SwitchDoc Labs

The Smart Garden System Version 2
Weather Add-On Assembly and Test

July 2020
Version 1.2

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Why you should build this project

Imaging buying a fully functional computer for $35 and then tracking the weather at your home, and even watering your houseplants from your phone? Imagine learning a little about electronics without messing with soldering, resistors, and transistors? Ever been curious about "coding" but have no interest in taking a class? This great little project will take you less than six hours at your kitchen tables and when you are done, you will know:

- What a solenoid and valves do
- The purpose of a relay
- Python Coding Language
- How simple computer works
- How stuff connects to the Internet and your phone

This is the ultimate IoT you have been reading about – the Internet of Things. If you are a tinkerer and love to invent stuff, this is for you. Engage your kids and learn something new together!

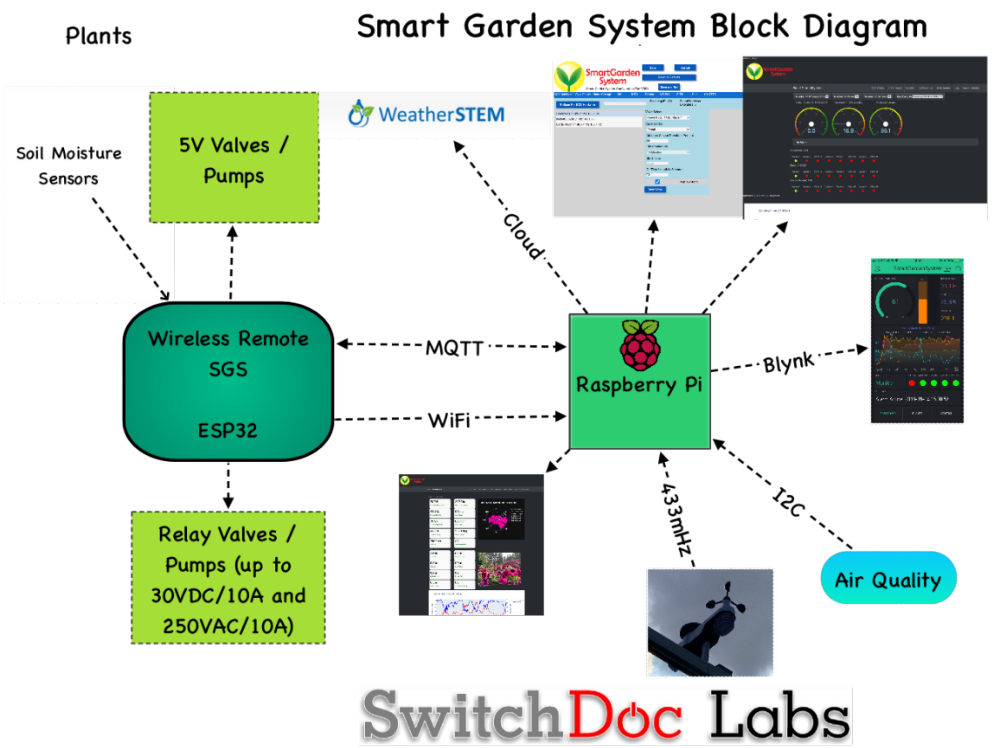
Ready to begin!

Find a clean, dry indoor workspace where you can spread out the parts without them being disturbed.

- Static is your enemy. You can control static by touching a grounded object such as a radiator with one hand when touching an electronic component with the other. If you are a geek you can buy an anti-static mat for as little as $25.
- Always keep water away from the electronics and power supply! Keep that coffee cup at a distance!
- The Smart Garden System electronics are designed for indoor use only and should be placed in a dry environment. Of course, certain parts are designed for outdoor use, such for monitoring the weather, soil moisture, and watering your yard.
- This is not a toy! Keep it out of reach of young children and pets.
- SwitchDoc Labs assumes no liabilities in the use of this kit, beyond the refund of the purchase price.

Part 1 – Assembling the Smart Garden System

Begin your project by assembling the Smart Garden System components. You will need to complete steps outlined in the Smart Garden System Assembly and Test Manual. Do not be tempted to assemble the Weather Station first. You will understand why when you begin connecting the two modules as shown below:



Part 2 – Assembling the Weather System

Now that you have completed assembly of the Smart Garden System, you will tackle the Weather System. By now you will be familiar with the basic steps. Like before, let us review components:

Part A
SwitchDoc Labs WeatherRack2

Part B
Indoor Temperature / Humidity Sensor
(or Similar)

Part C
SDR Radio / Antenna

Part D
SkyCam Raspberry Pi Camera

Part E
50cm Camera Cable

Part F
15cm Raspberry Pi Cable (unused)

Part G
Mounting Pole
(Fits under Part A in Weather Sensor box)

