SwitchDoc Labs

WeatherSense
Solar Powered Lightning Detector
WeatherProofing Manual

March 2021
Version 1.1

Table of Contents

Cautions when building and using WeatherSense Sensors

1) Keep all water away from the electronics and power supply at all times!
2) This is not a toy! Keep it out of reach of young children and pets.
3) SwitchDoc Labs assumes no liabilities in the use of this kit, beyond the refund of the purchase price.

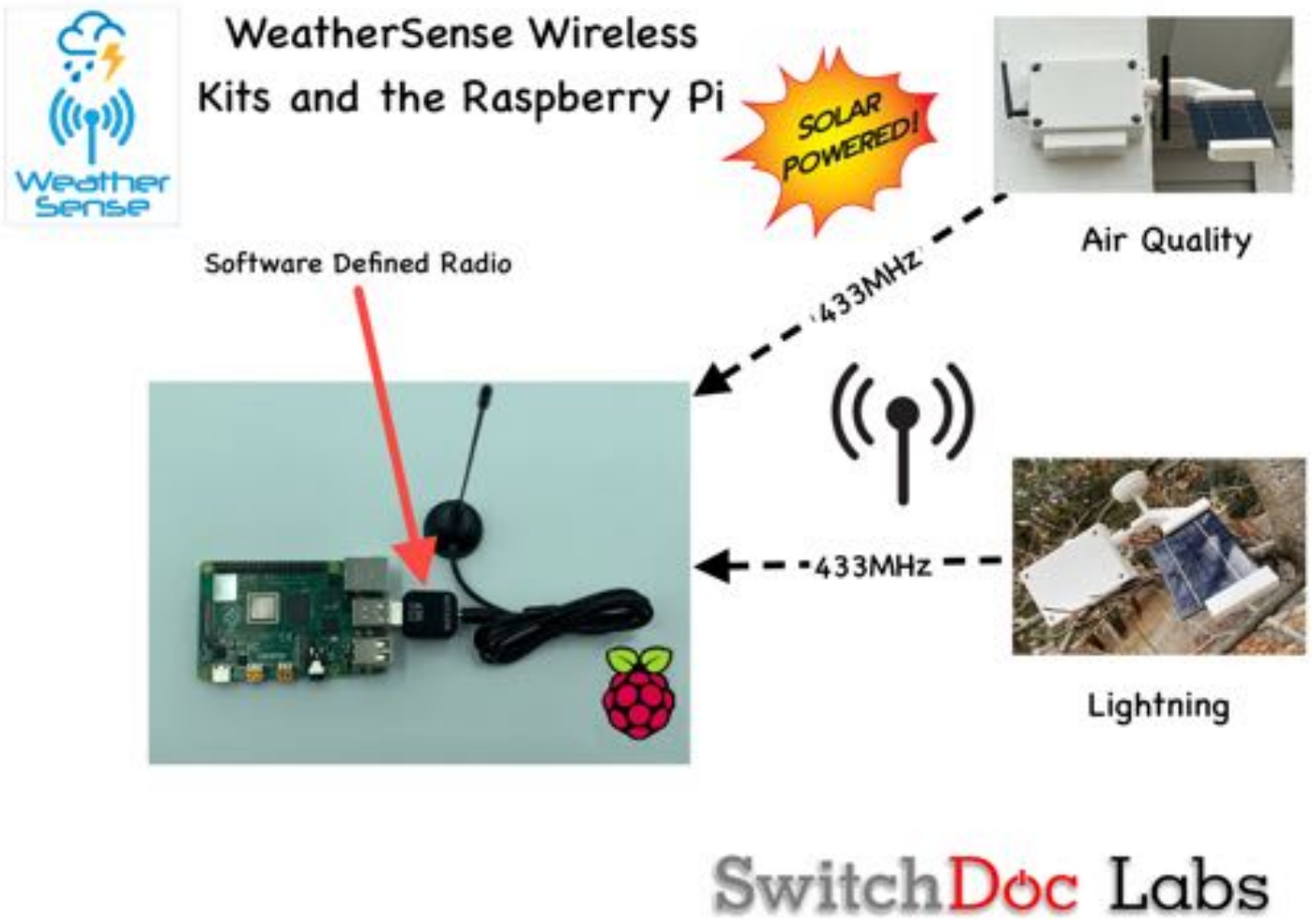
Errata

What is The WeatherSense Solar Powered Lightning Detector Sensor?

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

The **heart** of the new WeatherSense Sensors is the our new 433MHz MiniProPlus CPU board in working in conjunction with the AS3935 Lightning Detector Sensor.

The **WeatherSense Lightning Detector** kit is so simple that even middle school children can build it with just a little adult help for configuration and installation.



