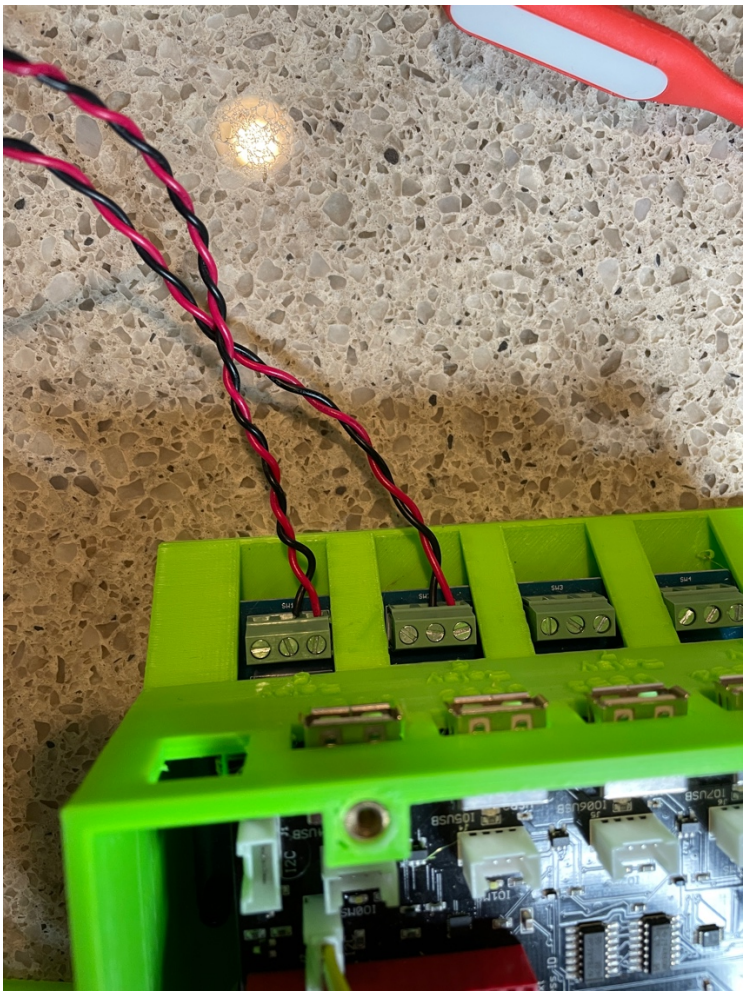


Step 10) Connect the other end of the Twisted Pair Wire (Part C) from Step 9 and screw them into the terminals on the SmartGarden3 Extender marked Relay 6. Make sure you screw the wires in the terminals shown.

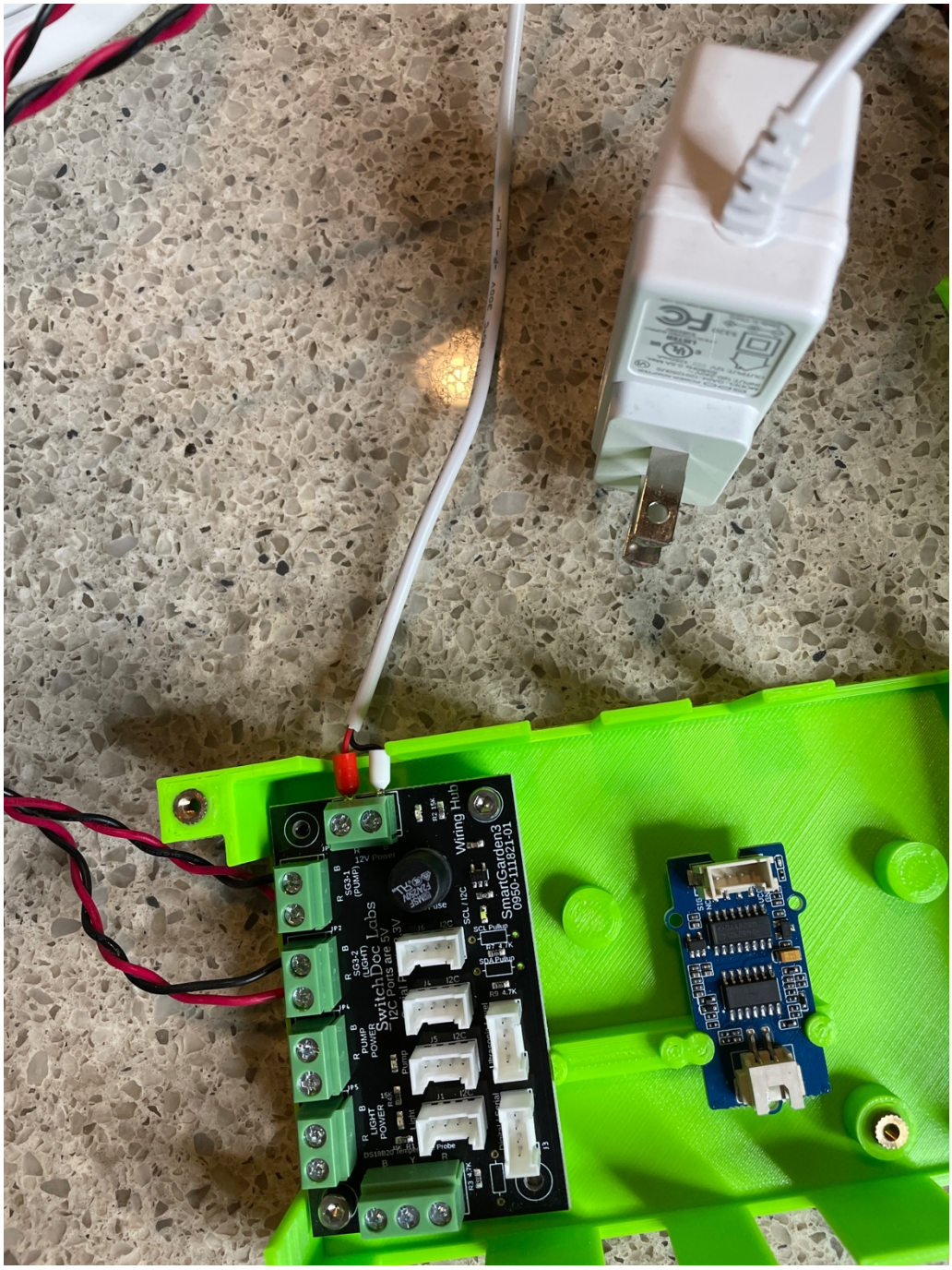
Step 11) Take the second Twisted Pair Cables (Park C) and screw down the wires as shown (Red to “R” and Black to “B”) below.



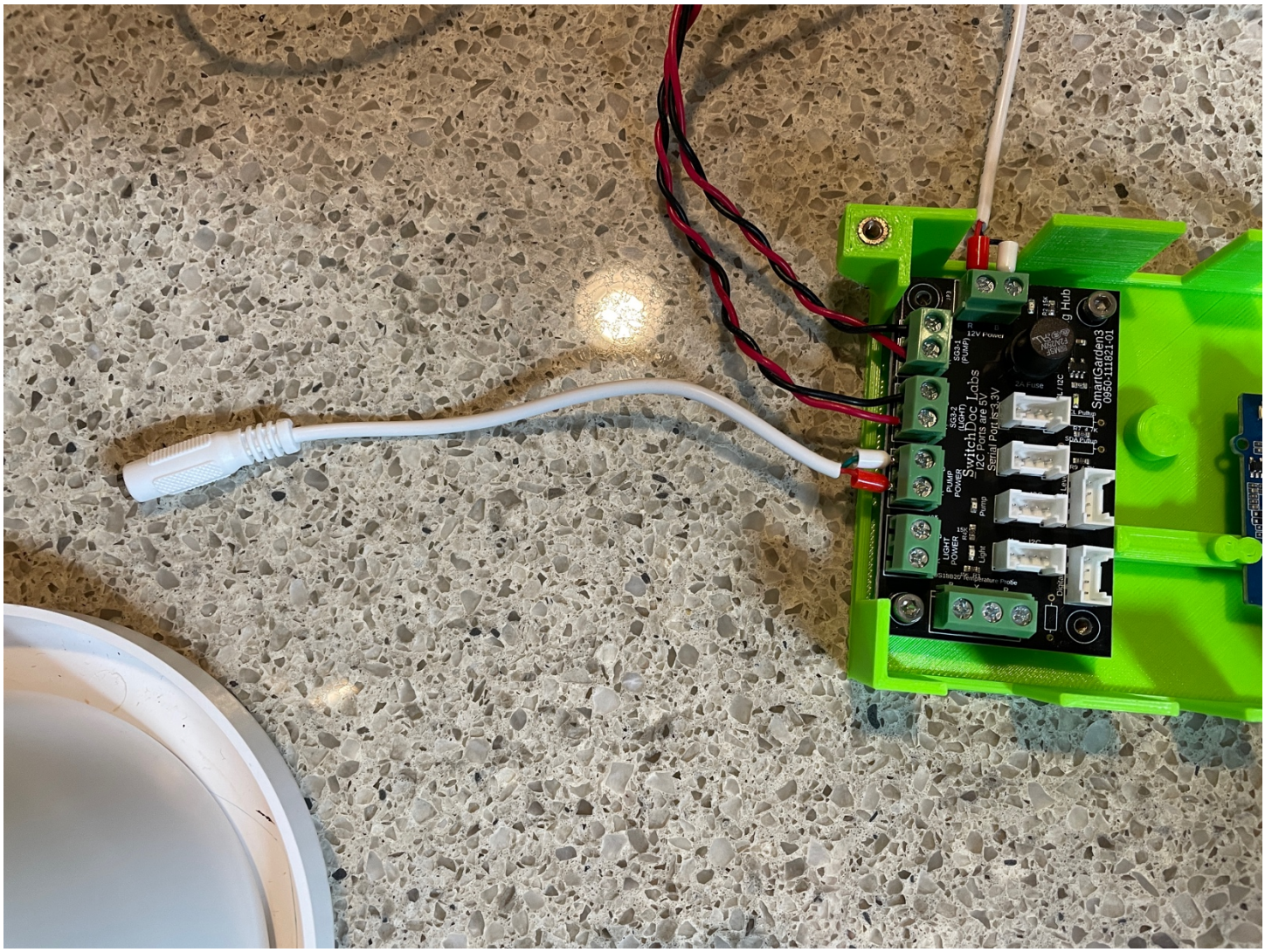
Step 12) Now screw down the other end of the Twisted Pair Wires (Park C) from Step 11 into the SmartGarden3 Extender marked Relay 5 as shown.



