CircuitPython Libraries on Linux and ODROID C2

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https://learn.adafruit.com/circuitpython-libaries-linux-odroid-c2

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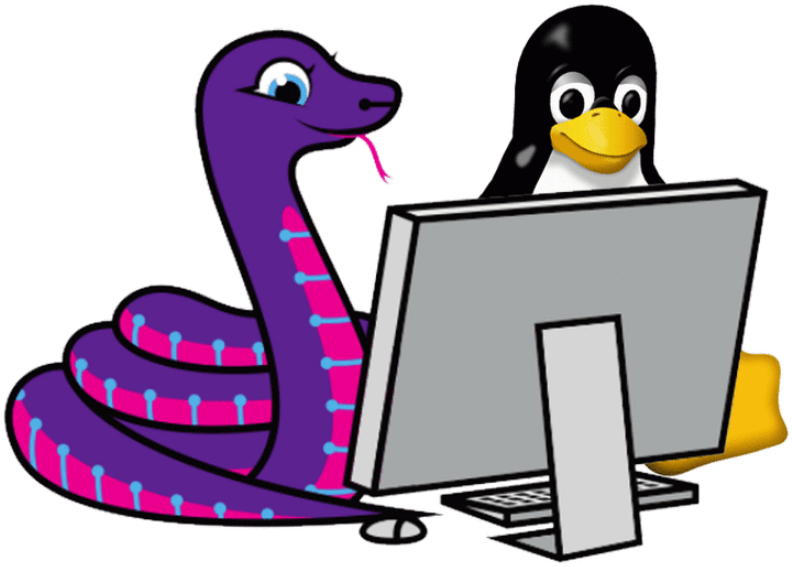
Overview

This guide describes using CircuitPython **libraries** on small Linux computers, running under regular Python. It is not about running the CircuitPython firmware itself on those boards.



Here at Adafruit we're always looking for ways to make making easier - whether that's making breakout boards for hard-to-solder sensors or writing libraries to simplify motor control. Our new favorite way to program is **CircuitPython**.

Why CircuitPython?

CircuitPython is a variant of MicroPython, a very small version of Python that can fit on a microcontroller. Python is the fastest-growing programming language. It's taught in schools, used in coding bootcamps, popular with scientists and of course programmers at companies use it a lot!

CircuitPython adds the Circuit part to the Python part. It lets you program in Python and talk to Circuitry like sensors, motors, and LEDs!

CircuitPython on Microcontrollers

CircuitPython runs on microcontroller boards, such as our Feather, Metro, QT Py, and ItsyBitsy boards, using a variety of chips, such as the MicroChip SAMD21 SAMD51, the Raspberry Pi RP2040, the Nordic nRF52840, and the Espressif ESP32-S2 and ESP32-S3.

All of these chips have something in common - they are microcontrollers with hardware peripherals like SPI, I2C, ADCs etc. We squeeze Python into 'em and can then make the project portable.

But...sometimes you want to do more than a microcontroller can do. Like HDMI video output, or camera capture, or serving up a website, or just something that takes more memory and computing than a microcontroller board can do...

CircuitPython Libraries on Desktop Linux

By adding a software layer, you can use CircuitPython hardware control capabilities with "regular Python", as found on your desktop or single-board Linux computer/ There are tons of projects, libraries and example code for CircuitPython on microcontrollers, and thanks to the flexibility and power of Python its' pretty easy to get that code working on micro-computers like the Raspberry Pi or other single-board Linux computers with GPIO pins available.

You'll use a special library called **adafruit_blinka** (https://adafru.it/BJS) (named after Blinka, the CircuitPython mascot (https://adafru.it/BJT)) that provides a layer that translates the CircuitPython hardware API to whatever library the Linux board provides. For example, on Raspberry Pi we use the python RPi.GPIO (https://adafru.it/BJU) library. For any I2C interfacing we'll use ioctl messages to the `/dev/i2c` device. For SPI we'll use the `spidev` python library, etc. These details don't matter so much because they all happen underneath the **adafruit_blinka** layer.