Full Open Source Arduino IDE compatible C Software that you can Modify and the open source Python3 software for the Raspberry Pi.

We provide the Python3 software (for the Raspberry Pi) and C for the WeatherSense Lightning Detector. All open source with the kit. The Pure Python software can be modified to add new sensors, support new cloud software and connect up to your own projects and software.

Before You Build Your WeatherSense Lightning

You should build and test your WeatherSense Lightning system as BEFORE you put it in the optional 3D Printed case. The WeatherSense Air Quality Assembly and Test manual will tell you how to do that. Get it working first, then put it in the case. Believe us, it is always easier to debug the system before you close it up in the case! All manuals are available on the WeatherSense Lightning Product page on shop.switchdoc.com.

Step by Step Assembly and Parts List

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.

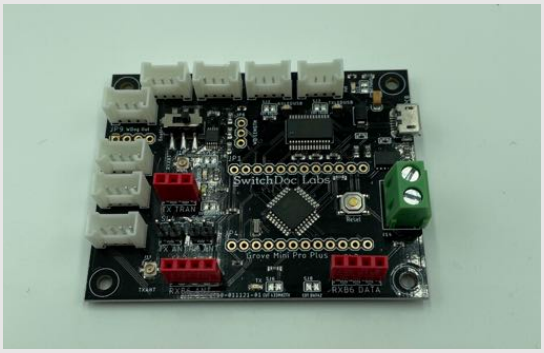
What are we doing here?

We are assembling and weatherproof the WeatherSense Lightning System.

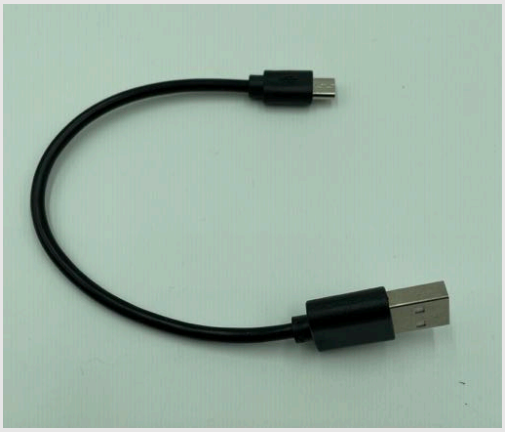
In this manual, we are going to assemble the WeatherSense Lightning system and test all the functions.

Parts List

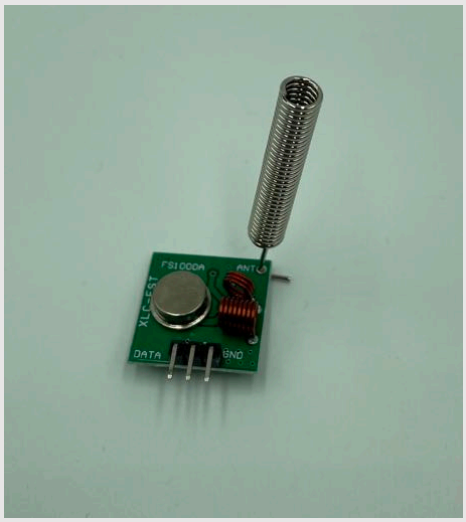
Part A
SwitchDoc Labs Grove Mini Pro Plus