Parts you need to buy separately from the kit

- 3 AA Batteries
- 2 AAA Batteries
- Extra electrical

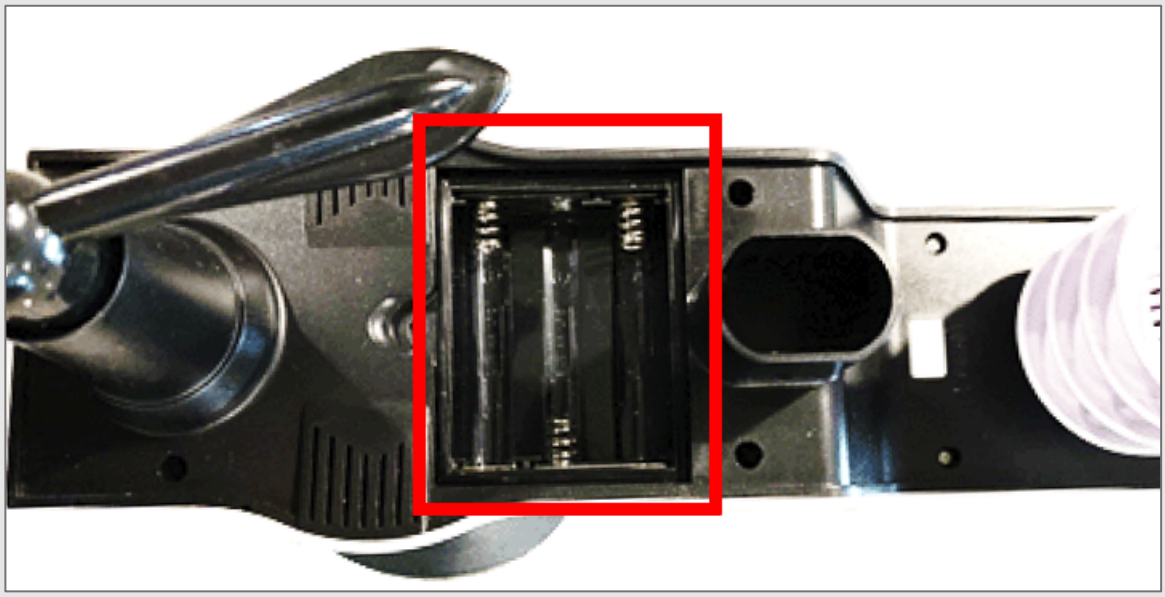
Assembling the Weather Add-on Kit

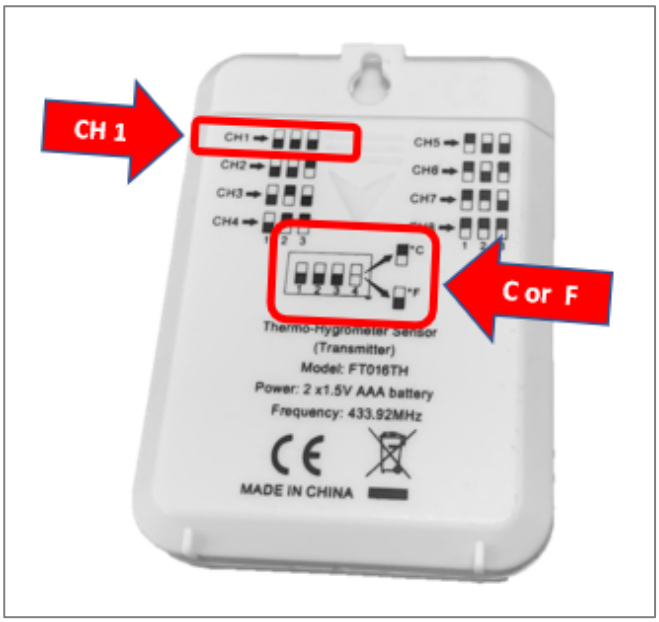
We will assemble the Weather Add On module and add it to the Smart Garden System you already assembled. Make sure the Smart Garden System works as advertised before adding the Weather Kit, otherwise you will juggle too many variables when troubleshooting. There is nothing more frustrating!

Remember what wat said previously about static? Like COVID, static charge is invisible. We have a pile of fried Raspberry PI's from static! You just need to touch grounded metal before handling parts, such as a radiator. Avoid shuffling your feet. And before starting assembling, you should layout all the parts and familiarize yourself with them.

Step 1: Put three AA Batteries in the battery compartment of the Main Sensor Unit (Part A). Put the panel back on and screw them down if needed.