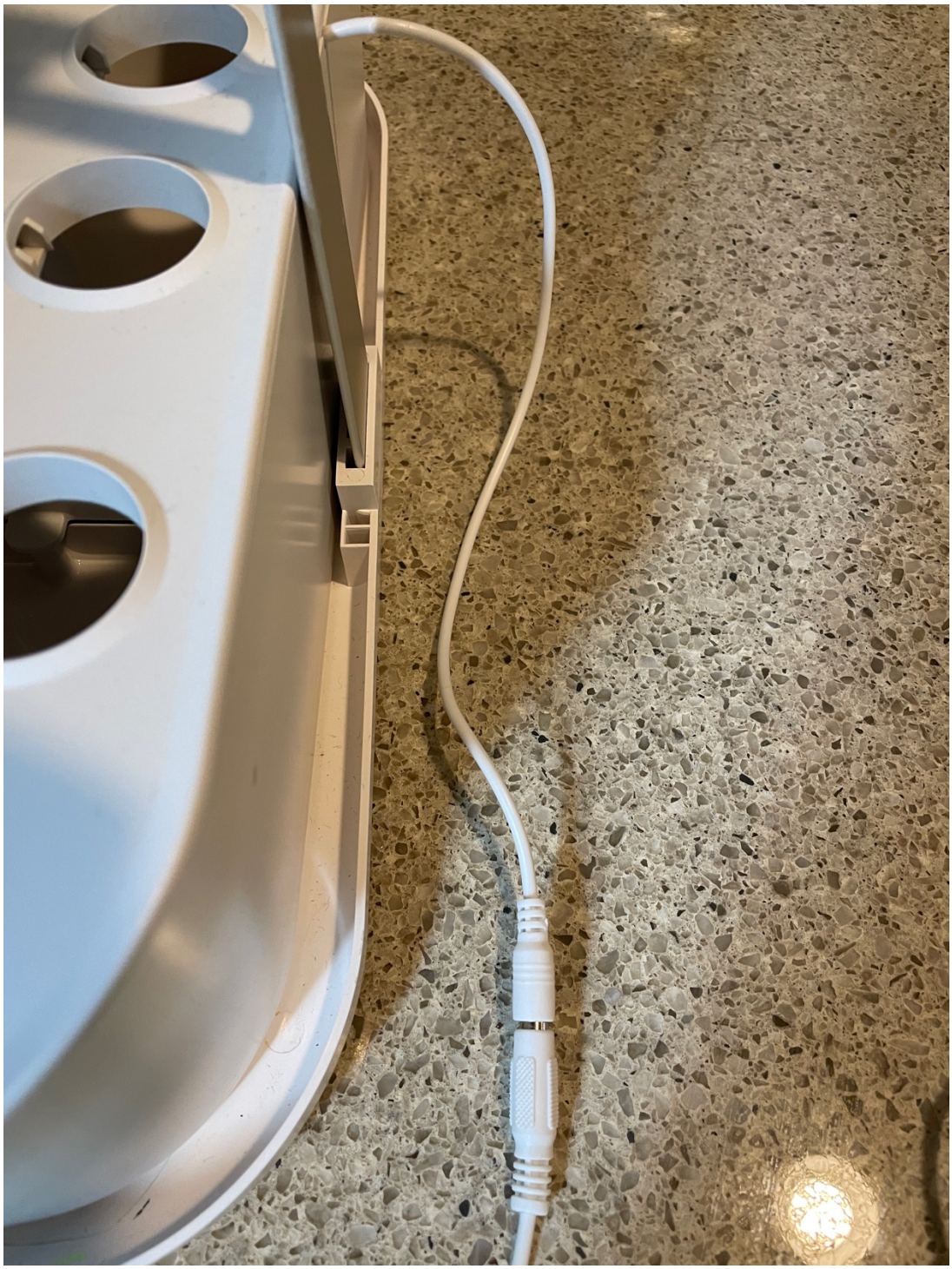
Step 13) Now take the Power cord from the Hydroponics Unit (Part A) and screw the terminals in as shown on the Wiring Hub (Part B). Note that the Red wire goes into the terminal marked “R” and the other wire into the terminal marked “B”. **MAKE SURE YOU GET THIS CORRECT! THIS IS THE POWER FOR THE BOARD AND HYDROPONICS UNIT.** Check it and check it again.



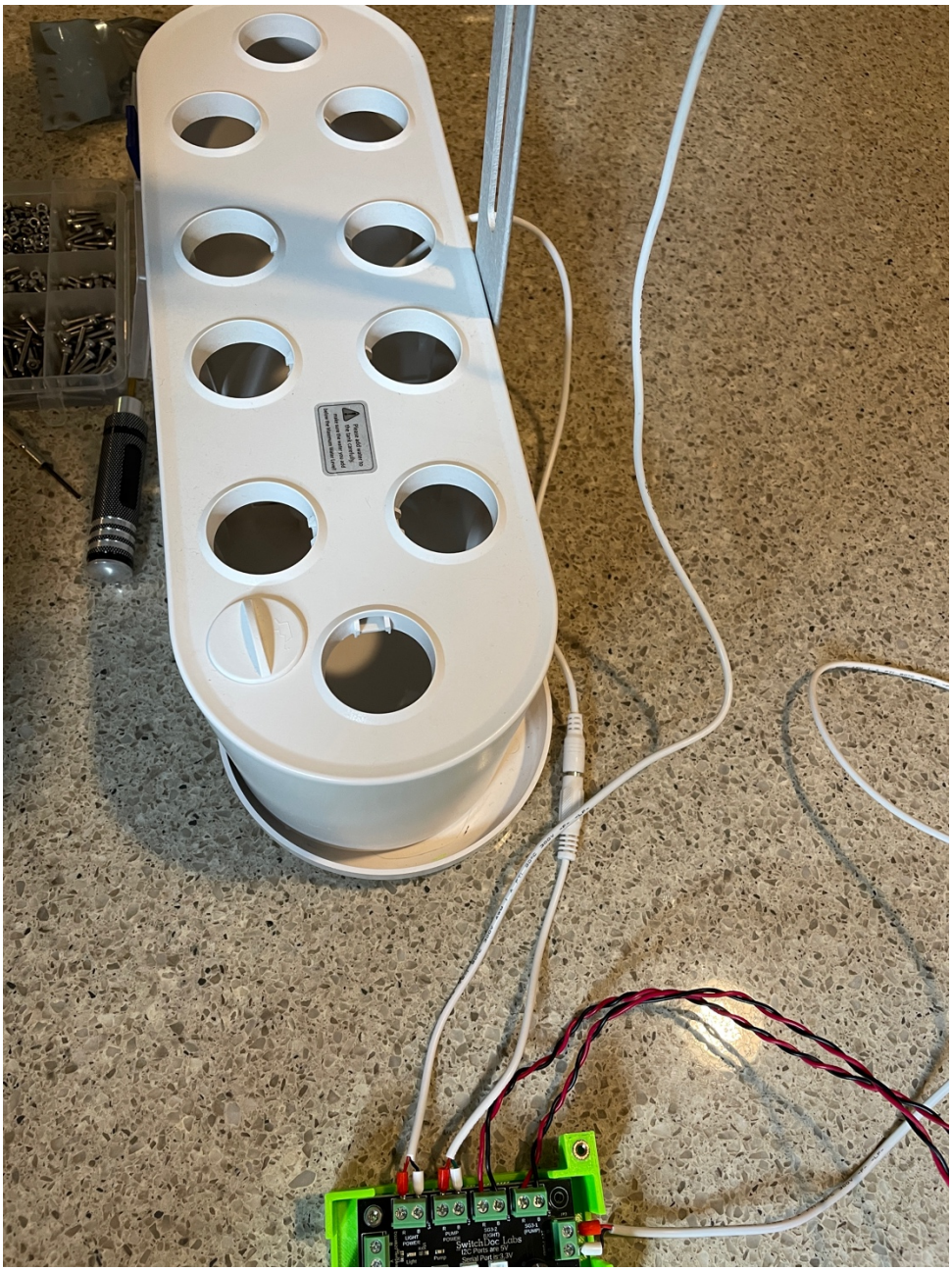
Step 14) Connect the cable that plugs into the Pump (short cable) on the Hydroponics Unit (Part A) into the Screw terminal shown. Again connected Red to “R” and the other wire (which may be brown, black or white) into the connector marked “Pump Power” on the Wiring Hub Board (Part B).