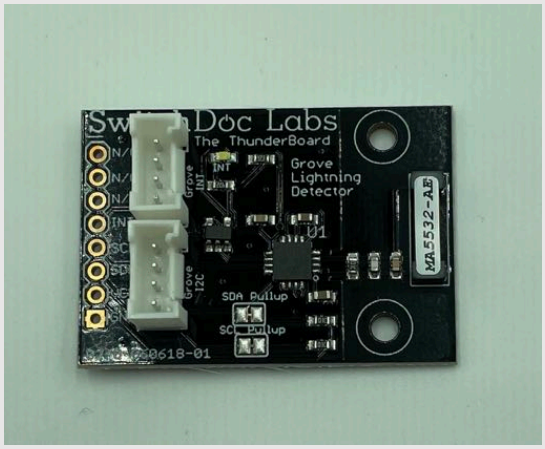
Part B
Short USB A to Micro USB



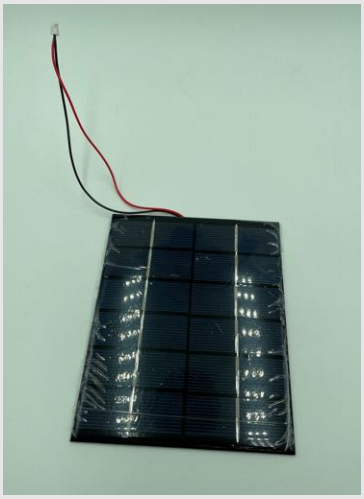
Part C
433MHz Transmitter with Antenna



Part D
ThunderBoard AS3935 Lightning Detector

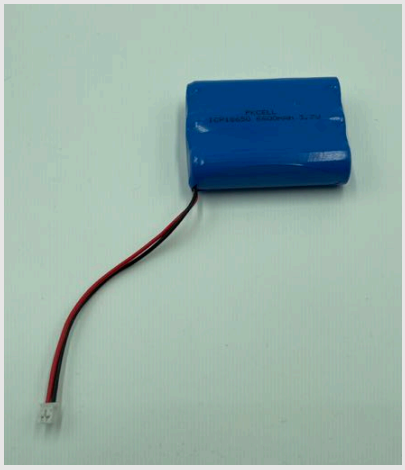


Part E
330mA 6V Solar Panel



Part F
SunAirPlus2 Solar Power Data Collector and Controller

Part G
3.7V LiPo Battery (Not included)



Part H
One (1) 20cm Grove Cables

Part I
Box Bottom

Part J
Box Top

Part K
Air Quality Housing (Not used)

Part L
Optional Power Box Plug

]]]]

Part M
Box Plug

Part N
Joiner

Part O
Bent Joiner

Part P
Saucer Lightning Housing Top

Part Q
Saucer Lightning Housing Bottom

Part R
Solar Bracket

Part S
One (1) 50cm Grove Cable

Parts you need to buy separately from the kit

- 3.7V LiPo Battery
- Raspberry Pi

- Compatible SDR Software Defined Radio (For example: https://hpjhlytllzrwf4qn-24552113.shopifypreview.com/products/software-defined-radio-sdr-and-antenna)
- 16GB SD Card (unless you bought the SD Card from SwitchDoc Labs)
- Power Supply for the Raspberry Pi

What else do you need for Assembly and Weatherproofing?

- 1 – 510mm x 3.6mm screen spline (any hardware store)
- 6 – 6mm M3 screws (Amazon - https://amzn.to/2K200QC)
- 8 – 5mm M3 screws
- 4 – 8mm M3 screws
- 2 – 16mm M3 screws
- 2 – 12mm M3 Screws
- 8 – 5mm M3 Brass Threaded Inserts (Amazon - https://amzn.to/39Rf9iL)

(All this hardware is available as a small hardware package here:
https://shop.switchdoc.com/products/weathersense-Lightning-Lightning-hardware-parts-kit)

1 Package of Duct Seal (for covering holes and screws)
(Amazon - https://amzn.to/33SMkyE
Any Hardware Store)

How to select a LiPo Battery

The WeatherSense Lightning requires 3.7V LiPo battery.

How large of a LiPo battery you need depends on how much sun you get and how often you have cloudy weather. Generally, we would recommend a 6600mAh battery such as https://www.adafruit.com/product/353. Adafruit has a great selection and you can find good ones on SparkFun.com too.

WARNING: if you get them off of Amazon, check the wiring. Most of them are wired backwards.
Here's a great website showing the problem and how to rewire the batteries if you wish:

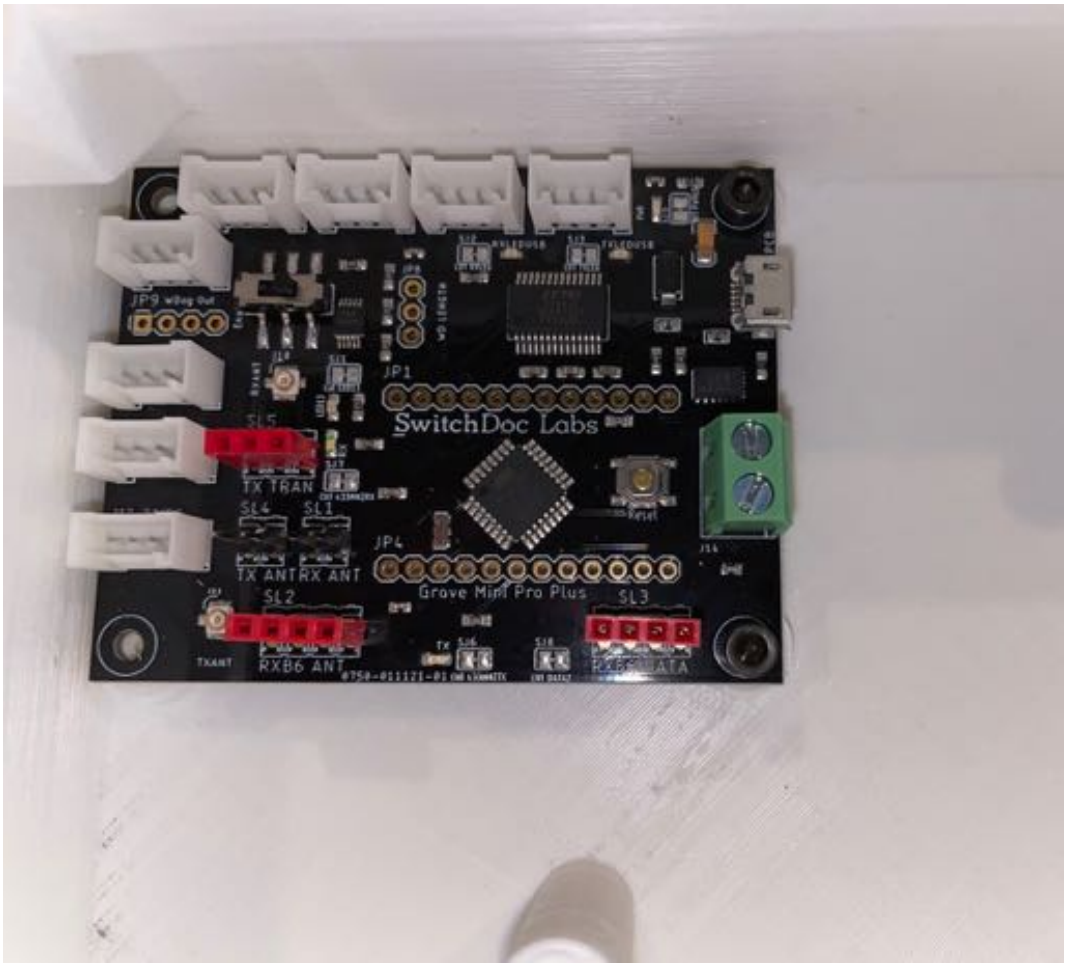
https://docs.particle.io/tutorials/learn-more/batteries/

Step by Step Assembly

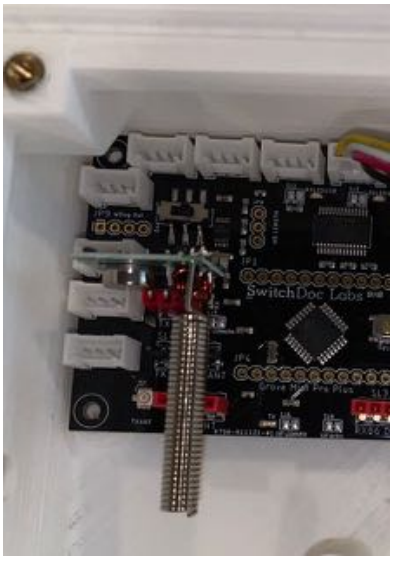
You will need to disassemble the unit that you assembled in the WeatherSense Lightning Assembly and Test and follow the assembly instructions below.

Step 1: Superglue 4 5mm brass inserts into the bottom box (Part I) as in the picture below. Use a screw to help you position and glue the inserts into the box. Apply glue to the outside of the inserts then push them into the hole and gently unscrew the screw. If they are too tight to push in, gently pound the screw (with the insert attached as below) into the bottom box.

Step 2: Attach the MiniProPlus (Part A) to the bottom box (Part I) using two 5mm screws as shown below. As always, tighten, but don't over tighten the screws as you will strip the plastic threads.

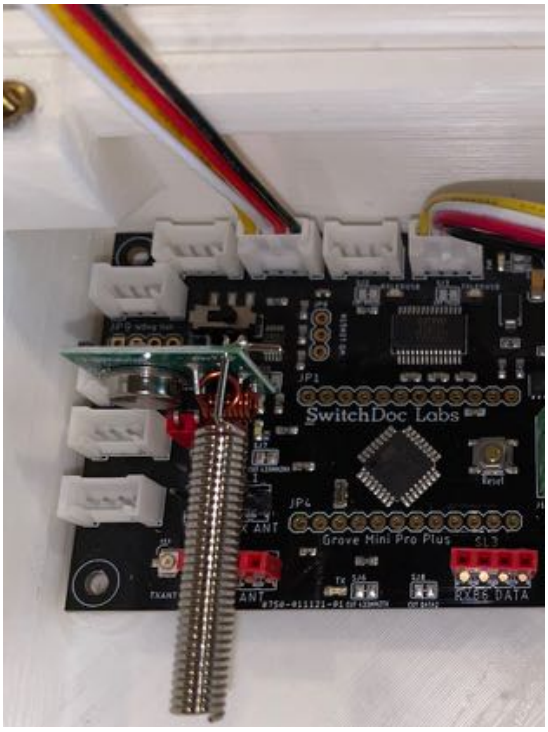


Step 3: Take the 433MHz transmitter (Part C) and plug it into the TX header on the MiniProPlus board (Part A). Make sure you have bent the pins slightly (down-up-down) to ensure that you get a good connection.