Part A
SwitchDoc Labs WeatherRack2
(Main sensor unit showing battery chamber)





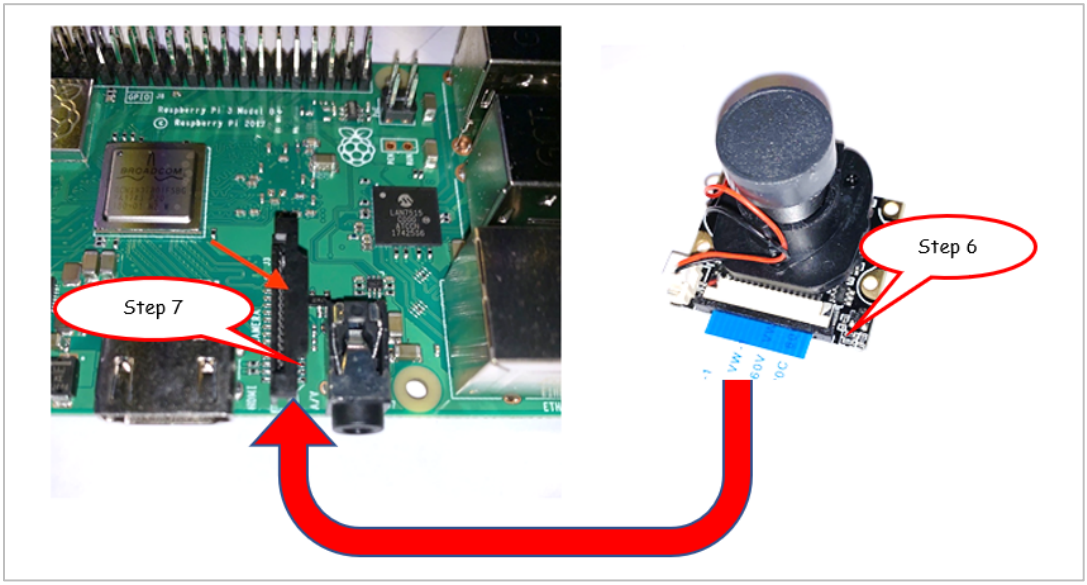
Step 2: Put <u>two</u> AA batteries in the battery compartment of the Indoor Wireless Sensor (Part B). Set the dip switch inside to Channel 1 and then your choice of units of C or F. Put the panel back on and screw them down if needed.

Step 3: Attach the Mounting Pole (Part G) to the base of the Weather Sensor Unit (Part A) using one of the supplied screws. It is up to you how to mount the Weather Sensor to your roof or deck. In general, the higher the better.

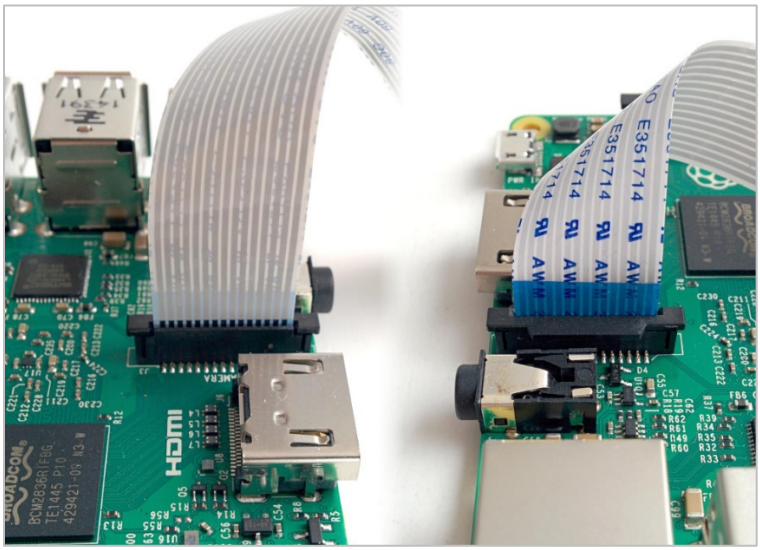
Step 4: Place the indoor temperature and humidity sensor (Part B) anywhere in your home, away from water!

Step 5: Plug the SDR USB Dongle (Part C) into the Antenna (Part C). Then plug the USB Dongle into your Raspberry Pi as shown:

Step 6: Connect the 50cm Raspberry Pi Camera Cable (Part E) to the Raspberry Pi. Gently pull up on the black camera connector wings next to the HDMI connector.



Step 7: Insert the cable (Part E) into the cable slot on the Raspberry Pi. The cable slots into the connector situated between the Ethernet and HDMI ports, with the silver connectors facing the HDMI port. Push down the wings on the camera connector.



Step 8: To attach the SkyCamera (Part D), install one end of the 50cm Pi Camera Cable (Part E) into the SkyCamera connector by gently lifting the black wings, pushing in the cable and then pushing the black wings back down into the connector. Make sure the cable is in straight. You can remove the camera cap at this time.

Congratulations!

You have complete assembly of your Weather Add-on kit
for the Smart Garden System. May the coding begin!

Testing your Weather Add-on

If you purchased the optional SwitchDoc Labs SD Card containing all of the software you can proceed to Step 10.

