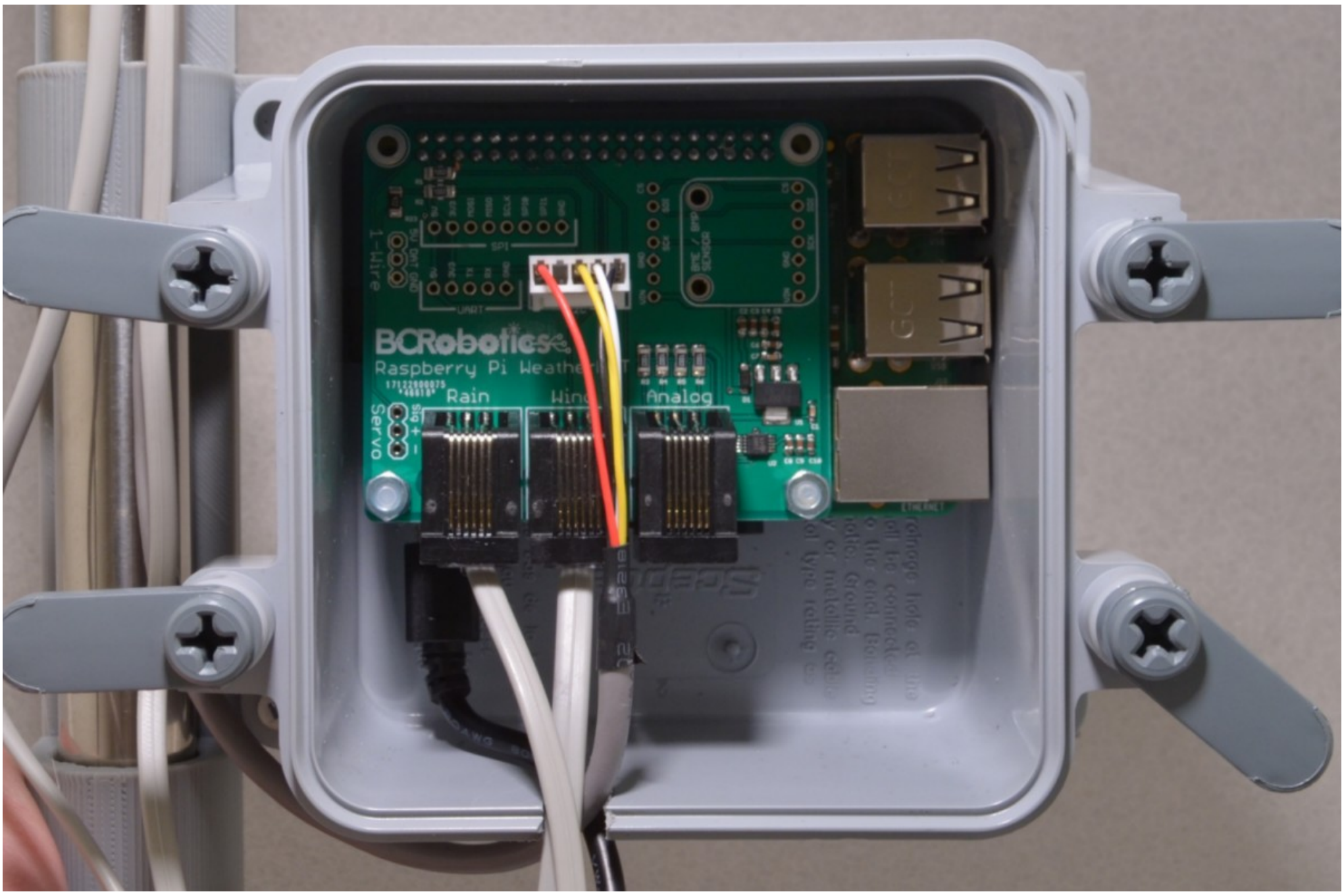


Raspberry Pi Weather Station – Part 1

Chris @ BCR March 21, 2020 29 Comments

In this tutorial we are going to go in a little bit of a different direction – this will be a project tutorial, which when followed, will result in a working Raspberry Pi based Weather Station that streams data to the ThingSpeak Data service. We will break this down into four components: A board overview and assembly guide, collecting the data using python, sending the data to ThingSpeak, and finally a section looking at installation outdoors. The tutorial is focused on our Raspberry Pi Weather Board, designed and manufactured here at BC Robotics.

About the Board:

The Pi Weather Board was designed to make the often messy task of connecting a bunch of different sensors to the Pi as organized as possible without compromising on choice of sensors. The board also addresses the Pi's inability to read analog inputs with a built in 4 channel 12-bit Analog to Digital Converter.

So what parameters does it measure? The board itself doesn't have any sensors on it, so this is going to depend on which sensors you choose to go with. Following this tutorial with the suggested parts will result in a weather station monitoring Wind Speed, Wind Direction, Rainfall, Temperature, Air Pressure, and Humidity. Going forwards, additional sensors could be added without much trouble.

The Parts Needed:

This tutorial will be requiring a few common parts:

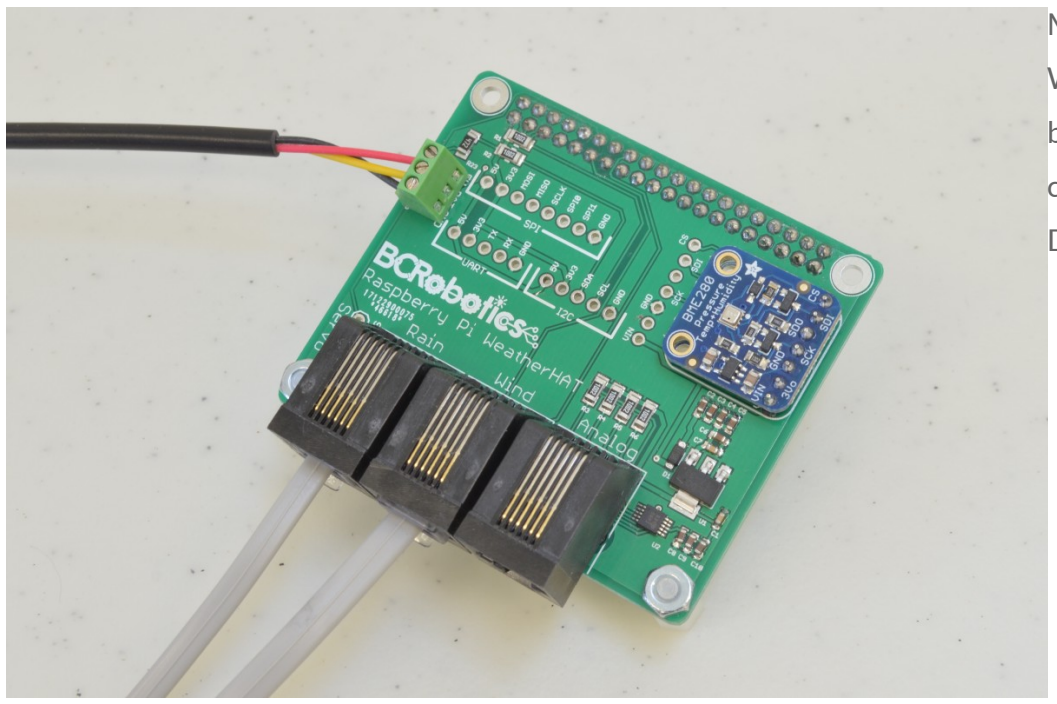
[list type=”check”]

- 1 x Raspberry Pi (4 or 3A+ recommended)
- 1 x microSD card (with Raspbian 2018-06-27)
- 1 x Pi 3 or Pi 4 power supply
- 1 x Raspberry Pi Weather Board
- 1 x SparkFun Weather Meters
- 1 x DS18B20 Temperature Sensor
- 1 x Adafruit BME280 Temperature / Pressure / Humidity Sensor
- 1 x Raspberry Pi GPIO Header
- 1 x Raspberry Pi HAT Hardware
- 1 x 3 Pin 2.54mm Screw Terminal

[/list]

Going forwards there will also be tools and other components required – we will discuss these throughout the next 3 parts of this tutorial.

Step 1 – A Quick Overview of the assembly steps

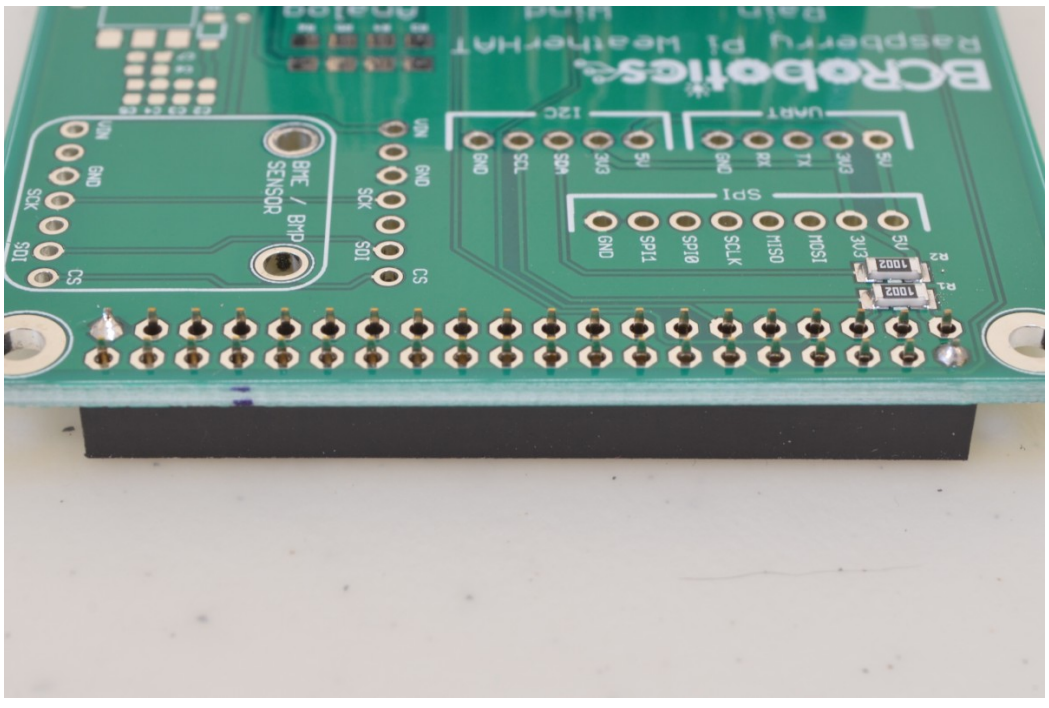


Most of the difficult tasks have already been taken care of by the Weather Board so assembly wont be too bad! We are going to start by soldering the stacking header to the Pi Weather HAT. Once that is completed, we will solder Adafruit BME280 breakout board, add the DS18B20 Temperature Sensor, and plug all of the sensors in.