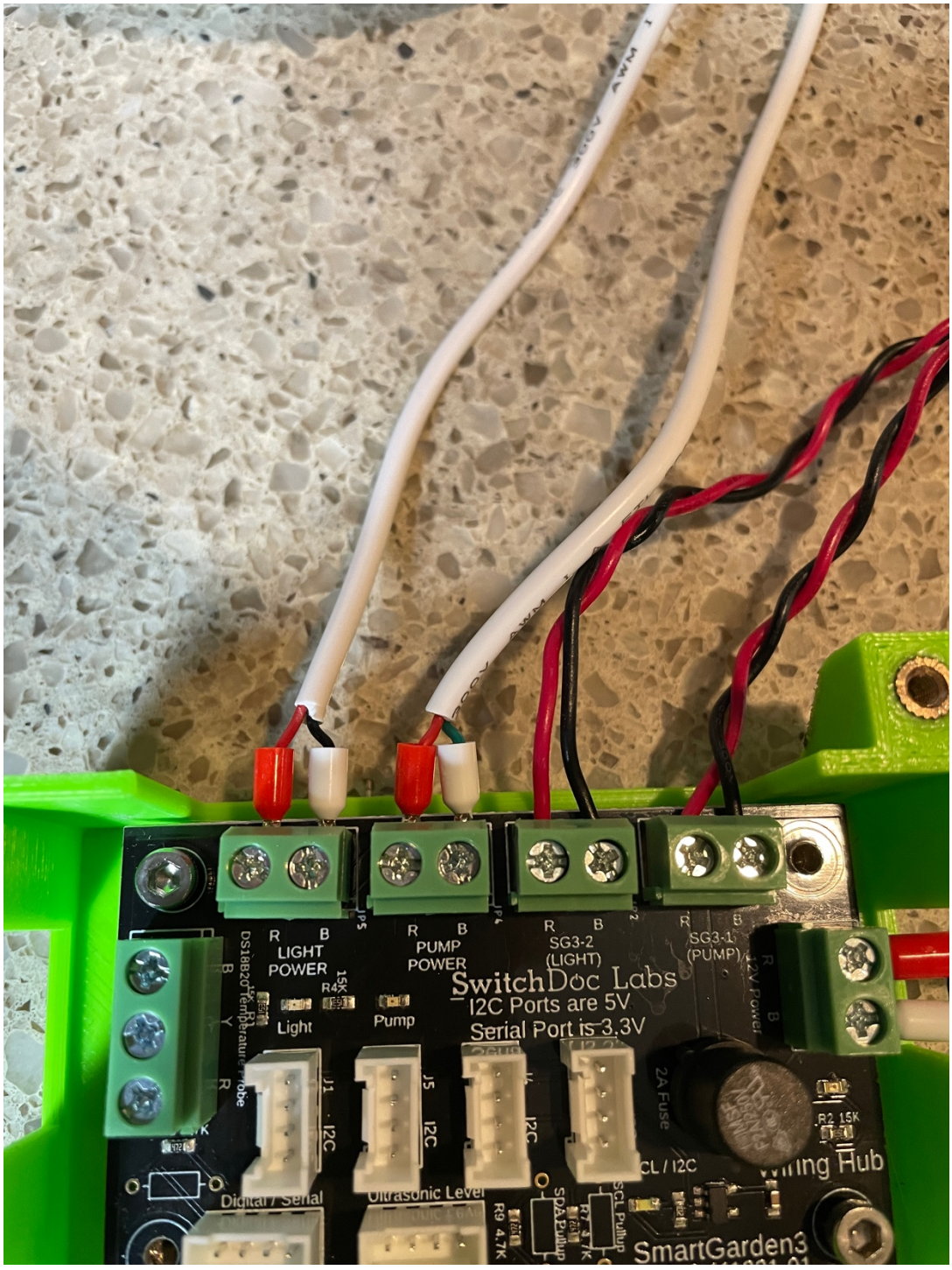


Step 15) Plug the Cord from Step 14 into the Pump Cable on the Hydroponics Unit (Part A) as shown.

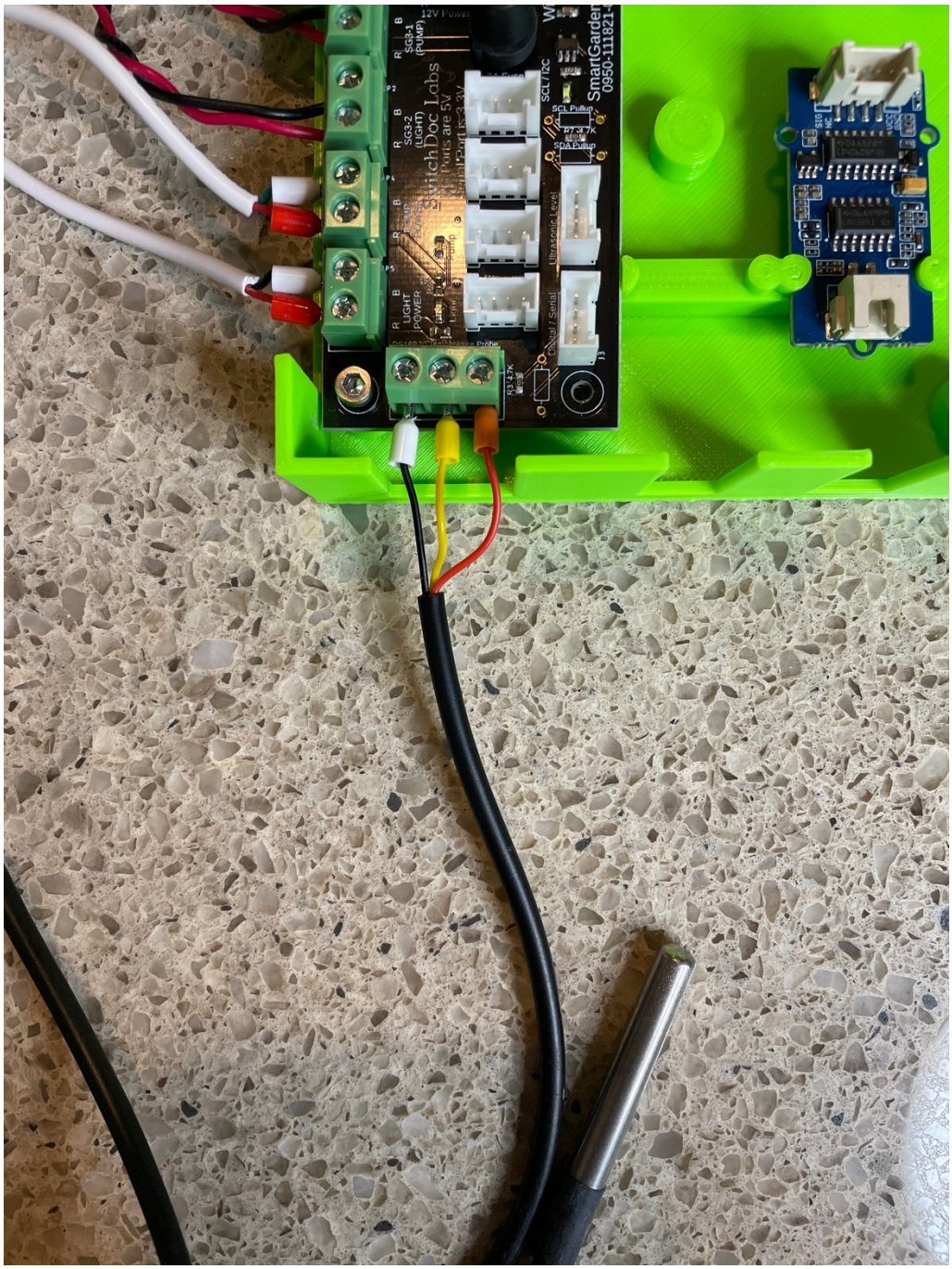


Step 16) Connect the cable from the LED lights on the Hydroponics Unit (Part A) into the connector marked “Light Power” on the Wiring Hub (Part B). Red to “R” and the other wire into the screw marked “B”.

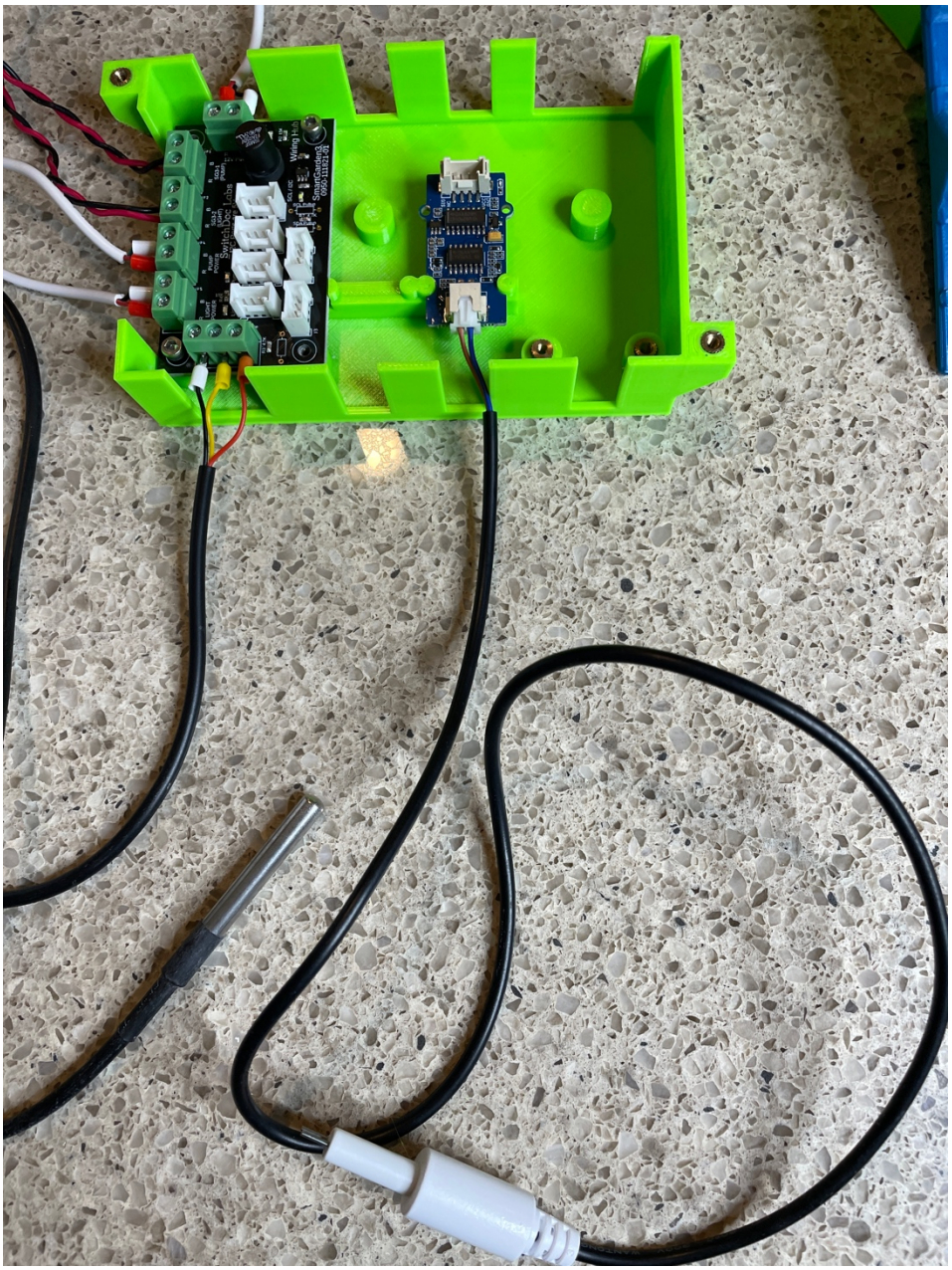



LIGHT POWER
PUMP POWER
SG3-2 (LIGHT)
SG3-1 (PUMP)
SwitchDoc Labs
I2C Ports are 5V
Serial Port is 3.3V
Light
Pump
2A Fuse
Digital / Serial
Ultrasonic Level
SmartGarden3