Step 9: Install the SDL modified version of rtl_433 software on your SD card. The next steps assume you know how to bring up a terminal window on your Raspberry Pi

Step 10: Withing the Terminal window go to the /home/pi directory and type:

```
git clone https://github.com/switchdoclabs/rtl_433.git
```

Step 11: Then compile it as follows:

```
cd rtl_433/
mkdir build
cd build
cmake ..
make
make install
```

Step 12: Before proceeding, check to make sure you installed the batteries in the Main Weather Sensor and in Indoor Temperature Humidity Sensor. Then test your installation by entering the following:

```
cd /home/pi/SDL_Pi_SmartGardenSystem2

sudo python3 testWeatherSensors.py
```

You should see the following. Do not be concerned with "NOTFOUND" on the third line.

```
pi@SwitchDocLabs:~/SDL_Pi_SmartGardenSystem2 sudo python3 testWeatherSensors.py
Starting Wireless Read
rtl_433 version -128-NOTFOUND branch master at 202007090750 inputs file rtl_tcp RTL-SDR

Use -h for usage help and see https://triq.org/ for documentation.

Trying conf file at "rtl_433.conf"...

Trying conf file at "/root/.config/rtl_433/rtl_433.conf"...

Trying conf file at "/usr/local/etc/rtl_433/rtl_433.conf"...

Trying conf file at "/etc/rtl_433/rtl_433.conf"...

quiet option (-q) is default and deprecated. See -v to increase verbosity


      Consider using "-M newmodel" to transition to new model keys. This will become the
default someday.

      A table of changes and discussion is at https://github.com/merbanan/rtl_433/pull/986.


Registered 2 out of 147 device decoding protocols [ 146-147 ]

Found Rafael Micro R820T tuner

Exact sample rate is: 250000.000414 Hz
```

```
[R82XX] PLL not locked!

Sample rate set to 250000 S/s.

Tuner gain set to Auto.

Tuned to 433.920MHz.

Allocating 15 zero-copy buffers

{"time" : "2020-07-24 14:04:32", "model" : "SwitchDoc Labs F007TH Thermo-Hygrometer",
"device" : 233, "modelnumber" : 5, "channel" : 3, "battery" : "OK", "temperature_F" : 71.000,
"humidity" : 42, "mic" : "CRC"}

This is the raw data: {"time" : "2020-07-24 14:04:32", "model" : "SwitchDoc Labs F007TH
Thermo-Hygrometer", "device" : 233, "modelnumber" : 5, "channel" : 3, "battery" : "OK",
"temperature_F" : 71.000, "humidity" : 42, "mic" : "CRC"}

{"time" : "2020-07-24 14:04:46", "model" : "SwitchDoc Labs FT0300 AIO", "device" : 12, "id" :
0, "batterylow" : 0, "avewindspeed" : 13, "gustwindspeed" : 20, "winddirection" : 245,
"cumulativerain" : 1353, "temperature" : 1190, "humidity" : 27, "light" : 52649, "uv" : 33,
"mic" : "CRC"}

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"device" : 12, "id" : 0, "batterylow" : 0, "avewindspeed" : 13, "gustwindspeed" : 20,
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```

What does all this code this mean?

The testWeatherSensors.py program pushes the 433MHz signals into the Raspberry Pi, decodes them and formats the results as a JSON packet that will be provided to the Smart Garden System for processing.

Two types of data packets are received from the testWeatherSensors.py program:

- **Radio packets** from the indoor temperature and humidity sensors (SwitchDoc Labs F007TH). You can have up to 8 sensors hooked up to your Smart Garden System to distribute all over your home! The temperature is displayed in Fahrenheit, but you can change it to Celsius in the SGSConfigure panel.

```
{"time" : "2020-07-24 14:04:32", "model" : "SwitchDoc Labs F007TH Thermo-Hygrometer",
"device" : 233, "modelnumber" : 5, "channel" : 3, "battery" : "OK", "temperature_F" :
71.000, "humidity" : 42, "mic" : "CRC"}
```

- **Main Weather Sensor packet** (SwitchDoc Labs FT0300 AIO) and contains a full complement of exciting weather information:


```
{"time" : "2020-07-24 14:04:46", "model" : "SwitchDoc Labs FT0300 AIO", "device" : 12, "id" :
0, "batterylow" : 0, "avewindspeed" : 13, "gustwindspeed" : 20, "winddirection" : 245,
"cumulativerain" : 1353, "temperature" : 1190, "humidity" : 27, "light" : 52649, "uv" : 33,
"mic" : "CRC"}
```


The values and units are:

- avewindspeed (to get m/s, divide by 10)
- gustwindspeed (to get m/s, divide by 10)
- windirection (degrees)
- temperature (to get F, subtract 400 and divide by 10)
- humidity (%)
- cumulativerain (to get mm, divide by 10)
- light (Lux)
- UV (UV Index)

This completes the testing of the Weather Sensors! If you experience difficulty you should first adjust placement of your antenna (not too close – you can over-modulate the receiver), check your batteries and recheck your assembly steps.

You are now ready to configure the Smart Garden System to use the Weather Add-on Kit

Configuring your Smart Garden System to display Weather

You have already assembled and tested the Smart Garden System, right? You should have completed all steps in the Smart Garden System Assembly and Test Manual.

Step 13: Open SGSConfigure by entering the following:

Run SGSConfigure.py