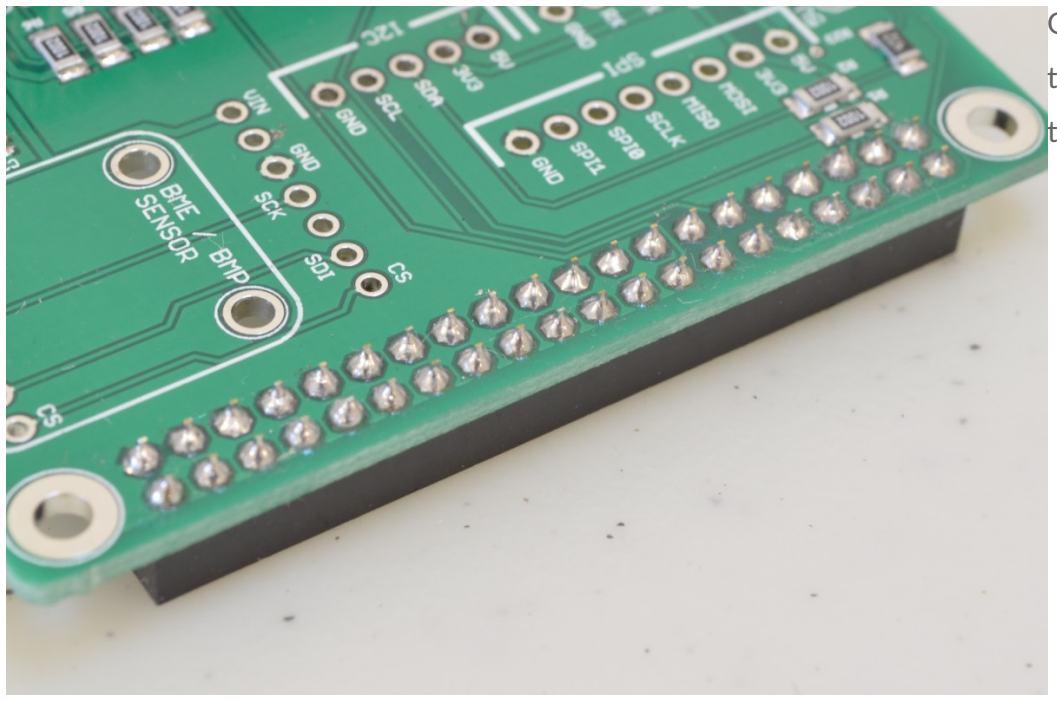
Step 2 – Soldering the header

First we need to solder the header that allows this board to plug into the Raspberry Pi. We recommend using this header, but any compatible Raspberry PI GPIO header will work. If you haven’t soldered before, or want a quick refresher course, have a look at this awesome comic: Soldering Is Easy! https://mightyohm.com/.../FullSolderComic_EN.pdf

Start by Tacking two opposite corners of the connector in place and checking the connector alignment. We do this to ensure the connector is sitting correctly before soldering all 40 pins; once these have all been soldered, it is very difficult to adjust the alignment.



Step 3 – Soldering the header (continued)



Once the connector is aligned to the board, and you are happy with the alignment, solder the remaining pins. It should look something like the attached photo when you are finished!

Step 4 – BME280 Part 1

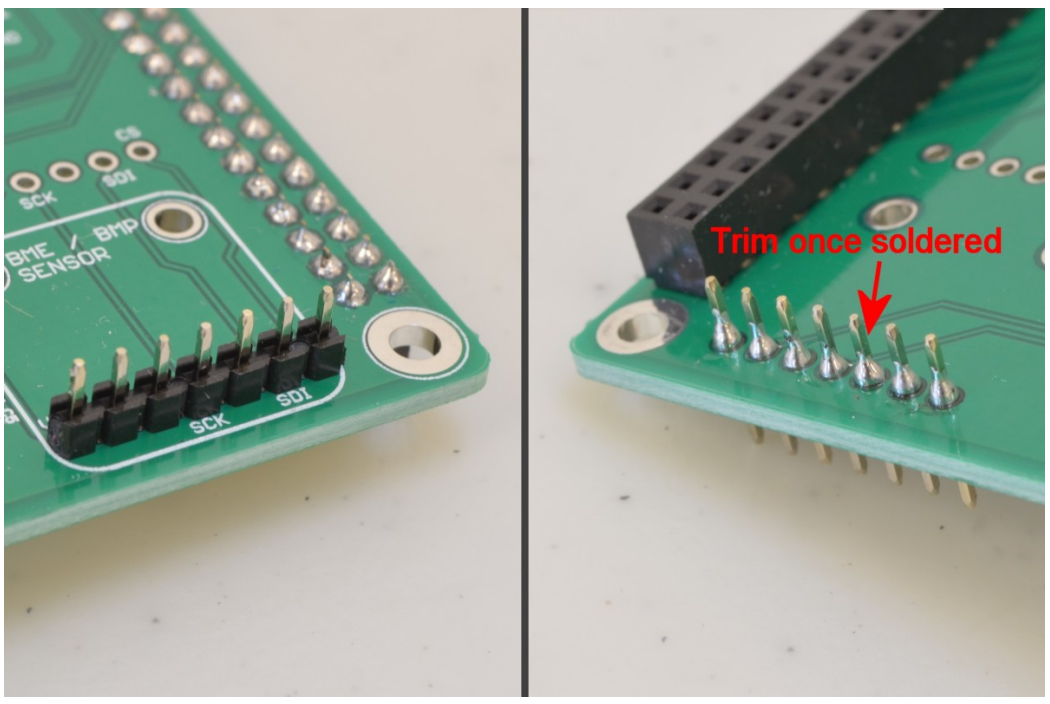
The BME280 is an awesome little Temperature / Humidity / Pressure sensor and it works great with the Pi!

Raspberry Pi 3:

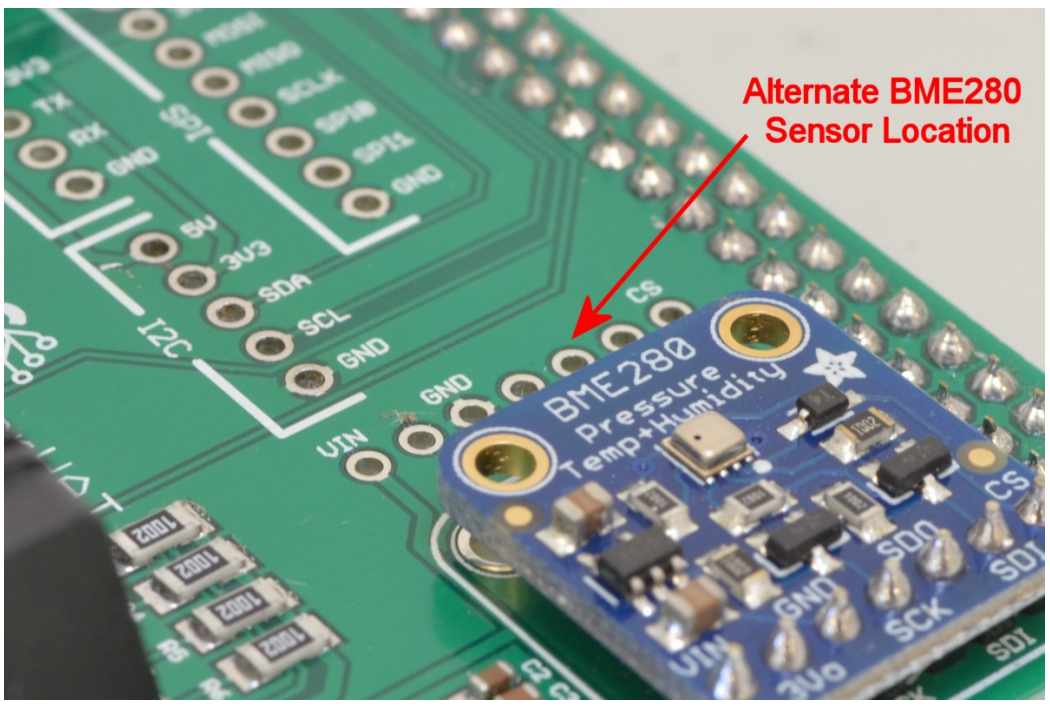
If you are using the Raspberry Pi 3, simply attach as shown. There are no special instructions for this one!

Raspberry Pi 3+:

If you are using the Raspberry Pi 3+ there are a few things to consider. The Pi3+ has an extra 4 pin header for Power over Ethernet (POE) capabilities. This connector will likely contact the pins on the bottom of the BME280 if it is installed in the normal position on the Weather Board. There are two ways this can be avoided: Remove the POE header (since it can be easily re-installed later) or install the BME280 in the alternate pin location as shown in the attached image.

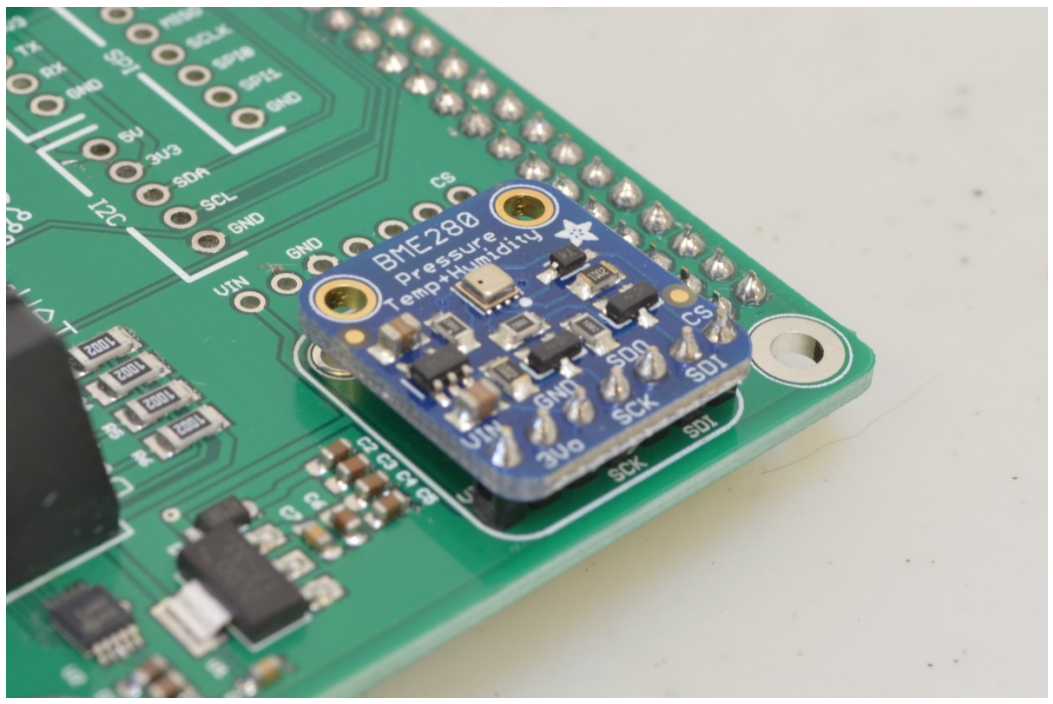


Once you have sorted out where it will be located, solder in the chunk of breakaway header to the Pi Weather Board. This breakaway header is normally included with the BME280.



Step 5 – BME280 Part 2

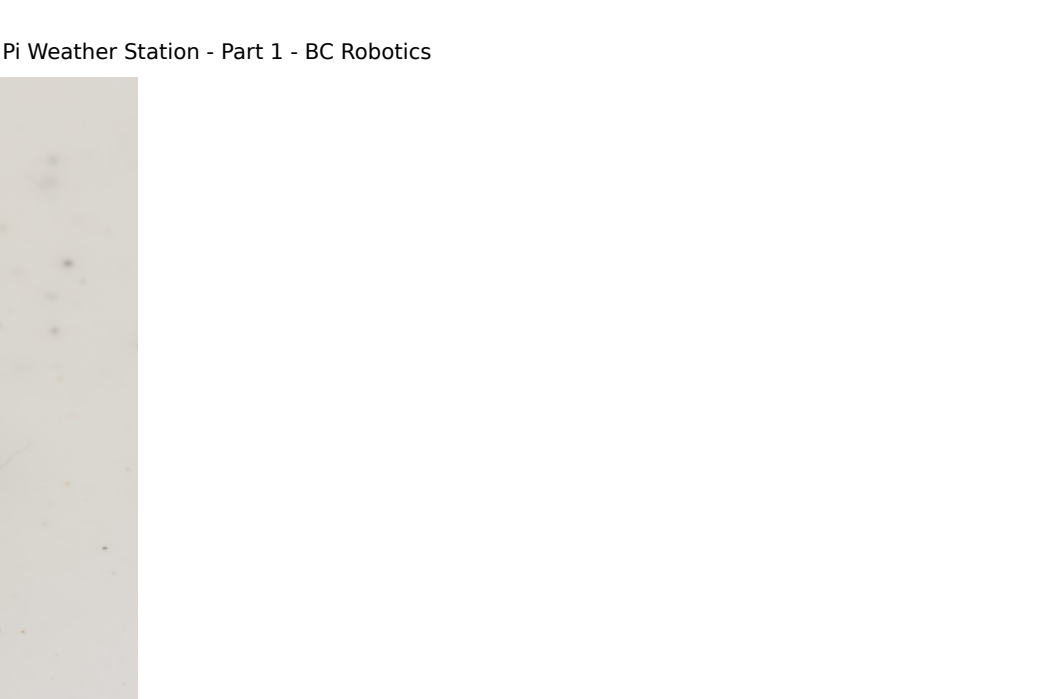
Flip the board back over, and place the Adafruit BME280 on the pins, matching the orientation to that of the board footprint. Tack one of the corners to set the board in place, and once you are happy with the position, solder the remaining pins.