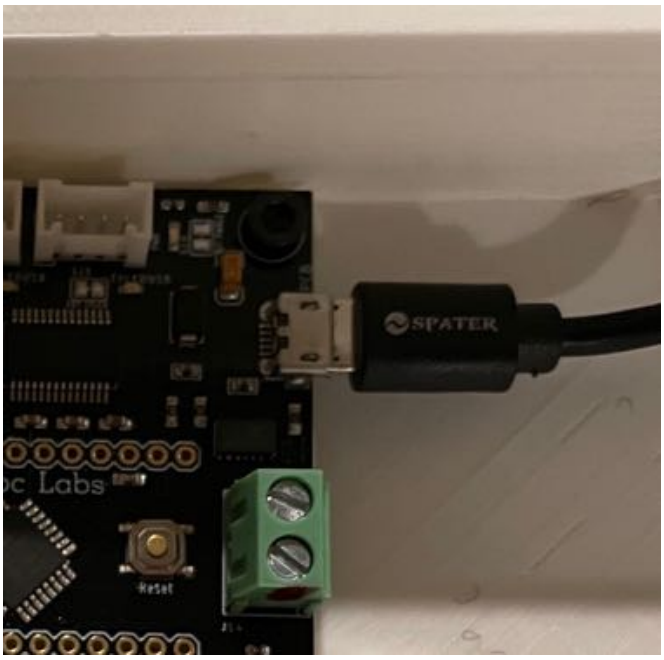


Step 4: Take the 50cm Grove Cable (Part H) and plug it into the Grove connector marked J5-I2C on the MiniProPlus board (Part A). Route it out the hole in the bottom box (Part I).

Step 5: Plug the 20cm Grove cable (Part H) into the J7-I2C Grove connector on the MiniProPlus (Part A).

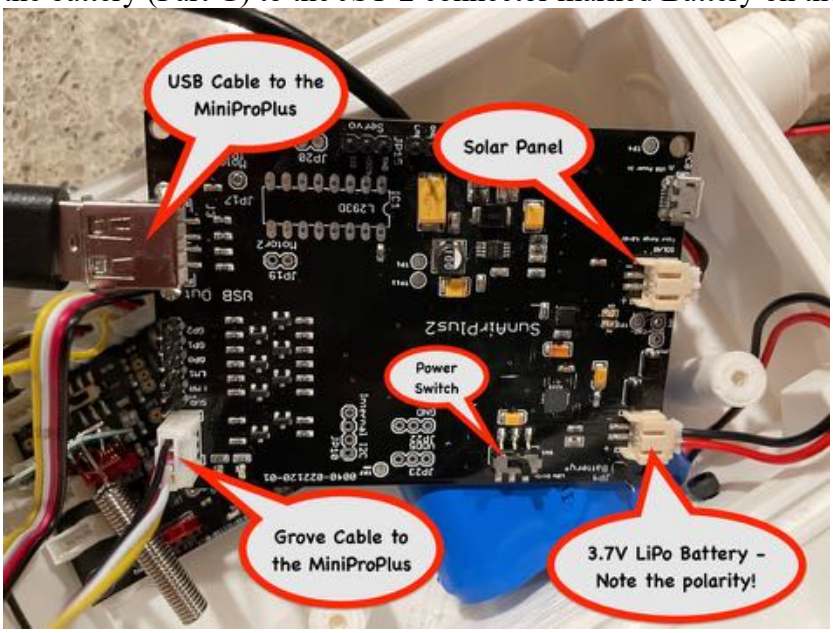


Step 6: Plug the USB micro to USB Type A cable (Part B) into the MiniProPlus (Part A).



Step 7: Insert your LiPo Battery (not included – example shown as Part G) into the space provided. You can use Velcro or double sided tape to secure the battery to the bottom box (Part I).

Step 8: Making sure the SunAirPlus2 switch is in the off position (slide towards the battery connector), plug in the battery (Part G) to the JST-2 connector marked Battery on the SunAirPlus2 Board (Part F) as shown below.