The upshot is that most code we write for CircuitPython will be instantly and easily runnable on Linux computers like Raspberry Pi.

In particular, you'll be able to use all of our device drivers - the sensors, led controllers, motor drivers, HATs, bonnets, etc. And nearly all of these use I2C or SPI!

The rest of this guide describes how to install and set up Blinka, and then how to use it to run CircuitPython code to control hardware.

Running CircuitPython Code without CircuitPython

There are two parts to the CircuitPython ecosystem:

- **CircuitPython firmware**, written in C and built to run on various microcontroller boards (not PCs). The firmware includes the CircuitPython interpreter, which reads and executes CircuitPython programs, and chip-specific code that controls the hardware peripherals on the microcontroller, including things like USB, I2C, SPI, GPIO pins, and all the rest of the hardware features the chip provides.

- **CircuitPython libraries,** written in Python to use the native (built into the firmware) modules provided by CircuitPython to control the microcontroller peripherals and interact with various breakout boards.

But suppose you'd like to use CircuitPython **libraries** on a board or computer that does not have a native CircuitPython **firmware** build. For example, on a PC running Windows or macOS. Can that be done? The answer is yes, via a separate piece of software called **Blinka**. Details about Blinka follow, however it is important to realize that the **CircuitPython firmware is never used**.

CircuitPython firmware is NOT used when using Blinka.

Adafruit Blinka: a CircuitPython Compatibility Library

Enter **Adafruit Blinka**. Blinka is a software library that emulates the parts of CircuitPython that control hardware. Blinka provides non-CircuitPython implementations for `board`, `busio`, `digitalio`, and other native CircuitPython modules. You can then write Python code that looks like CircuitPython and uses CircuitPython libraries, without having CircuitPython underneath.

There are multiple ways to use Blinka:

- Linux based Single Board Computers, for example a Raspberry Pi
- Desktop Computers + specialized USB adapters
- Boards running MicroPython

More details on these options follow.

Raspberry Pi and Other Single-Board Linux Computers

On a Raspberry Pi or other single-board Linux computer, you can use Blinka with the regular version of Python supplied with the Linux distribution. Blinka can control the hardware pins these boards provide.

Desktop Computers

On Windows, macOS, or Linux desktop or laptop ("host") computers, you can use special USB adapter boards that that provide hardware pins you can control. These

boards include MCP221A (https://adafru.it/lfV) and FT232H (https://adafru.it/xia) breakout boards, and Raspberry Pi Pico boards running the **u2if** software (https://adafru.it/Sje). These boards connect via regular USB to your host computer, and let you do GPIO, I2C, SPI, and other hardware operations.

MicroPython

You can also use Blinka with MicroPython, on MicroPython-supported boards (https://adafru.it/SBi). Blinka will allow you to import and use CircuitPython libraries in your MicroPython program, so you don't have to rewrite libraries into native MicroPython code. Fun fact - this is actually the original use case for Blinka.

Installing Blinka

Installing Blinka on your particular platform is covered elsewhere in this guide. The process is different for each platform. Follow the guide section specific to your platform and make sure Blinka is properly installed before attempting to install any libraries.

> Be sure to install Blinka before proceeding.

Installing CircuitPython Libraries

Once Blinka is installed the next step is to install the CircuitPython libraries of interest. How this is down is different for each platform. Here are the details.

Linux Single-Board Computers

On Linux single-board computers, such as Raspberry Pi, you'll use the Python `pip3` program (sometimes named just `pip`) to install a library. The library will be downloaded from pypi.org (https://adafru.it/19ff) automatically by `pip3`.

How to install a particular library using `pip3` is covered in the guide page for that library. For example, here is the `pip3` installation information (https://adafru.it/OkF) for the library for the LIS3DH accelerometer.

The library name you give to `pip3` is usually of the form `adafruit-circuitpython-*libraryname*`. This is not the name you use with `import`. For example, the LIS3DH sensor library is known by several names:

- The GitHub library repository is Adafruit_CircuitPython_LIS3DH (https://adafru.it/uBs).
- When you import the library, you write `import adafruit_lis3dh`.
- The name you use with `pip3` is `adafruit-circuitpython-lis3dh`. This the name used on pypi.org (https://adafru.it/19ff).