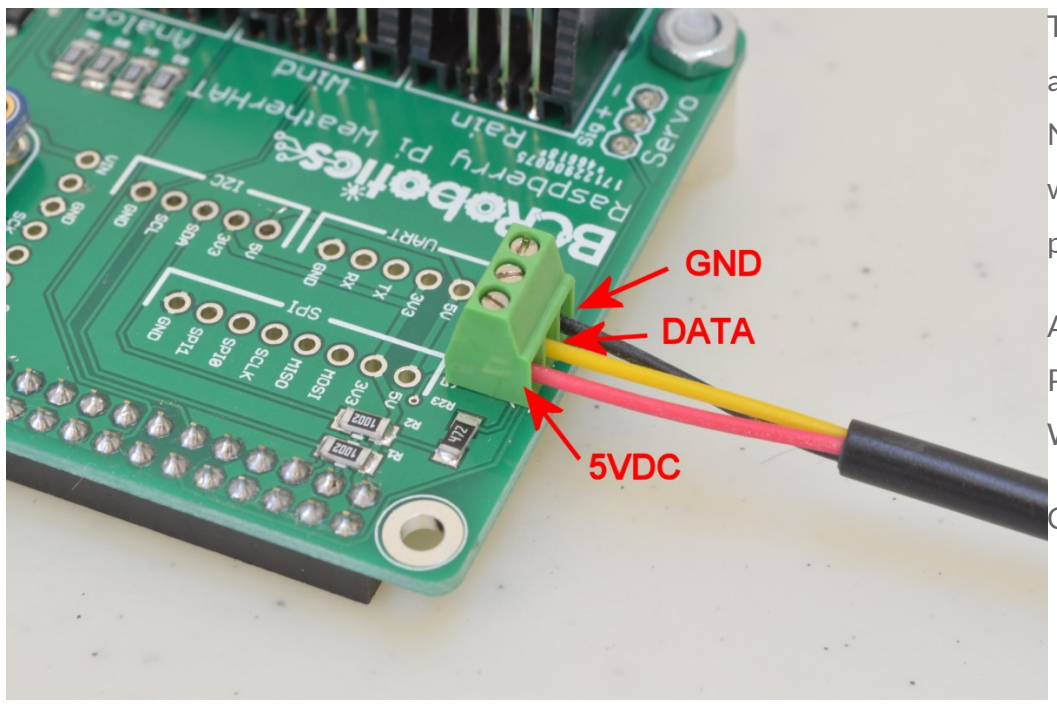
Step 6 – DS18B20

Next we are going to install a screw terminal to connect the DS18B20 Temperature Sensor. The DS18B20 is weatherproof, so the probe will actually be mounted outside of the box, with the wires running into the board, so having them removable will make the installation into a box much easier going forwards. If you prefer, you could also solder the wires direct to board.

We went with a screw terminal on this one, but any standard 3 pin 2.54mm pitch connector would work. Just like all the other connectors, tack one pin in place, check the alignment, and solder the remaining pins.



Step 7 – DS18B20 Continued



The DS18B20 can ship with two different sets of wire colors – these are often seen with Red, Black and White or Red, Black, and Yellow. Normally Red will be power, Black will be Ground, and White / Yellow will be the Data pin. Be sure to check the pinout, we list it on our product page for the DS18B20.

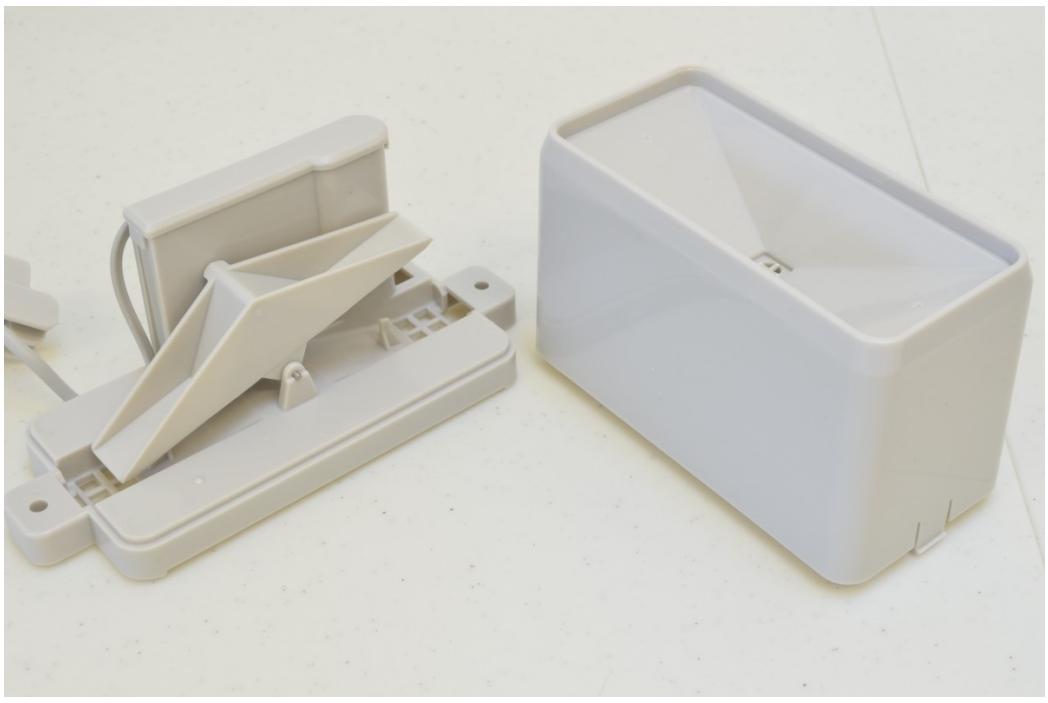
A 4.7K Ohm Resistor is normally needed to between the 5V and Data Pin when using the sensor; this is taken care of by the Raspberry Pi Weather Board – so no need to wire one in!