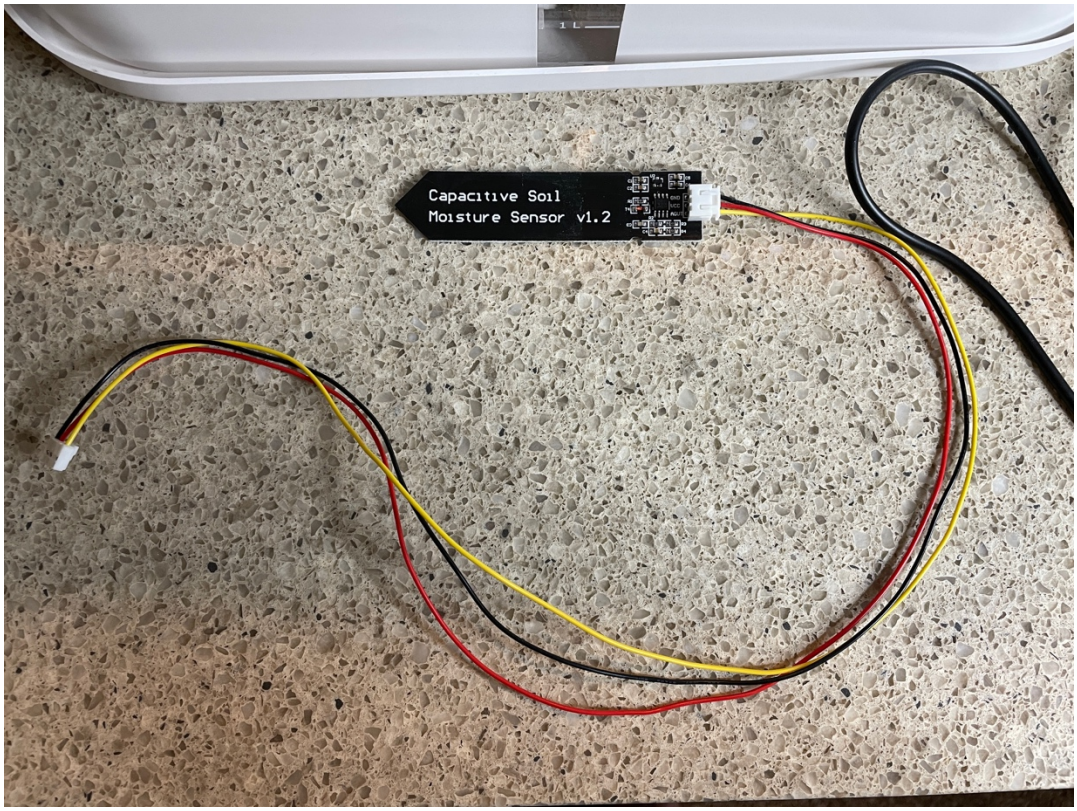
Step 17) Connect the three wires from the DS18B20 Waterproof Temperature Probe (Part D) into the connector at the bottom of the Wiring Hub (Part B) Black into “B”, Yellow into “Y” and Red into “R” as shown.



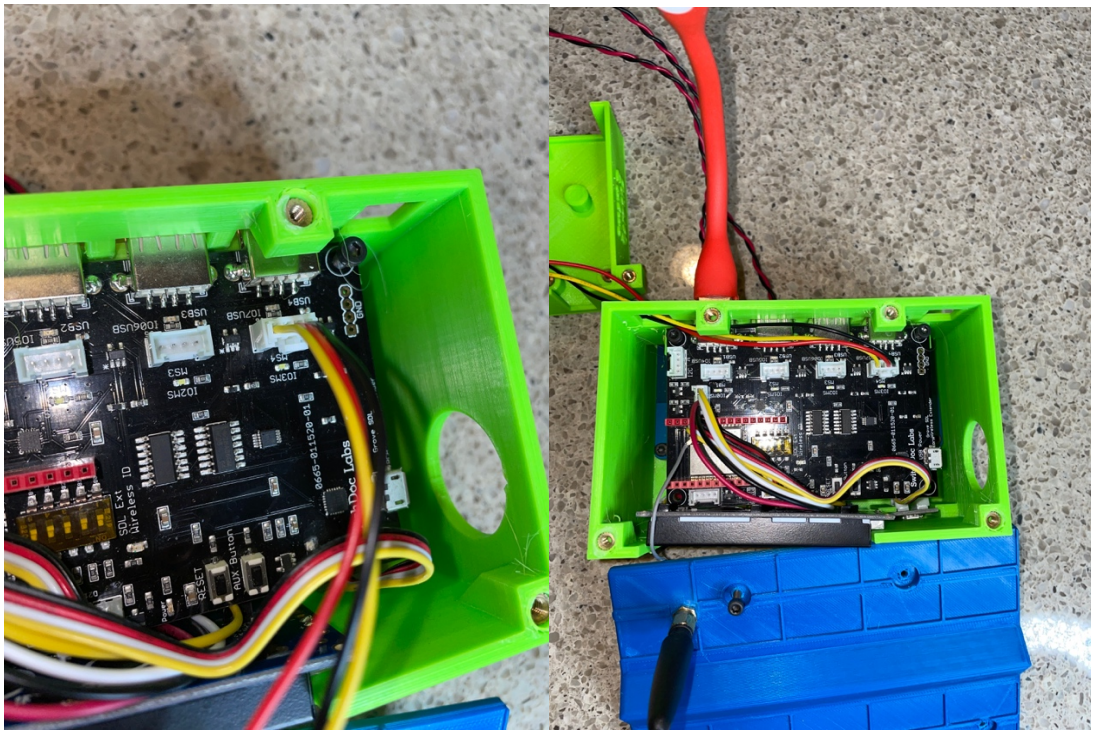
Step 18) If you disconnected the TDS Probe from the TDS controller Board (PartE), reconnect it now as shown.



Step 19) Connect the Capacitive Moister Level Sensor (Part F) and the included cable.

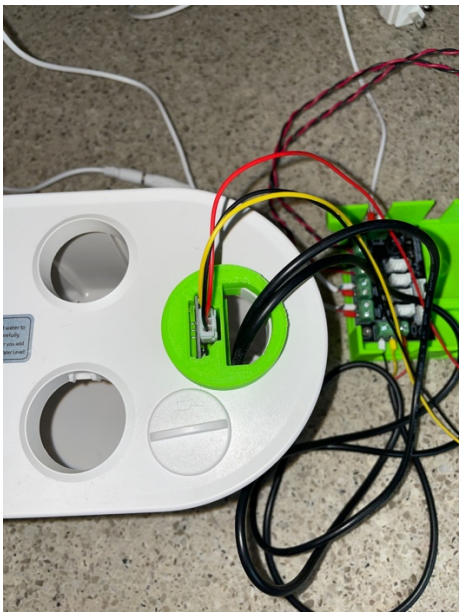


Step 20) Plug the other end of the cable from the Capacitive sensor (Part F) into the SmartGarden3 Wireless Extender port marked “MS4” on the Extender Board. Route it through the leftmost hole on the back of the Wireless Extender.

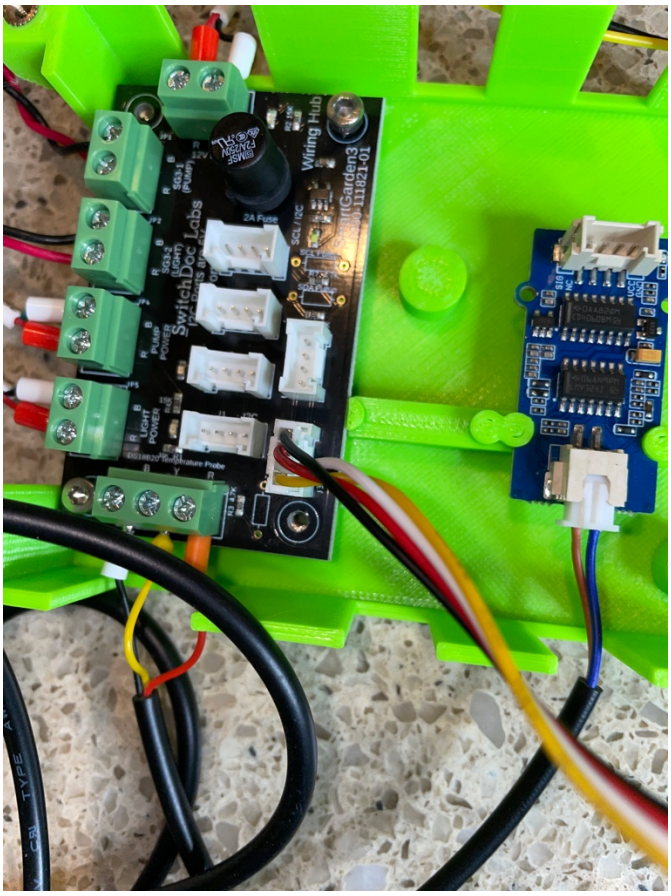


Step 21) Place the two probes (Part D and Part E) through the hole in the 3D Printed Hydroponics Sensor Mount (Part M). Push the Capacitive Sensor (Part F) in the slot in the top, orienting the connector correctly to fit flush into the Sensor Mount (Part M).

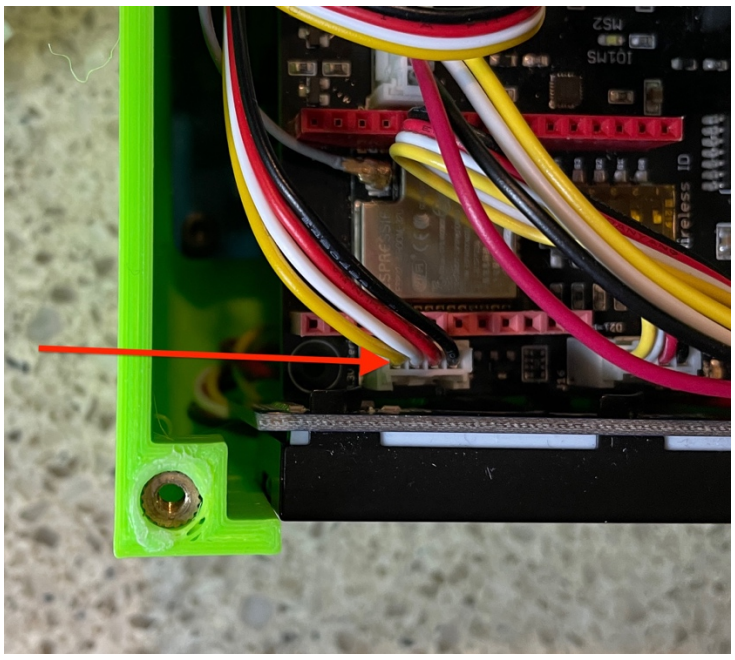
Step 22) Push the assembled 3D Printed Hydroponics Sensor Mount (Part M) into the rightmost hole of the Hydroponics Unit (Part A) as shown.