Libraries often depend on other libraries. When you install a library with `pip3`, it will automatically install other needed libraries.

Desktop Computers using a USB Adapter

When you use a desktop computer with a USB adapter, like the MCP2221A, FT232H, or u2if firmware on an RP2040, you will also use pip3. However, **do not install the library with** `sudo pip3`, as mentioned in some guides. Instead, just install with `pip3`.

MicroPython

For MicroPython, you will not use `pip3`. Instead you can get the library from the CircuitPython bundles. See this guide page (https://adafru.it/ABU) for more information about the bundles, and also see the Libraries page on circuitPython.org (https://adafru.it/ENC).

CircuitPython & ODROID

CircuitPython Libraries on Linux & ODROID

The next obvious step is to bring CircuitPython ease of use **back** to 'desktop Python'. We've got tons of projects, libraries and example code for CircuitPython on microcontrollers, and thanks to the flexibility and power of Python its pretty easy to get it working with micro-computers like ODROID or other 'Linux with GPIO pins available' single board computers.

We'll use a special library called **adafruit_blinka** (https://adafru.it/BJS) (named after Blinka, the CircuitPython mascot (https://adafru.it/BJT)) to provide the layer that translates the CircuitPython hardware API to whatever library the Linux board provides. For example, on ODROID we use the python **libgpiod** bindings. For any I2C interfacing we'll use ioctl messages to the `/dev/i2c` device. These details don't matter so much because they all happen underneath the **adafruit_blinka** layer.

The upshot is that any code we have for CircuitPython will be instantly and easily runnable on Linux computers like ODROID.

In particular, we'll be able to use all of our device drivers - the sensors, led controllers, motor drivers, HATs, bonnets, etc. And nearly all of these use I2C or SPI!

Wait, isn't there already something that does this - libgpiod?

libgpiod is a python hardware interface class (https://adafru.it/FNd) that works on ODROID, it works just fine for I2C, SPI and GPIO but doesn't work with our drivers as its a different API

By letting you use CircuitPython libraries on ODROID via **adafruit_blinka**, you can unlock all of the drivers and example code we wrote! And you can keep using **libgpiod** if you like. We save time and effort so we can focus on getting code that works in one place, and you get to reuse all the code we've written already.

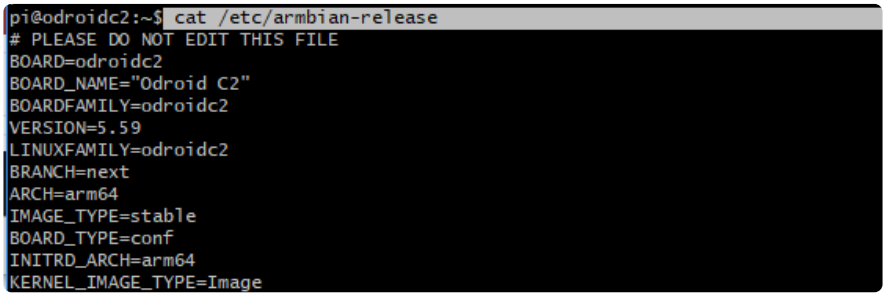
What about other Linux SBCs?

Yep! Blinka can easily be updated to add other boards. We've started with the one we've got, so we could test it thoroughly. If you have other SBC board you'd like to adapt check out the adafruit_blinka code on github (https://adafru.it/BJX), pull requests are welcome as there's a ton of different Linux boards out there!

Initial Setup

Blinka supports the ODROID C2, C4, M1, M1S, N2, XU4, and XU4Q boards. To see a complete list of supported ODROID boards, visit https://circuitpython.org/blinka?q=odroid.