Connect your DS18B20 according to the color code of your sensor.

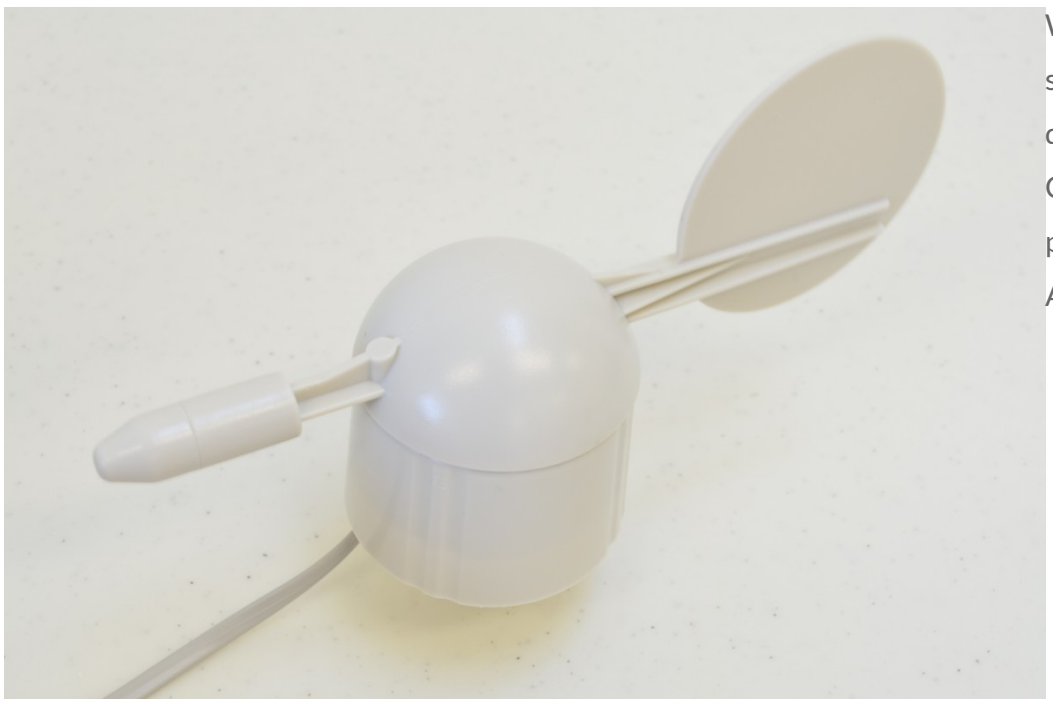
Step 8 – Rain and Wind Speed

The Wind Speed, and Rain Gauge are both basic digital sensors. The Anemometer (Wind Speed) is measured by counting how fast it spins in a given amount of time while the Rain Gauge measures how many

times the gauge tips a precise amount of water over a given period of time. There is no soldering for these ones – they will just plug in along with Wind Direction. More information on the sensors and how they work can be found on their data sheet.

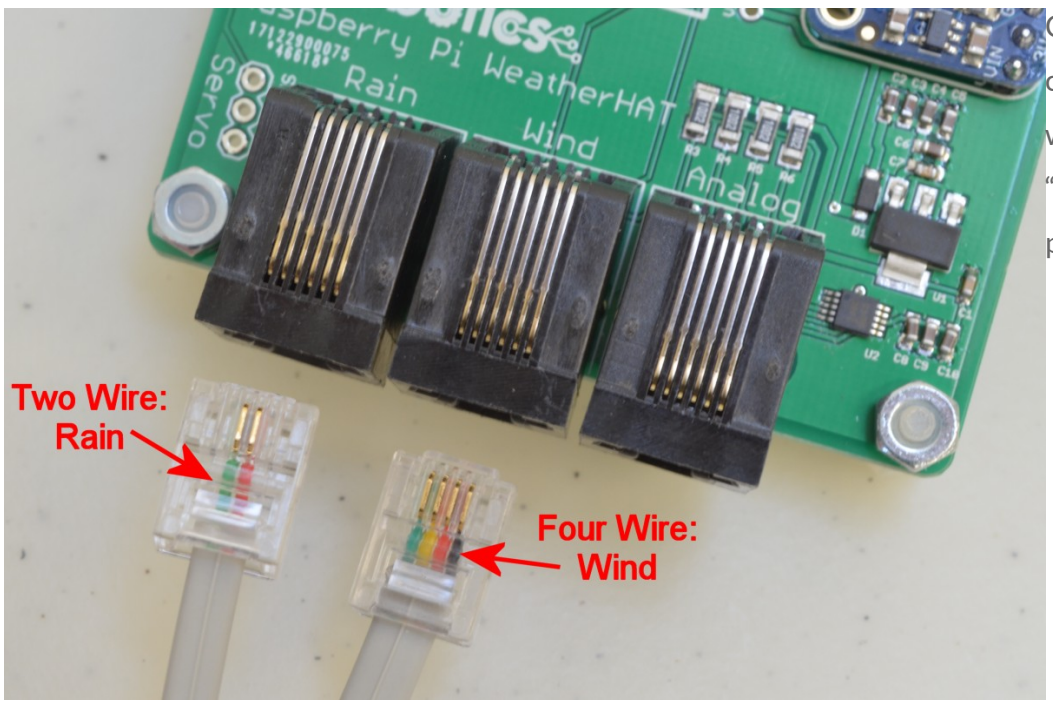


Step 9 – Wind Direction



Wind Direction is a bit more difficult with the Pi – Wind Direction sensors are often analog, and this one is no exception. So why are the difficult? Well, the Raspberry Pi doesn't have an Analog to Digital Converter. But no worry – the Weather Board also handles this problem. We have included a 4 Channel Analog to Digital Converter. All we have to do is plug it in!