```
sudo python3 SGSConfigure.py
```

You will see something like this:

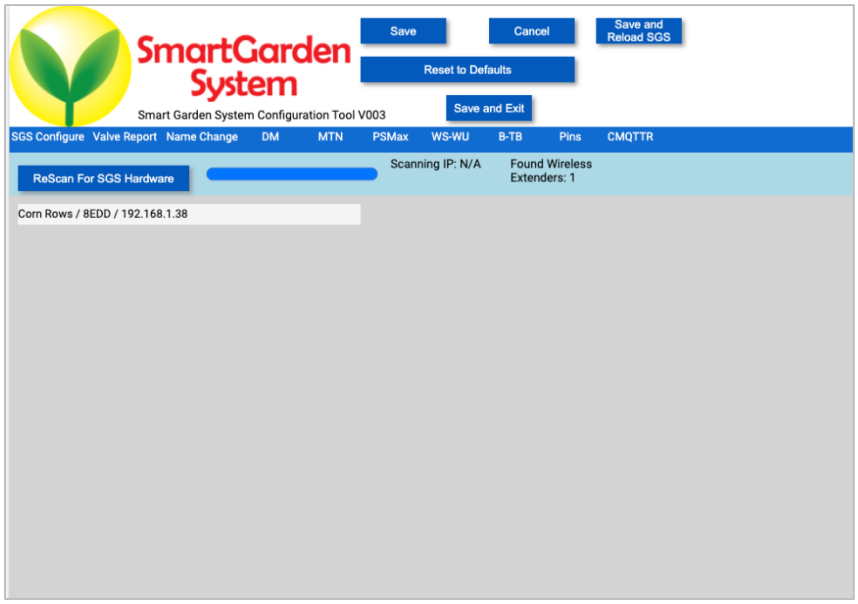
```
pi@SwitchDocLabs:~/SDL_Pi_SmartGardenSystem2 $ sudo python3 SGSConfigure.py
SGSConfigure.py:24: DeprecationWarning: AppURLopener style of invoking requests is
deprecated. Use newer urlopen functions/methods
  myURLOpener = AppURLopener()
remi.server      INFO     Started httpserver http://0.0.0.0:8001/
remi.request     INFO     built UI (path=/)
SGS.JSON File does not exist
SGSConfiguration.JSON File does not exist
```

Now open up a browser window (either on the Raspberry Pi or on another computer on your local WiFi network) and enter this URL:

On your Raspberry Pi: http://127.0.0.1:8001/

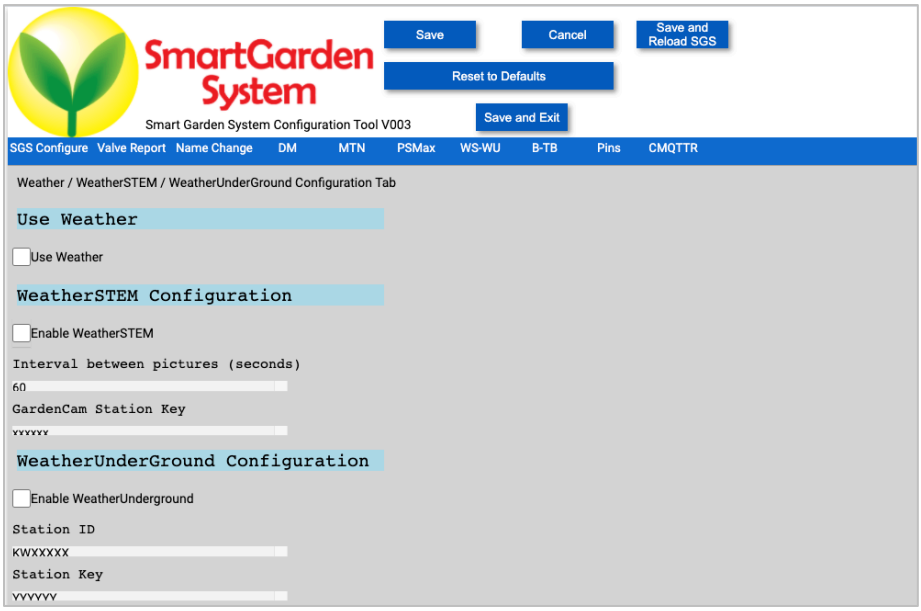
On another computer type: http://xxx.xxx.xxx.xxx:8001/

Where "xxx.xxx.xxx.xxx" is the IP address of your Raspberry Pi that you wrote down above.
You will see something like this screen on your browser:



Step 14: Click on the WS-WU button:

You will see a screen like this:



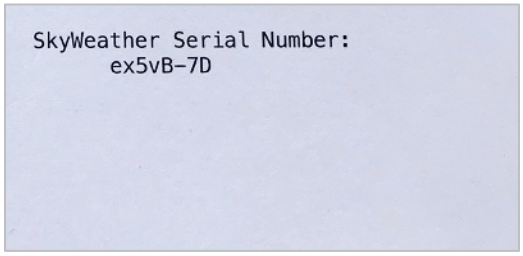
Check the "Use Weather" check box and if you are going to use WeatherSTEM, then check the "Enable WeatherSTEM" box if you want to display your GardenCam on WeatherSTEM (see more information about WeatherSTEM below).

Put your GardenCam Station Key (the SkyWeather Serial Number) in the "GardenCam Station Key" box.

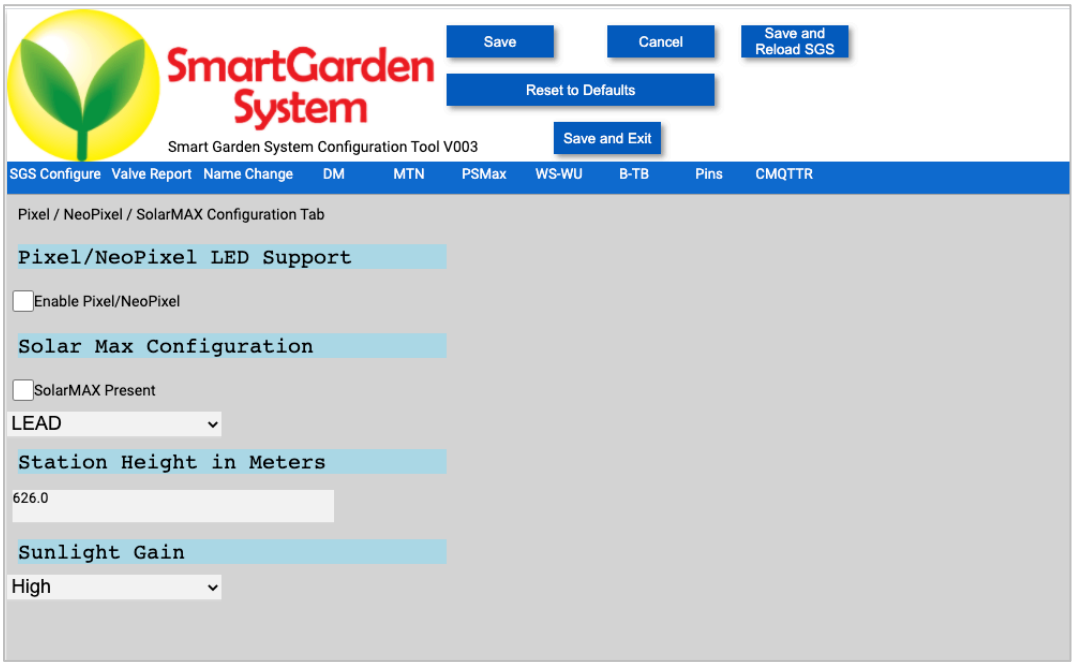
Step 15: Finding your SkyWeather Serial Number in your Smart Garden System

When you buy a Weather Add-on kit for the Smart Garden System, you will receive an 8 character serial number that you will use to link your weather station with WeatherSTEM. This 8 character code (also known as the **device key**) will be entered into both the SkyWeather software and into the WeatherSTEM website. Your code will look something like this: **X7d3dkkk. Don't use this example code in your configuration file. It will not work. Do not use the serial number in the picture below. It will not work.**