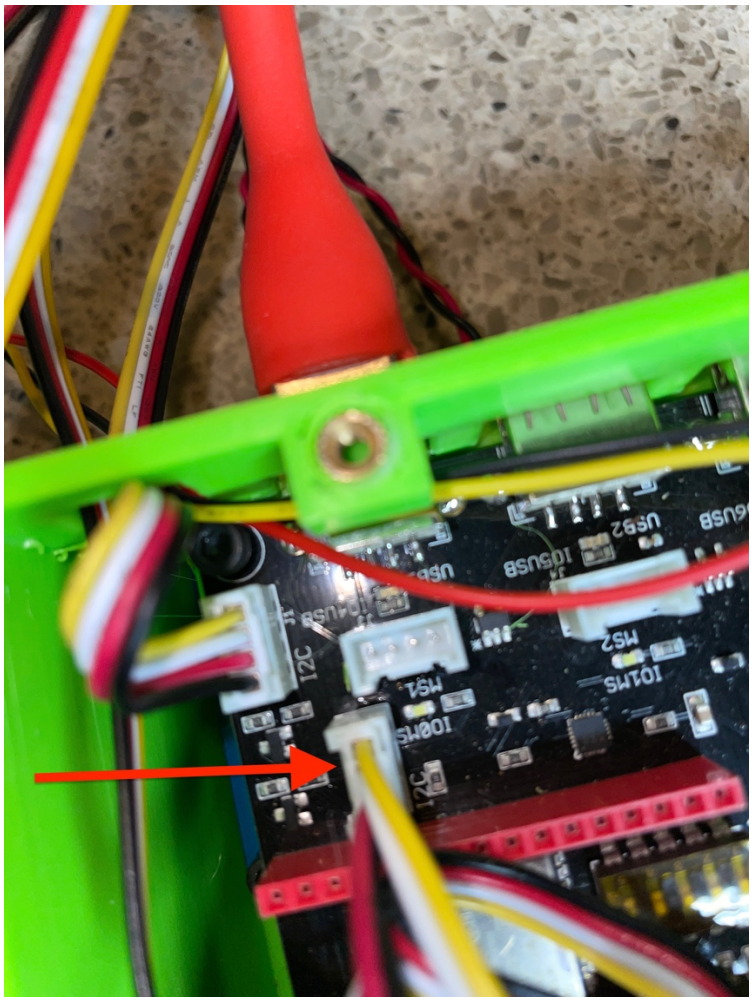
Step 23) Take one 50cm Grove Cable (Part G) and plug one end into the Grove connection on the Wiring Hub (Part B) marked “Digital / Serial” as shown.



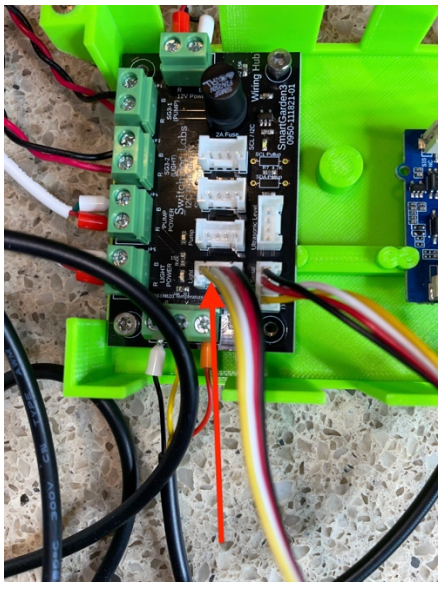
Step 24) Plug the other end of the 50cm Grove Cable (Part G) from Step 23 into the Grove connector on the SmartGarden3 Extender marked 3.3V Serial as shown.



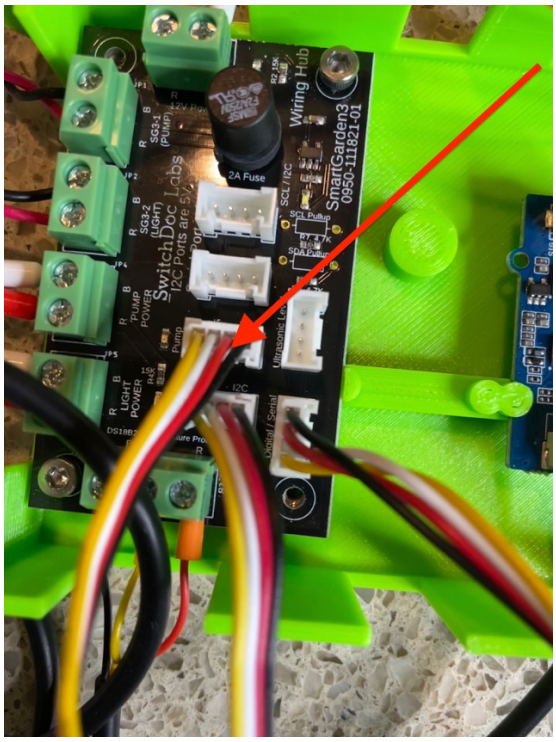
Step 25) Take one 50cm Grove Cable (Part G) and plug one end of the cable into the Grove connector marked I2C on the Wireless Extender as shown. Note: There are two connectors marked I2C on the Wireless Extender Board. You may use either of these depending on how you wired the extender.



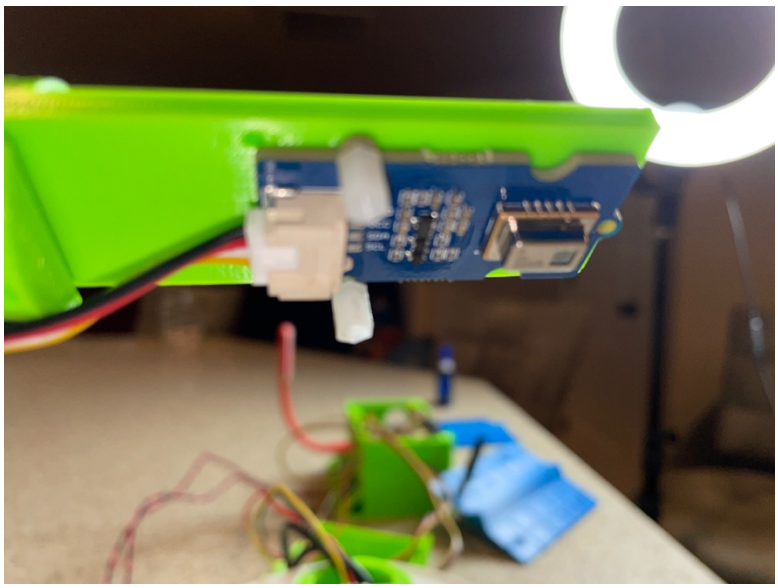
Step 26) Take the other end of the 50cm Grove Cable (Part G) from Step 25 and plug it into the Wire Hub Board (Part B) in the bottom slot marked I2C (shown below).



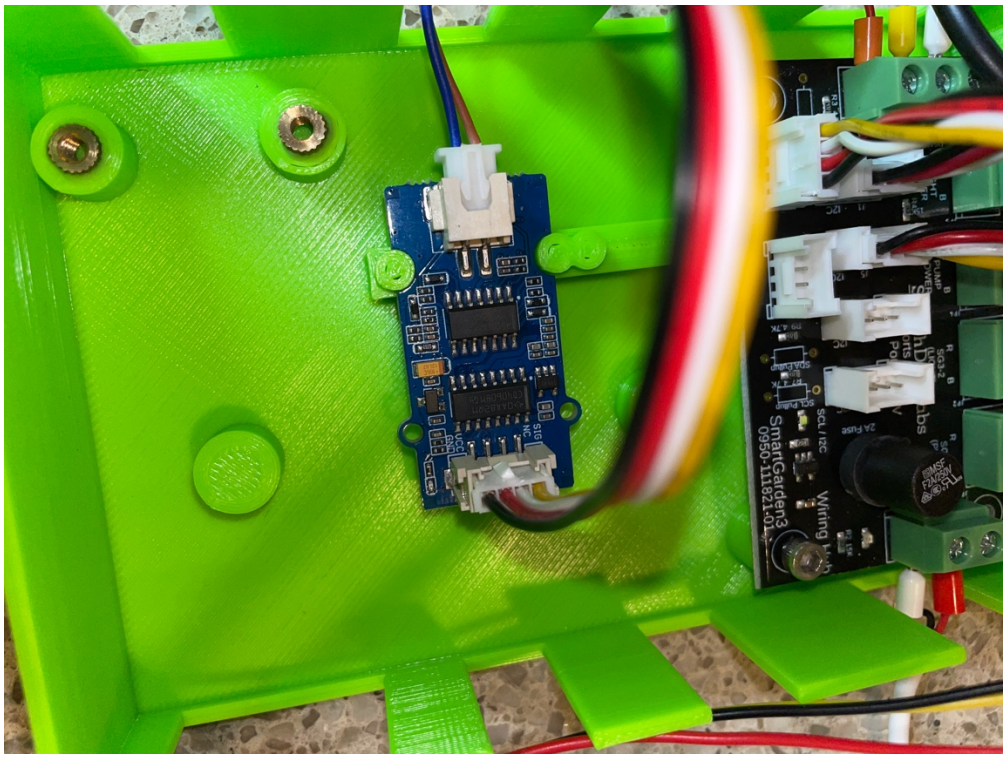
Step 27) Take a 50cm Grove Cable (Part G) and plug one end into the Grove connector marked I2C on the Wire Hub board (Part B) as shown.