Step 10 – Connecting the Wind & Rain Sensors

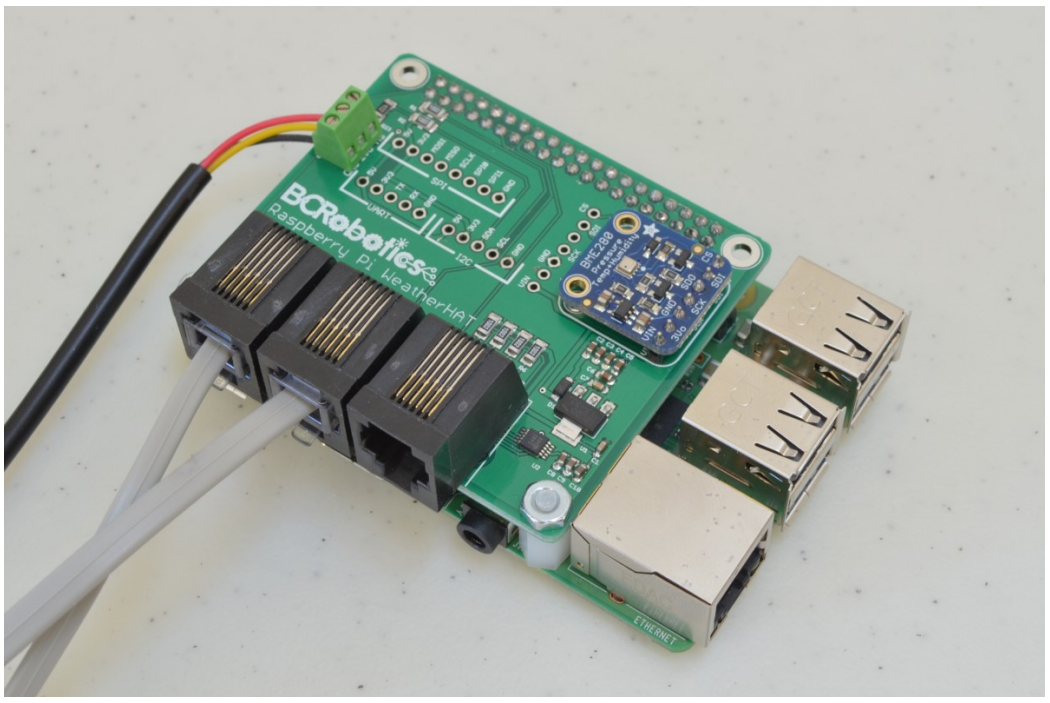


Connecting these sensors is quite straight forward – if you look carefully, one of the two RJ11 plugs at the end of their cables has 4 wires in it, while the other has two. Plug the 4 wire line into the "Wind" plug on the Weather Board, plug the 2 wire line into the "Rain" plug.

Step 11 – Double Check Your Work!

Before we power anything up, it is always a good idea to go through and make sure there are no issues with the work that has been done. Make sure all the solder joints are clean, with no un-intended

bridging. Check to make sure all the sensors are plugged in correctly, add the two standoffs as shown, and connect the board to the Raspberry Pi. If using the Raspberry Pi 3+ be sure to check the POE header (located near the USB ports) is not contacting the header from the BME280 header between the Pi and the Pi Weather Board.



In the next section of this tutorial we will be getting the Raspberry Pi set up with the Raspbian operating system, installing software libraries for each sensor, and writing some basic Python code to read the sensor outputs. Ready to tackle it? Head over to Part 2!

[info]Have A Question?

If you have any questions, or need further clarification please post in the comments section below; this way future users of this tutorial can see the questions and answers!

[/info]

28 THOUGHTS ON “RASPBERRY PI WEATHER STATION – PART 1”

SCOOBYTOO

June 27, 2018

Reply

What is the timing on the second part. Can you provide the starting point with what software libraries your going to use.

CHRIS @ BCR

June 27, 2018

Reply

We are going to use the Adafruit ADS1x15 library and the Adafruit BME280 library – detailed tutorial should be out in a couple weeks

LOUIS DE LANGE

October 17, 2018

Reply

Apart from the issue of mounting the weatherboard on the Pi, is there any reason why this project cannot be done with the Pi Zero W?

FRONT DESK @ BCR

October 17, 2018

Reply

Louis, aside from mounting, no there isn’t any reason you couldn’t go with the Pi Zero (or an A+ with a Wifi dongle for that matter). With the Zero you could probably look at reversing how the boards stack (if you haven’t soldered the Zero header already) and just mount the weatherboard with the zero above (or off to the side using a right angle header https://bc-robotics.com/shop/2-x-20-right-angle-header/) – Just be careful with the pin orientations in that case!

GARETH

April 3, 2019

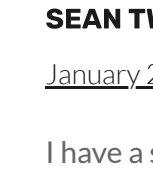
Reply

Is the Raspberry PI HAT hardware required (https://bc-robotics.com/shop/raspberry-pi-hat-hardware/)
I can't see this as part of the instructions.

GARETH Reply

May 16, 2019

Hi,
What does the Raspberry PI Hat hardware do? I see it's listed as part of the components, but not part of the tutorial.



CHRIS @ BCR Reply

May 17, 2019

HAT hardware is designed to keep the board from contacting the Raspberry Pi – and keep everything firmly connected – a good idea to have!

RONNY P. Reply

January 14, 2020

I have a Raspberry Pi Model B revision 2.0 from 2012 lying around. Can this one be used to build a weather station as described in the tutorial?