You will find your SkyWeather Serial Number on your packing slip (this one will not work).



Step 16: Click on the PSMax tab on the SGSConfigure browser window. Put the altitude of your station in meters in the "Station Height in Meters" to make your sea level barometric pressure more accurately.



Step 17: Now click on "Save and Reload SGS" button wait 15 minutes and your weather station will start displaying on the dash_app in the Smart Garden System and will also start recording lots of weather to your database.

If SGS2 was not running at this time, start the Smart Garden System program now. (sudo python3 SGS2.py)

What is WeatherSTEM?

EDUCATORS: WeatherSTEM.com has a tremendous amount of curriculum material available about using WeatherSTEM (and the Smart Garden System) in your classroom.

More than ever in our history, schools across the United States face the challenge of better preparing students to enter careers where competency in STEM-related subject areas (Science, Technology, Engineering, and Mathematics) is a requirement.

We believe weather provides an excellent foundation for STEM education. It also provides myriad opportunities for exposing students to topics from a plethora of disciplines in the scope of a single activity. Any weather situation, from the most benign scenario where a few cumulus humilus clouds dot the sky to the most intense Category 5 hurricane, can turn into a discussion covering everything from algebra to zoology.

WeatherSTEM is a platform built by Ucompass CEO Edward Mansouri who has a Bachelors degree (Penn State) and Masters degree (Florida State) in Meteorology. Fascinated by weather since childhood, Mansouri created the WeatherSTEM platform to infuse K-12 STEM curriculum with live data collected by weather instruments, cloud cameras, agricultural probes, and other sensors.