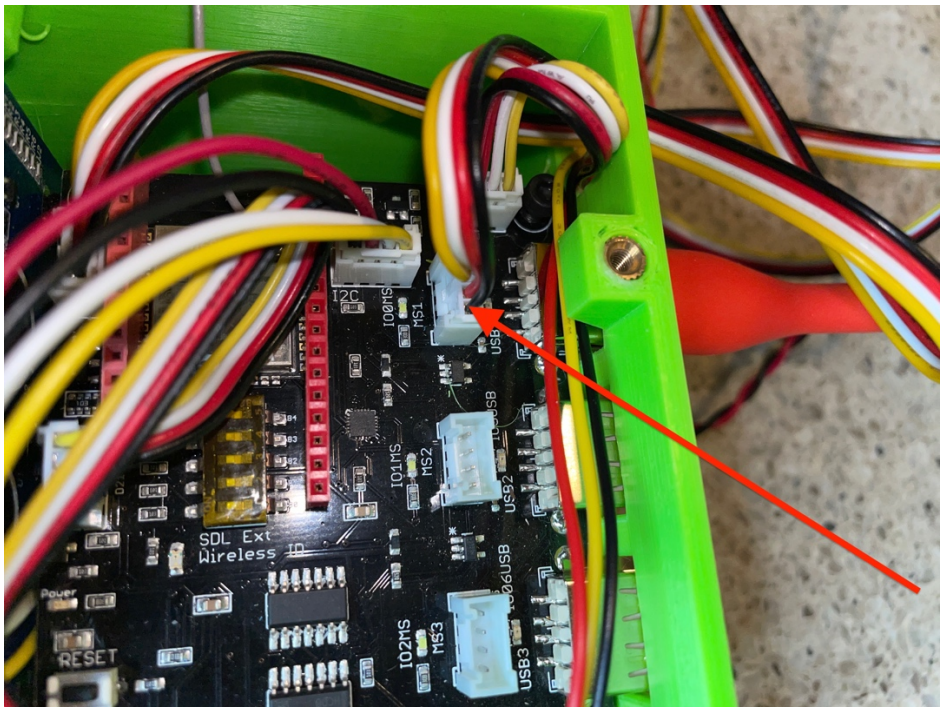
Step 28) Plug the other end of the 50cm Grove Cable (Part G) from Step 27 into the Grove connector on the AMG8833 8x8 Infrared Thermal Sensor (Part H). Thread the Grove cable through the space in the center of the Hydroponics Bracket.



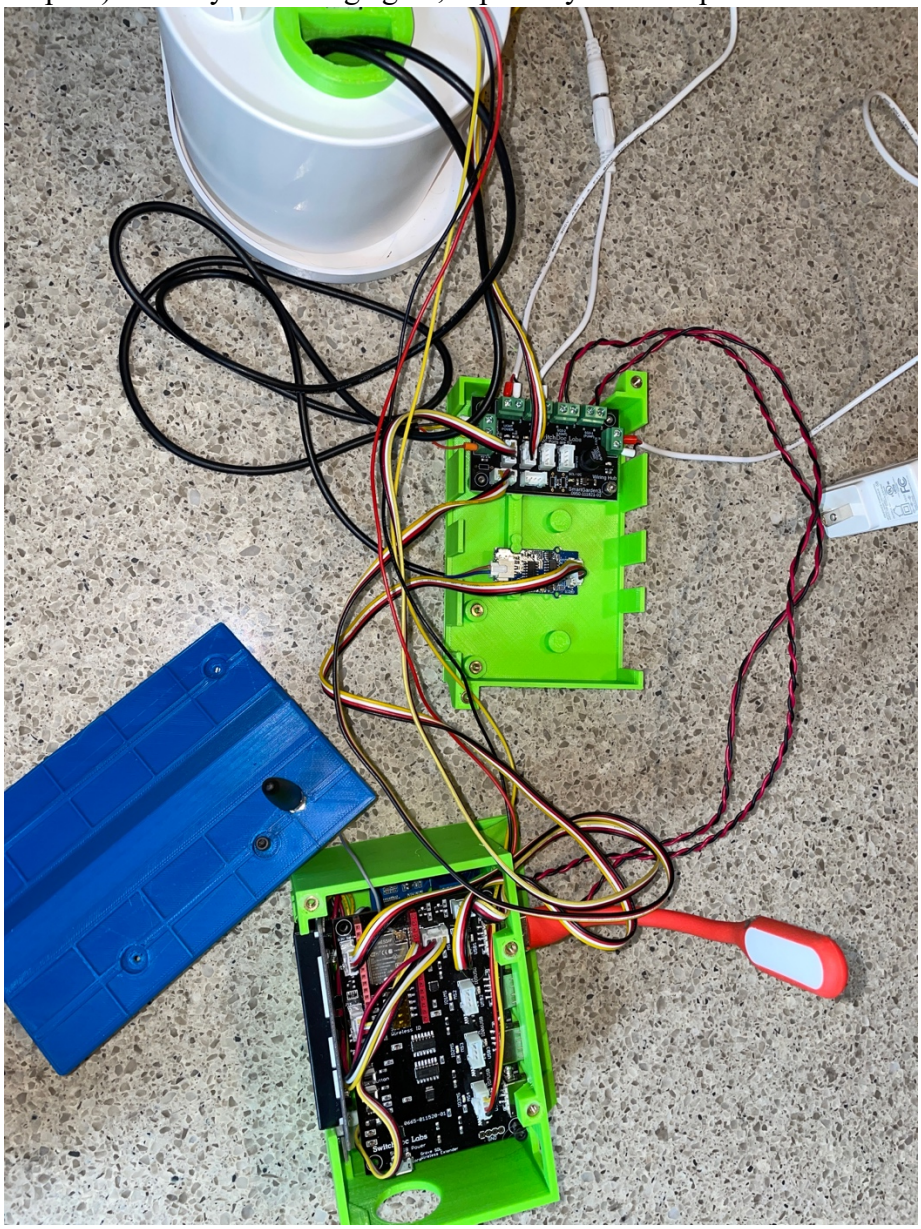
Step 29) Take a 50cm Grove Cable (Part G) and plug one end into the Grove connector on the TDS Sensor (Part E).



Step 30) Take the other end of the 50cm Grove Cable (Part G), route it through the left most hole on the SmartGarden3 Wireless Extender and plug it into the Grove Connector marked “MS1” on the Extender Board as shown.



Step 31) Check your wiring again, especially the 12V power connection.



Congratulations! You have now completed the initial assembly of the SmartGarden3 Hydroponics System. On to testing!

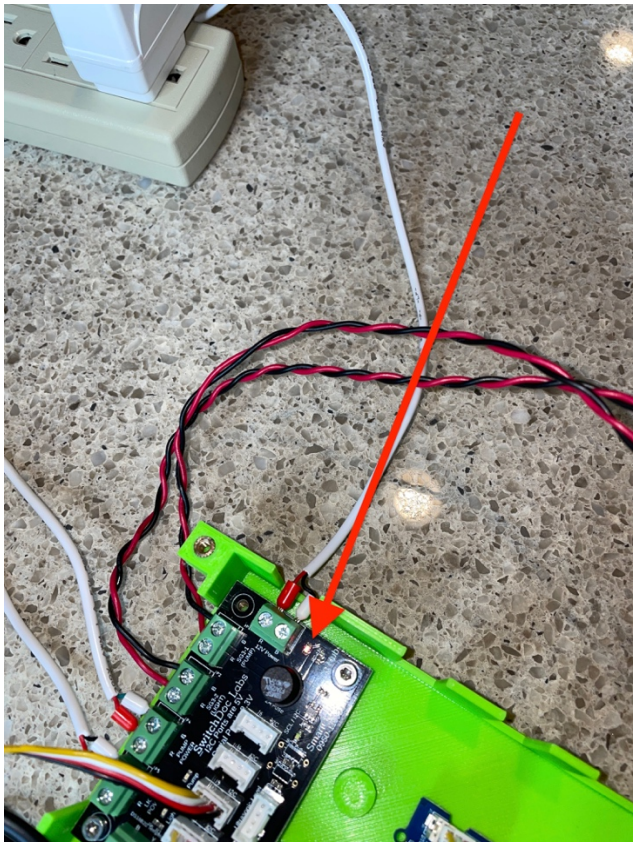
Testing your Smart Garden3 Hydroponics Setup

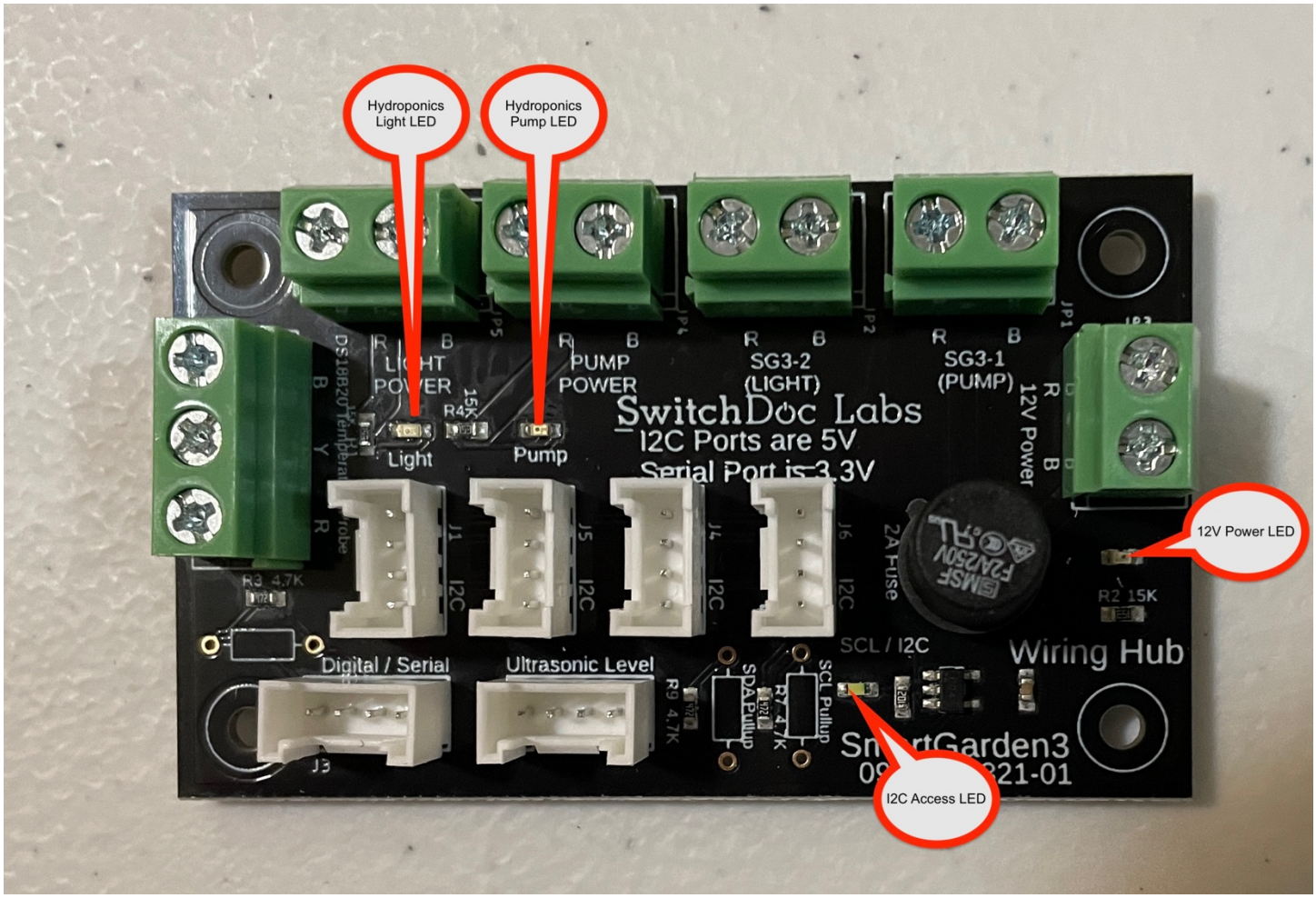
This section assumes you have completed the SmartGarden3 Extender testing and configuration. Go back to those two manuals if you have not done this.