CHRIS @ BCR Reply

January 14, 2020

Hi Ronny,
Yes, any version with the 40 Pin GPIO header will work – you will just need to use an external USB WiFi adapter if you want to connect via WiFi

---

SEAN TWOMEY Reply

January 24, 2020

I have a super silly question to ask. To quote your text from above "A 4.7K Ohm Resistor is normally needed to between the 5V and Data Pin when using the sensor; this is taken care of by the Raspberry Pi Weather Board – so no need to wire one in!" I am trying to understand when I would need a resistor, and how to select the correct one for whatever piece I am trying to fit in. What happens if I have a few things wired in? This I know is a super basic question, but thats where I am at. Trying to learn this stuff. Also, I know in this case the weather shield handles he resistor needs in this case, my question was more a general query.
Thanks so much for putting this tutorial together. I am just now trying to fumble my way thru it. I've been wanting to do a weather station for a good long while now!

CHRIS @ BCR Reply

January 25, 2020

Hey Sean,
In most cases, the item requiring the resistor would have information in its datasheet indicating what additional components are required to make it function. We mention it in the tutorial because it is very common for this sensor to ship with the required resistor in the package as well – which, in this case, is unneeded. Let us know if you have any additional questions!

SIMON Reply

June 22, 2020

This is about the DS18B20 proposed for the station. It is indicated from -10 ° C to + 85 ° C (± 0.5 ° C Accuracy). I would like to use this sensor in winter with temperatures of -40 ° C. What is Accuracy? Is it possible to use this sensor for such cold temperatures especially in Canada?

CHRIS @ BCR

Reply

June 29, 2020

It will handle -40, they claim right down to -55. From -10 to -29 they state an error margin of +/- 1 Degree , below -30 this increases to +/- 2 degrees.

DOUG

Reply

August 26, 2020

once you are below -30C a 2 degrees makes no difference, it's just COLD. lol

---

KENDRICK

Reply

September 23, 2020

Thanks for the great post. This has been on my TODO list for ages. I really appreciate the parts list and well documented instructions.

MARK

Reply

November 7, 2020

Hi, I have built the weather station which works when I manually start the Python code fine. the problem is it wont auto start. Any ideas for what I can try?

DAVE CHAPPELLE

Reply

January 12, 2021

You add it as a systemd service. Lots of basic tutorials on the internet to do this.

BRETT

Reply

March 20, 2021

Hi. I've set this all up on an older RPi 2B model. Getting the 'Unable to communicate with sensor, check permissions.' error and /sys/bus/w1/devices is empty. Green light showing on BME280. Any suggestions?

CHRIS @ BCR

Reply

March 20, 2021

Hey Brett,

Do you have 1-wire and i2c enabled in Raspi-config?

BRETT

Reply

March 20, 2021

Hi Chris. Yes so I figured that part out eventually and devices are showing up in /sys/bus/w1/devices. I've now got an issue with pip and Python 2.7, as Python 2.7 was EOL 2 months ago. It seems running the latest RPi OS + updates + python may not support these scripts without some python tweaking possibly as the BCRobotics-test-app.py is throwing errors. I am using the latest version of Raspberry Pi OS Lite if this helps.

BRETT

Reply

March 21, 2021

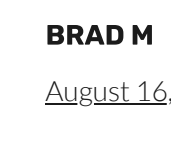
So bit of an update and sorry for the long post. I managed to start a fresh install but this time I made sure I used python3 for every install command, with a few other bits and pieces. I had to update about 2 lines of code in

BCRobotics.py ‘print “%s\r” % msg’ to ‘print (“%s\r” % msg)’ and add brackets to the very last line as well. My remaining issue is the ds18b20 sensor keeps dropping off and disappearing, causing the engine and StdReport to error out. The only way to temporarily fix this is to completely power down the Pi each time. I have tried 2 separate Pi’s and a 2nd HAT board too which I purchased, same result. Suggestions welcome as I’m almost there □

JM Reply

April 19, 2021

Hello,
I have bought and received the weatherHat and I thank you.
I wish to “extend” this weather station (add sensors (UV, light, environment, air quality,…), Weewx website,…). For i2c,, no pb, Serial too. For analog, what is the pinout of the 3rd RJ12 ? 3 pairs to the 3 ADS1015 inputs ?



CHRIS @ BCR Reply

April 19, 2021

Hello,
The Analog port is pinned as follows:

Looking down on the connector from left to right:
– Pin 1 & 2: ADC Channel 2 (A1)
– Pin 3 & 4: ADC Channel 3 (A2)
– Pin 5 & 6: ADC Channel 4 (A3)

Pins 1,3,5 are GND pins, Pins 2,4,6 are tied to 3.3V through 10K resistors and their respective ADC input. The pullup resistors are easily removable:
– Channel 2: Remove R4
– Channel 3: Remove R5
– Channel 4: Remove R6

Let us know if you have any further questions!

BRAD M Reply

August 16, 2021

Does the kit allow for additional sensors to be added, like a GPS sensor or Air Quality?

CHRIS @ BCR Reply

August 16, 2021

Hi Brad,
Yes – additional sensors can be added using the three headers in the top right corner of the board. We break out the UART, I2C, and SPI busses with complete with 3.3V or 5V power. Just insure everything maintains 3.3V logic level signals.

DAVE ALDOUS Reply

December 20, 2021

Where does the 4 Channel Analog to Digital Converter plug in to the weather board? Thanks.

CHRIS @ BCR Reply

December 21, 2021

Hi D

Hi Dave,

The 4 Channel ADC is built in to the board – there is no need to plug one in

---

DREW ROKEBY-THOMAS Reply

February 16, 2022

Is the 4 Channel ADC accessed via the analog phone jack port (can't remember the correct term)? Or what is the pinout for the analog port?

LEAVE A REPLY

Your email address will not be published.

Comment

Your Name *

Your Email *

Website

☐ **Save my name, email, and website in this browser for the next time I comment.**

Post Comment

Contact Us

Subscribe

We don't spam! Read our privacy policy for more info.

103 – 2052 Boxwood Road – Nanaimo BC, V9S5W7 – Canada