Experience The Data

The WeatherSTEM platform consumes live information to create and deliver interactive activities and assessments. The platform combines data from weather instruments, agricultural probes, Web cameras and other sensors to create immersive science education experiences and an introduction to "Big Data" and computer programming.

How will Smart Garden System Integrate with WeatherSTEM?

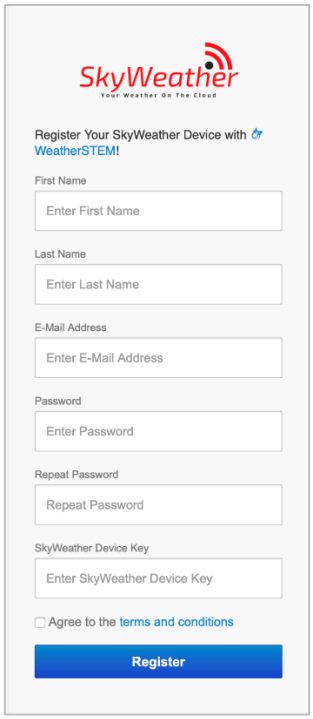
- Publish data and images to its own WeatherSTEM website once per minute
- Store data and images permanently that are accessible via the WeatherSTEM Data Mining Tool
- Integrate data and images into WeatherSTEM's education repository that you and your stakeholders will have access to
- Publish data and images to the WeatherSTEM SkyWeather social media platform integrated with Twitter, Facebook, and YouTube
- Create daily time-lapse "sky movies"
- Integrate data into WeatherSTEM's Safety Platform featuring lightning alerts and other important situational awareness notifications
- Offer the capability for real-time, moment by moment data streaming
- Enable real-time access to the data via WeatherSTEM's API
- So much more!

Setting up your WeatherSTEM Account

Your WeatherSTEM account is where you register your Smart Garden Systemstation for the WeatherSTEM cloud data storage and display.

Go to “skyweather.weatherstem.com” and you will see the screen below:

Click on “Register a SkyWeather Device” Fill out the form, paying special attention to the SkyWeather device key (your serial number from the SkyWeather sticker on your Smart Garden System packing slip above.

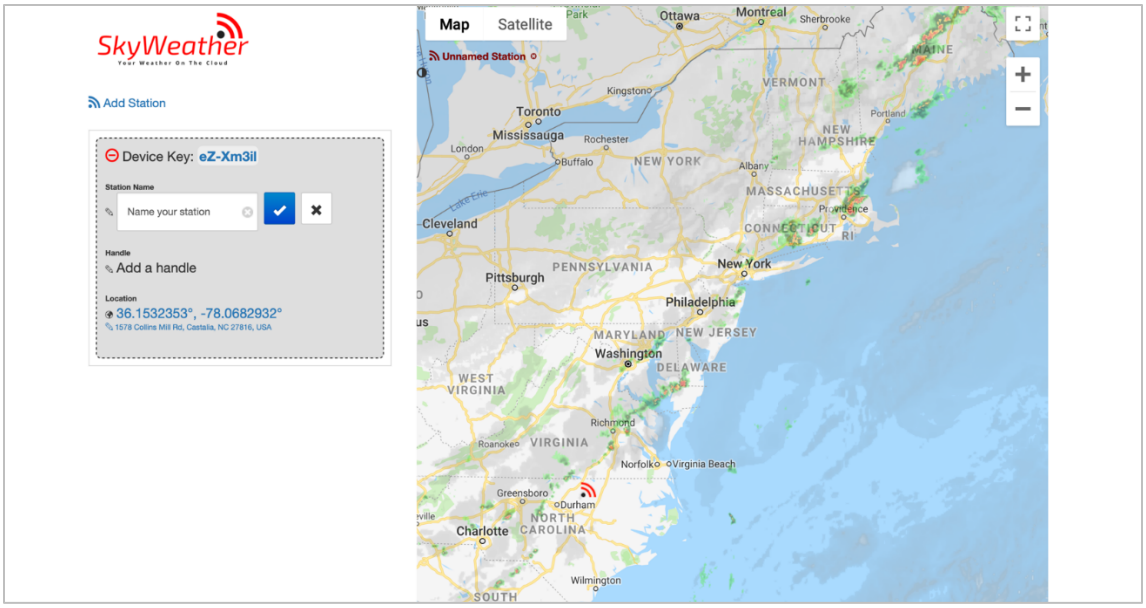


Respond to the email from skyweather@weatherstem.com to complete linking your account.