- Step-By-Step Assembly and Test Manual for SmartGarden3
- Operations and Configuration Manual for SmartGarden3

Make sure you have started SG3.py and the dash_app as shown in the Operations Manual.

Step 1) Plug in the Power for the Hydroponics Unit (Part A). In a few seconds, you should see a red light labeled “12V Power”. If you don’t see this light, immediately unplug your unit and check all the wiring. Especially the wiring for the 12V Power.





Step 2) Plug power into your SmartGarden3 Wireless Extender and wait 2 minutes while the unit powers up. You should see the I2C Access LED light flash periodically.

Step 3) Open your dash_app On your Raspberry Pi:

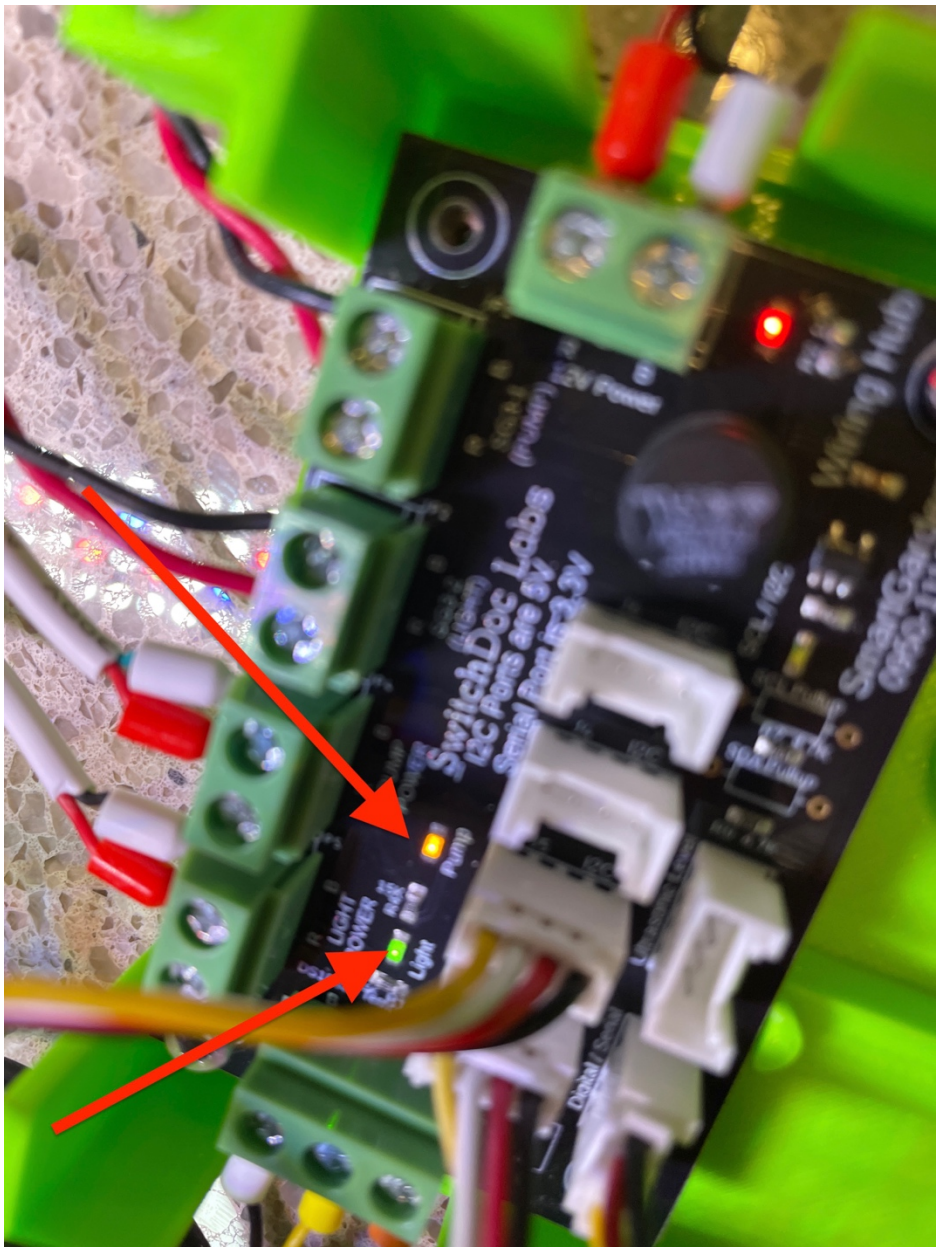
http://127.0.0.1:8010/

Or on another computer type:

http://xxx.xxx.xxx.xxx:8010/

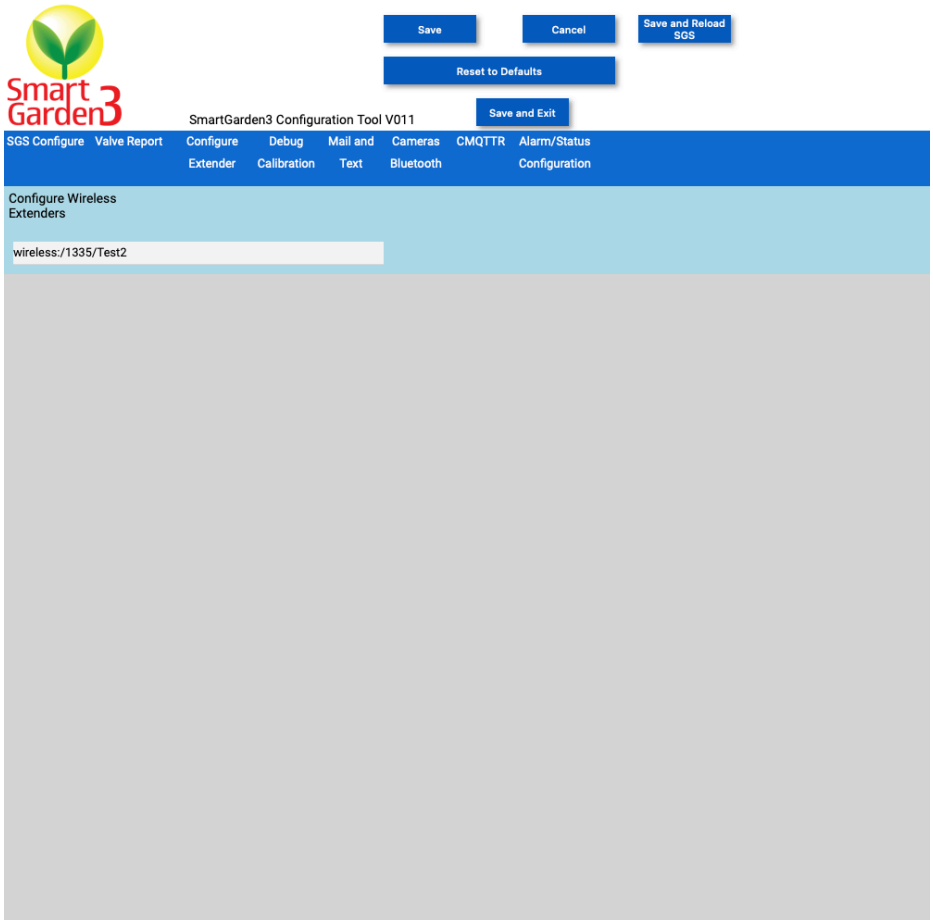
Where “xxx.xxx.xxx.xxx” is the IP address of your Raspberry Pi that you wrote down during configuration of your Raspberry Pi.

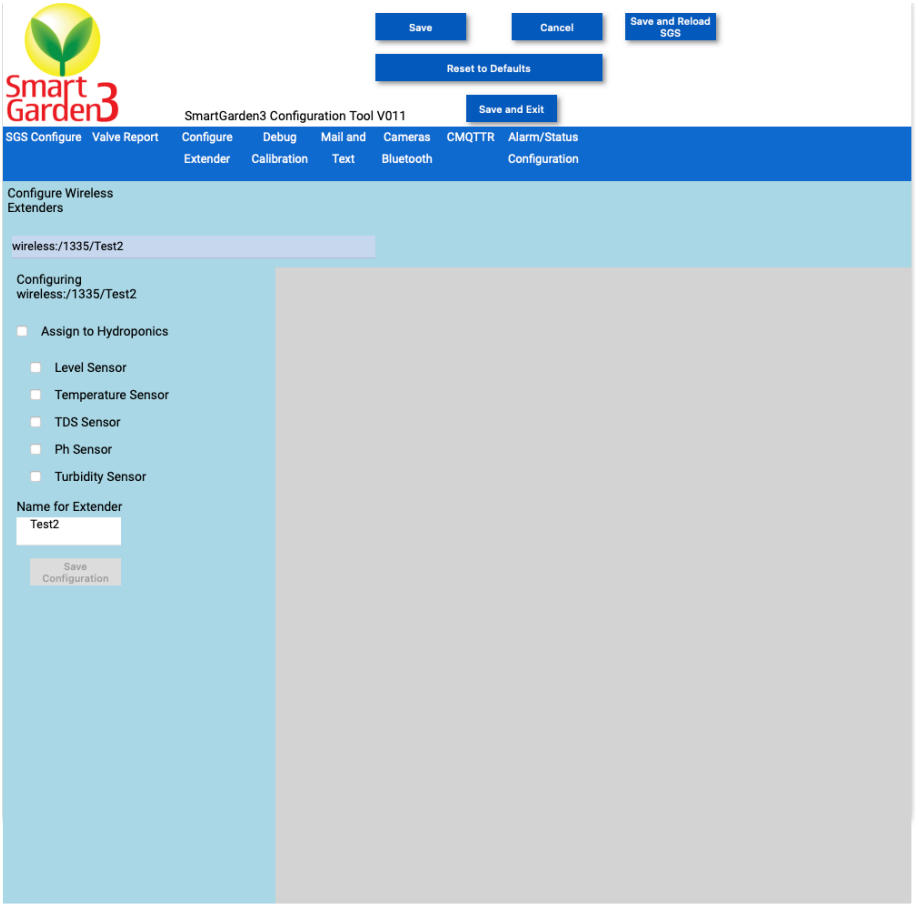
Step 4) Click on the dash_app tab “Manual Control”. Then click on the Valve 5 button to turn on the LED Light on your Hydroponics Unit and then Valve 6 to turn on the pump (without water it may just make a noise or flash a green light). You will also see the Pump and the Light LEDs turn on.