At any time after armbian is installed, it's easy to tell what board you have: simply **cat / etc/armbian-release** and look for `BOARD_NAME`



Install ARMbian on your ODROID C2

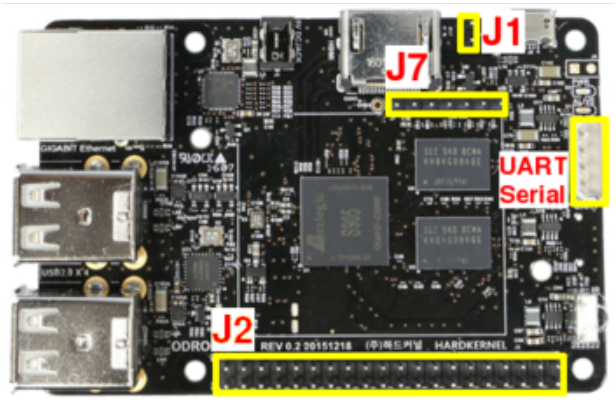
We're only going to be using armbian, other distros could be made to work but you'd probably need to figure out how to detect the platform since we rely on `/etc/armbian-release` existing. Using other operating systems and CircuitPython is your call, we cannot provide support for that.

Download and install the latest armbian, for example we're using https://www.armbian.com/odroid-c2/ (https://adafru.it/F0P)

There's some documentation to get started at https://docs.armbian.com/User-Guide_Getting-Started/ (https://adafru.it/Dby)

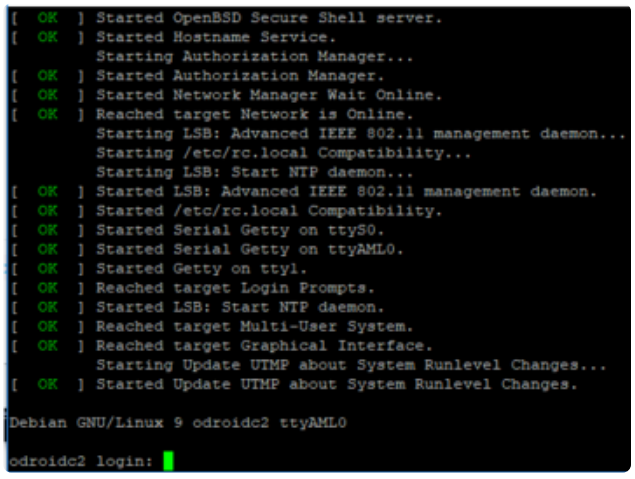
Blinka only supports ARMbian because that's the most stable OS we could find and it's easy to detect which board you have

Logging in

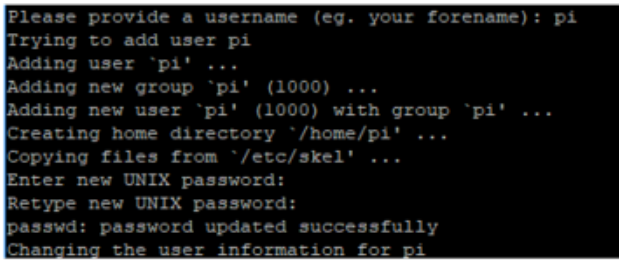


We've found the easiest way to connect is through a console cable, wired to the **UART Serial** port, and then on your computer, use a serial monitor at **115200** baud.

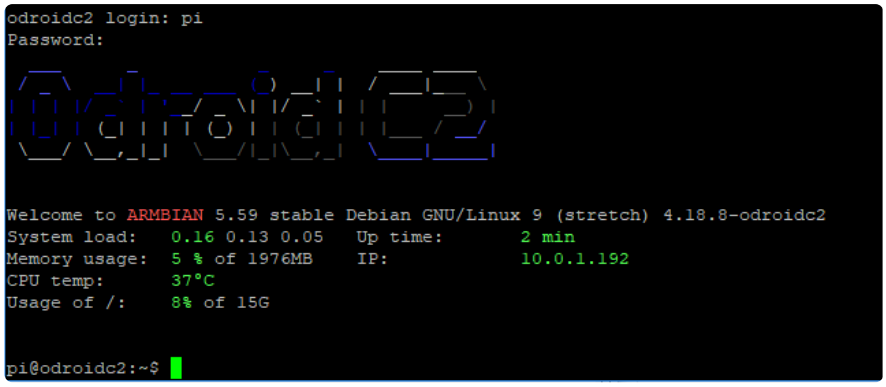
[USB to TTL Serial Cable - Debug / Console Cable for Raspberry Pi]
The cable is easiest way ever to connect to your microcontroller/Raspberry Pi/WiFi router serial console port. Inside the big USB plug is a USB<->Serial conversion chip and at...
https://www.adafruit.com/product/954



Once powered correctly and with the right SD card you should get a login prompt



After logging in you may be asked to create a new username, we recommend **pi** - if our instructions end up adding gpio access for the pi user, you can copy and paste them.