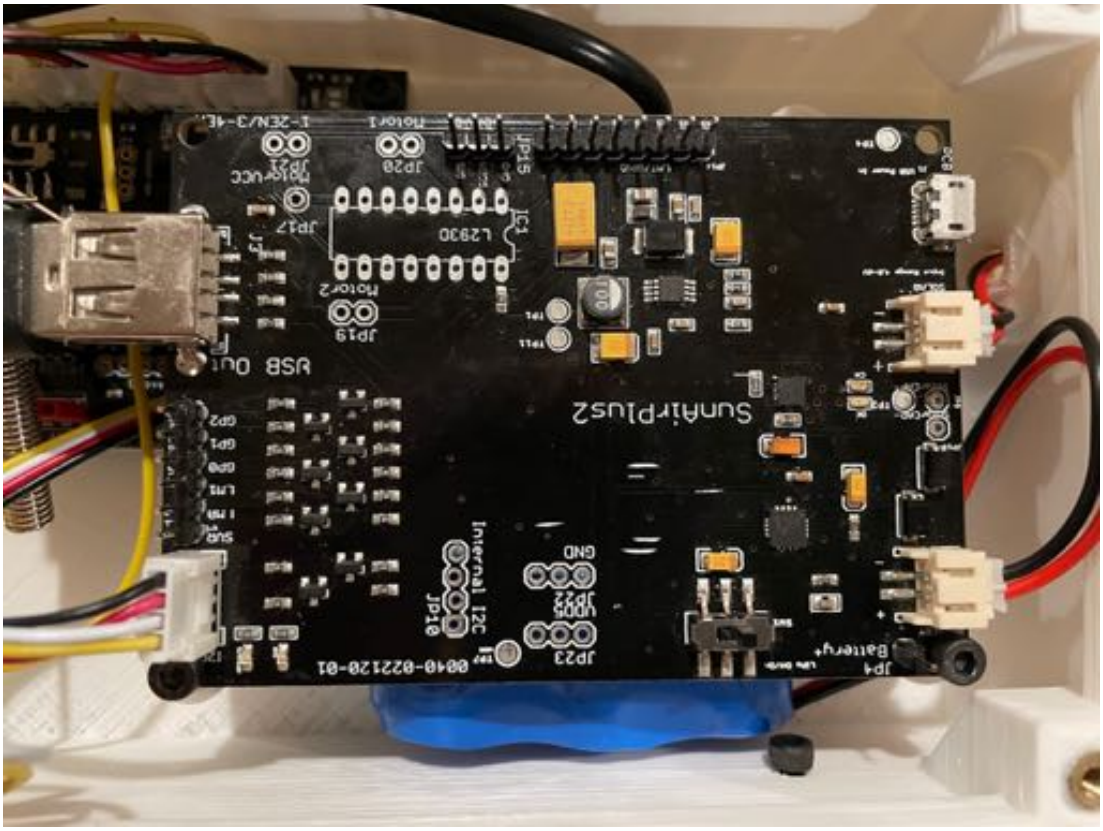


Step 9: Attach the Solar Panel (Part E) JST-2 plug to the JST-2 connector on the SunAirPlus2 (F) board as shown above.

Step 10: Attach the USB Cable (Part B) to SunAirPlus2 (Part F) as shown above.

Step 11: Plug in the 20cm Grove Cable connected to the MiniProPlus (Part A) (plugged into J7-I2C) into the SunAirPlus2 board Grove connector as shown above.

Step 12: Attach the SunAirPlus2 board (Part F) to the bottom box (Part I) using two 5mm screws as shown.



Step 13: Check to see that the Box Plug (Part M) fits in the right side hole of the bottom box (Part I). If it doesn't, file the Box Plug (Part M) down until it does fit. And it should fit pretty snugly.

Step 14: Screw the Joiner (Part N) into the Box Plug (Part M). Don't screw it all the way in. Just until it is snug.

Step 15: Take the two 16mm screws and thread them through the lock blocks on the right side of the bottom box (Part I) as shown.

Step 16: Take the Solar Bracket (Part R) and screw in the Joiner (Part N) and Box Plug (Part M) assembly. Again, don't screw it all in, just until it's snug and oriented correctly as shown below. The wire channel on the Box Plug (Part M) should be pointed down while the panel should up be at 45 degrees. You can use a drop of glue if the threads don't hold. This forms the Solar Bracket Assembly.

Step 17: Now take the Saucer Lightning Base (Part Q) and snap the ThunderBoard (Part D) in the slot as shown.

Step 18: Screw the Saucer Lightning Top (Part P) onto the Saucer Lightning Base (Part Q). This forms the Lightning Saucer Assembly.

Step 19: Screw the Lightning Saucer Assembly on to the long end of the Bent Joint (Part O). Don't apply to much pressure. Screw it in until tight, but it doesn't have to go in all the way. If it is still loose, put a drop of glue to hold it.

Step 20: Now take the Solar Bracket Assembly and screw the Lightning Saucer Assembly into the hole on the top of the Solar Bracket. When you have the Solar Bracket Assembly held at 45 degrees, the Lightning Saucer Assembly should point straight up.