Step 5) Start your SG3Configuration program and go to the Configure Extender Tab.

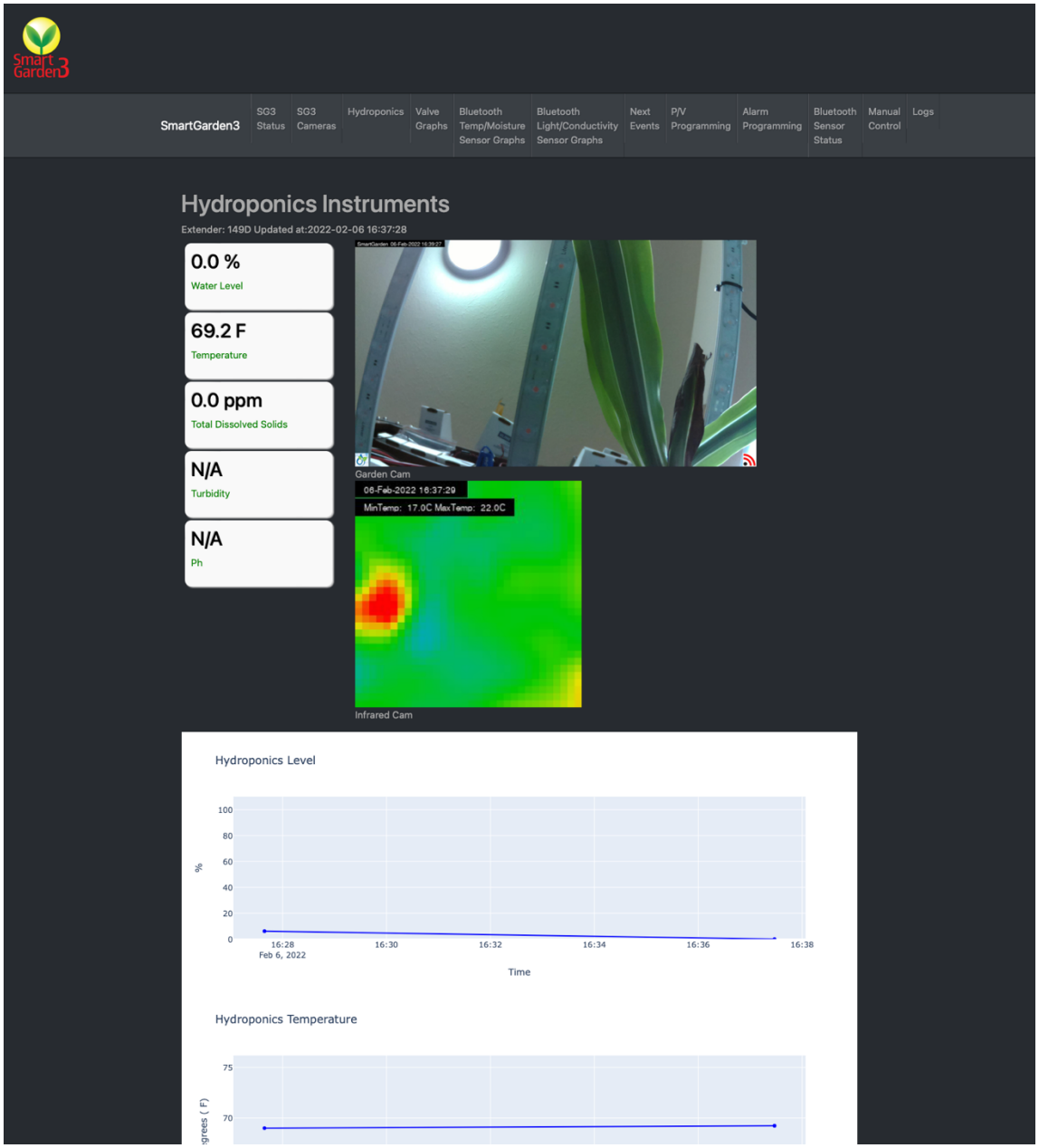
The Configure Extender tab is used to configure your Wireless Extender. Click on the name of the extender to bring up the configuration column.





Step 6) Check the “Assign to Hydroponics” and also on the “Level Sensor”, “Temperature Sensor”, and the “TDS Sensor” boxes. You can rename your Extender at this time too. Hydroponics might be a good name! Now uplug your Wireless Extender, plug it in again and wait two minutes.

Step 7) Wait an additional 15 minutes and then check out the Hydroponics page. You should see something like this (we know, not very interesting yet).



If you don't see information from your temperature sensor or aren't seeing a very low water level, go back and check your wiring. It is normal that the TDS sensor reads 0.0ppm with no water in the unit.

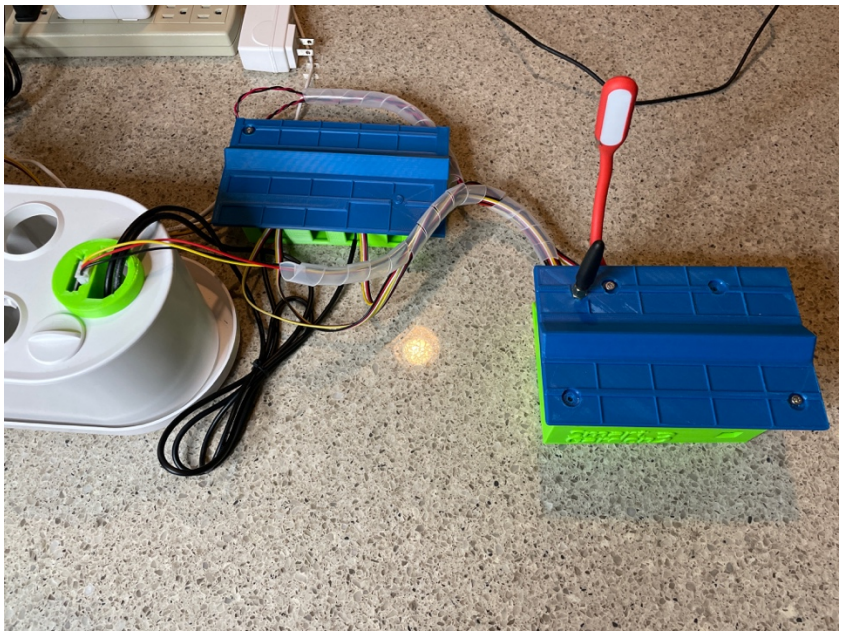
Congratulations. You have tested your SmartGarden3 Hydroponics unit.

Final Assembly

Unplug your Hydroponics unit and your SmartGarden3 Wireless Extender unit.

Step 1) Attach the Top of the Wire Hub Assembly (Part L) to the base of the Wire Hub (Part J) with two M3 screws.

Step 2) Attach the Top of the Smart Garden Wireless Extender to the Wireless Extender base with 4 M3 screws.



What Next? Final Config

Step 1) First calibrate your moisture level sensor. Fill your Hydroponics unit with water (to the Max line). Then run the program:

```
sudo python3 testHydroponicsLevel.py
```

And follow the directions on the screen. Write down the "Empty Tank Value" and "Full Tank Value" (something like 865 and 520), go into SG3Configure and go into the Debug and Calibration Tab and enter these values into the fields. Then hit "Save and Reload SGS" which will restart your SmartGarden3 system with the new values. You will see something like this:

```
pi@SwitchDocLabs:~/SDL_Pi_SmartGarden3 $ sudo python3 testHydroponicsLevel.py
SGS.JSON File exists
############################
Calibrate Hydroponics Level
############################
Hydroponics Found id=149D ip=192.168.1.8

1) Remove Moisture Sensor from Hydroponics Tank and Dry
Hit Return to Continue


Now reading Hydroponics Level Sensor 5 times (may take 3 minutes )

sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
```

```
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
####
Empty Tank Value=  865.0
####
2) Fill Hydroponics Tank to Full
Hit Return to Continue

3) Insert Moisture Sensor into the Wiring Housing in Tank
Hit Return to Continue


Now reading Hydroponics Level Sensor 5 times (may take 3 minutes)

sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
sending REST URL =  http://192.168.1.8/readHydroponicsSensors?password=admin
####
Full Tank Value=  520.0
####

Run SG3Configure again and insert above values on 'Debug/Calibration' Tab
############################
   Complete
```

Step 2) Next, using the SGS Configure Tab, set up the pump (Valve 5) to turn on for 15 minutes and off for 15 minutes all day. This is a good starting point.

Step 3) Using the SGS Configure Table, set up the the light (Valve 6) to turn on for 14 hours (50,400 seconds) and then off for 10 hours. Again, a good starting point.

Step 4) Go ahead and plant your Hydroponics garden following the directions in the hydroponics unit. Remember you can use Aerogarden™ Pods too in this unit.

You have a working system. You can add more sensors, more hydroponics units, build your own units. It's a flexible system.

Disclaimer

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SwitchDoc Labs, LLC has compiled and published this manual which covers the latest product description and specification. The contents of this manual are subject to change without notice.