Click on the link in the email and then login to your account.

Add the name of your station (Xandau, Palm Springs, CA – Paris, France or something like that) and then the handle of the station. The handle is what your station is called in URLs.

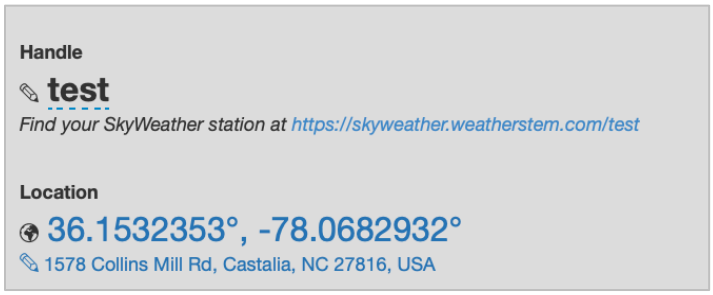
Select your location on the map on the right.



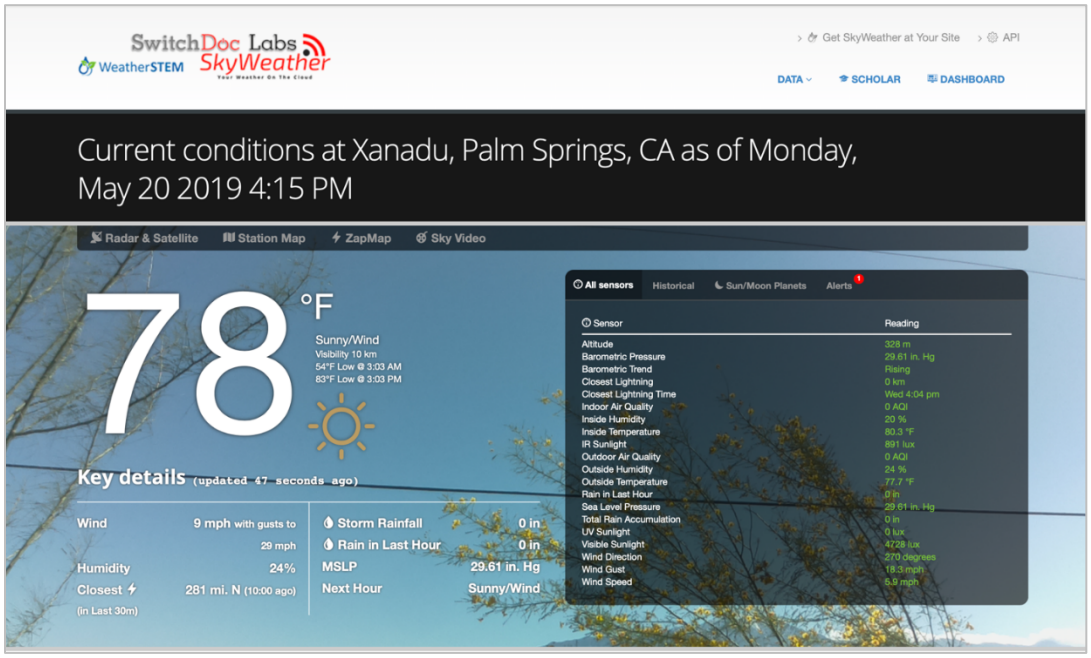
You can add additional SkyWeather stations from the add station links if you want to have more than one SkyWeather station on your account

Testing the Connection. Looking at your Station Results

After your Smart Garden System has been running for about 10 minutes, you will see your data appear. You are now connected to WeatherSTEM! Go to the link shown on your control page (see below – yours will be a different link) and you are now connected to WeatherSTEM.



At the link you will see a display like this:



Oh and one more exciting thing. After you station has been up for more than one day, click on the SkyVideo item and you will see time lapse videos that are generated on a daily basis and archived for a week.

Other WeatherSTEM Features

WeatherSTEM has a number of different features. It keeps historical information, generates graphs, generates a daily time lapse and has a complete API (Application Programming Interface) for more advanced programmers. Explore the WeatherSTEM system!

EDUCATORS: WeatherSTEM.com has a tremendous amount of curriculum material available about using WeatherSTEM (and SkyWeather) in your classroom.

Disclaimer

SwitchDoc Labs, LLC takes no responsibility for any physical injuries and possession loss caused by those reasons which are not related to product quality, such as operating without following the operating manual and cautions, natural disasters, or force majeure.

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.