Step 21: Plug the other end of the 50cm Grove Cable (Part S) into the Grove connector marked I2C on the ThunderBoard (Part D) inside the Saucer Lightning Assembly. Check it and get it in the right slot! If you don't plug it in the correct slot, nothing bad will happen but your Lightning Detector will not work.

Step 22: Remove the plastic from the front of the Solar Panel (Part E)

Step 23: Slide the Solar Panel (Part E) into the slots on the Solar Bracket (Part R) with the wires facing down. If it is too loose, secure with tape or glue.

Step 24: Slide the complete Solar Bracket Assembly into the bottom box (Part I) hole on the left side, making sure all wires are in the slot and not being pinched by the assembly. Align the holes on both sides of the Box Plug (Part M) with the lock screws. Tighten the lock screws. Use a wire tie to make the wires neat.

Initial Testing

Testing WeatherSense Lightning

If you have the SwitchDoc Labs SD Card, you can proceed to Step 4.

Step 1: Install the SDL modified version of rtl_433.

In a terminal window on your Pi at /home/pi type:

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

Then compile it on the Raspberry Pi:

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

Step 2: Install the WeatherSense Lightning Software using these commands:

```
cd
git clone https://github.com/switchdoclabs/SDL_Pi_WeatherSense.git
```

Step 3: Add needed python modules to your system (a list will be provided on forum.switchdoc.com in the near future). If you want to jump into it, run

```
sudo python3 WeatherSenseMonitor.py
```

And start adding in the missing libraries as they come up as missing imports, otherwise do at least the following:

Installing mariadb:
https://pimylifeup.com/raspberry-pi-mysql/

```
sudo apt-get install python3-dev libmysqlclient-dev
sudo pip3 install mysqlclient
```

Next:

```
sudo -u root -p < WeatherSenseWireless.sql
```

Step 4: Note the IP Address of your Raspberry Pi. Type in the following commands to get your IP address:

```
hostname -I
```

You will get something like this:

```
pi@SwitchDocLabs:~/SDL_Pi_WeatherSense Lightning $ hostname -I
192.168.1.44
```

Step 5: Update WeatherSense to the latest version. Type the following commands into a terminal window.

```
cd
cd SDL_Pi_WeatherSense
git pull
```

You will see something like this:

```
pi@SwitchDocLabs:~/SDL_Pi_WeatherSense$ git pull
remote: Enumerating objects: 19, done.
remote: Counting objects: 100% (19/19), done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 12 (delta 10), reused 12 (delta 10), pack-reused 0
Unpacking objects: 100% (12/12), done.
From https://github.com/switchdoclabs/SDL_Pi_WeatherSense Lightning
   f2193a0..c98a45c  master     -> origin/master
Updating f2193a0..c98a45c
Fast-forward
 README.md              |  2 ++
 SkyCamera.py           |  2 +-
 WeatherSense Lightning.py         |  2 +-
 pclogging.py           | 12 +++++++-----
 state.py               |  3 +++
 testWirelessSensors.py | 18 ++++++++++----------
 6 files changed, 22 insertions(+), 17 deletions(-)
```

Or, if your software is up to date:

```
pi@SwitchDocLabs:~/SDL_Pi_WeatherSense$ git pull
Already up to date.
```

Step 6: First we will test the reception of the wireless weather sensors. Test your SDR and WeatherSense installation as follows. Note you must have completed the WeatherSense Lightning assembly.

```
cd /home/pi/SDL_Pi_WeatherSense

sudo python3 WeatherSenseMonitor.py
```

Now start your Lightning sensor by turning the SunAirPlus2 switch to on. You will then see something similar to this on your terminal window:

```
pi@SwitchDocLabs:~/SDL_Pi_WeatherSense $ sudo python3 WeatherSenseMonitor.py
Pending jobs:
    readSensors (trigger: date[2021-02-27 12:13:55 PST], pending)
-----------------

Scheduled Jobs
######
-----------------
Read Wireless Sensors
######
Jobstore default:
    No scheduled jobs
-----------------
starting 433MHz scanning
######
processing Lightning TB Data
This is the raw data: {"time" : "2021-02-27 16:16:03", "model" : "SwitchDoc Labs TB", "len" : 44,
"messageid" : 0, "deviceid" : 1, "protocolversion" : 1, "softwareversion" : 1,
"weathersenseprotocol" : 16, "irqsource" : 0, "previousinterruptresult" : 0,
"lightninglastdistance" : 0, "sparebyte" : 0, "lightningcount" : 0, "interruptcount" : 0,
"loadvoltage" : 4.976, "batteryvoltage" : 4.208, "batterycurrent" : 52.800, "loadcurrent" : 27.000,
"solarpanelvoltage" : 2.960, "solarpanelcurrent" : -0.000, "auxa" : 3, "mic" : "CRC"}
```

What does the JSON from the WeatherSense Lightning Sensor mean?

The WeatherSenseMonitor.py python3 program reads in the 433MHz signals into the Raspberry Pi, decodes them and formats the results as a JSON packet that will be provided to the WeatherSenseMonitoring software for processing and storage in the database. More about the SDL_Pi_WeatherSense software in the WeatherSense Software Manual.

If you have other WeatherSense Sensors (such as SkyWeather2, WeatherRack2, F016TH Indoor sensors, etc), you will see them show up in the list too.

```
processing Lightning TB Data
This is the raw data: {"time" : "2021-02-27 16:16:03", "model" : "SwitchDoc Labs TB", "len" : 44,
"messageid" : 0, "deviceid" : 1, "protocolversion" : 1, "softwareversion" : 1,
"weathersenseprotocol" : 16, "irqsource" : 0, "previousinterruptresult" : 0,
"lightninglastdistance" : 0, "sparebyte" : 0, "lightningcount" : 0, "interruptcount" : 0,
"loadvoltage" : 4.976, "batteryvoltage" : 4.208, "batterycurrent" : 52.800, "loadcurrent" : 27.000,
"solarpanelvoltage" : 2.960, "solarpanelcurrent" : -0.000, "auxa" : 3, "mic" : "CRC"}
```

The values and units of the are:

- timestamp: When the packet has been received
- model: SwitchDoc Labs TB
- len: Number of bytes in the packet
- messageid: Reset to 0 on bootup
- deviceid: 1 – If you have more than one Lightning sensor, you can change this ID by recompiling the software
- protocolversion: Current protocol of the Lightning sensor
- softwareversion: This shows the current version of the software on the Mini Pro Plus
- weathersenseprotocol: 16 for WeatherSense Lightning
- irqsource: 0 for no interrupt, 1 for a noise interrupt, 4 for a disturber and 8 for lightning stroke.
- previousinterruptresult: same as above, but for an immediately preceding interrupt.
- lightninglastdistance: Distance of the current lightning bolt in km
- Sparebyte: not used
- lightningcount: Number of lightning interrupts since bootup
- interruptcount: Number of interrupts of all kinds since bootup

The solar data collected by the device is:

- loadvoltage: Voltage supplied to the computer (V)
- batteryvoltage: Voltage of the LiPo Battery (V)
- batterycurrent: Current being supplied by the battery (mA)
- loadcurrent: Current being supplied to the computer (mA)
- solarpanelvoltage: Voltage of the Solar Panel (V)
- solarpanelcurrent: Current being supplied by the Solar Panel (mA)

The AuxA variable contains state information about what sensors the WeatherSense Lightning has connected to and if the sensor is in low voltage mode.

Each bit of the lower four bits of the AuxA variable (0CAB) are coded as:

C = 1, Voltage below 2.8, Lightning interrupts are ignored, 0 means normal operation
A = 1, SunAirPlus2 (Solar) Present, 0 not present
B = 1, AS3935 ThunderBoard Present, 0 not present

Final Assembly

Step 1: Before you do anything else, make sure you move the power switch on SunAirPlus2 to on (the LEDs should light up).

Step 2: Push a small screw driver through all four holes on the Box Top (Part J) to prime the screw holes.

Step 3: Take the 510mm Screen Spline and push it into the Box Top (Part J) channel. Start in the middle of a long side. This becomes the bottom of the Box Top (Part J).

Step 4: Screw down the Box Top (Part J) with the spline gap at the bottom. Start all four 8mm screws until they just start into the brass inserts on the bottom box (Part I) and then go around and tighten all the screws down (but not too tightly!). This process adjusts for any minor alignment issues with your 3D Printer.

Final WeatherProofing

We suggest you use Duct Seal to seal the box. It can easily be removed for access or changes and will stay pliable for a long time.

Step 1: Using the Duct Seal, make small blobs and cover all the screw holes on the top of the assembled.

Step 2: Using the Duct Seal, make a small blob and cover the unused antenna hole on the right side of the box bottom (Part I).

Step 3: Using the Duct Seal, seal the wire channel under the Box Plug on the Solar Bracket Assembly. You can also seal around the Box Plug as it goes into the Box.

Step 4: Using the Duct Seal, seal the hole underneath the Saucer Lightning Assembly.

Step 5: Using the Duct Seal, seal the holes on the bottom of the box bottom (Part I) but leave one screw hole open for a vent.

Congratulations! Now go and enjoy all that data coming into your system. And check out the Advanced Programming manual.

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.