Once installed, you may want to enable mdns so you can ssh `pi@odroidc2.local` instead of needing to know the IP address:

```
sudo apt-get install avahi-daemon
```

then **reboot**

Update Your Packages

Run the standard updates:

```
sudo apt-get update
sudo apt-get upgrade
```

Install Python and set Python 3 to Default

There's a few ways to do this. Since Python 2 is no longer installed by default, we recommend something like this:

```
sudo apt-get install -y python3 git python3-pip
sudo update-alternatives --install /usr/bin/python python $(which python3) 2
```

This will make it so typing `python` runs `python3`.

Update Python Packages

```
sudo pip3 install --upgrade setuptools
```

Update all your Python 3 packages with

```
pip3 freeze - local | grep -v '^\-e' | cut -d = -f 1 | xargs -n1 pip3 install -U
```

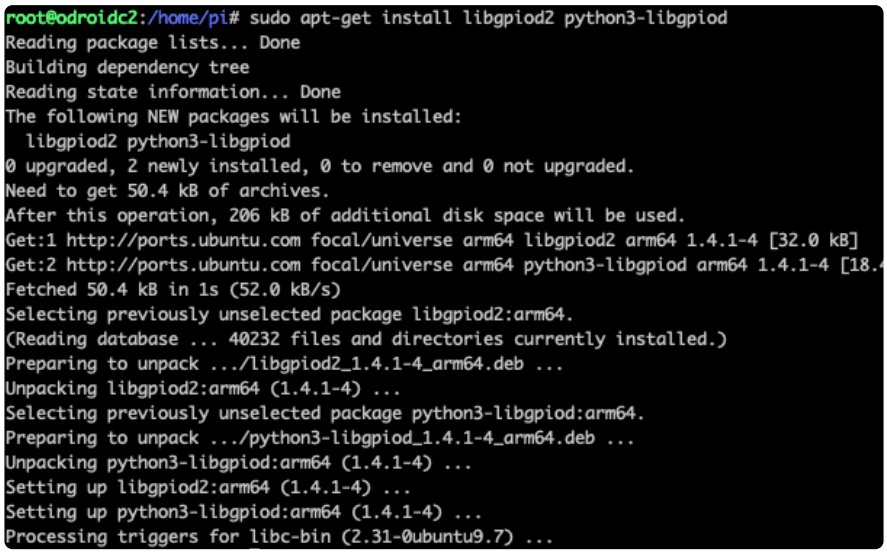
and

```
sudo bash
pip3 freeze - local | grep -v '^\-e' | cut -d = -f 1 | xargs -n1 pip3 install -U
```

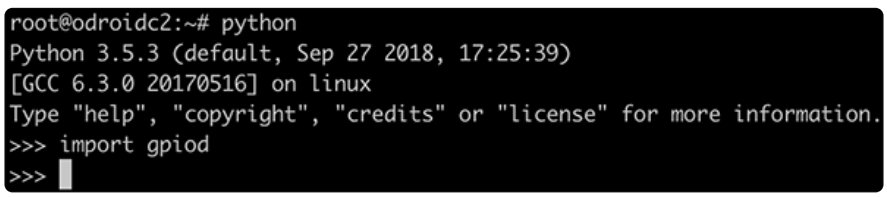
Install libgpiod

libgpiod is what we use for gpio toggling. To install run this command:

```
sudo apt-get install libgpiod2
pip3 install gpiod
```



After installation, you should be able to `import gpiod` from within Python 3:



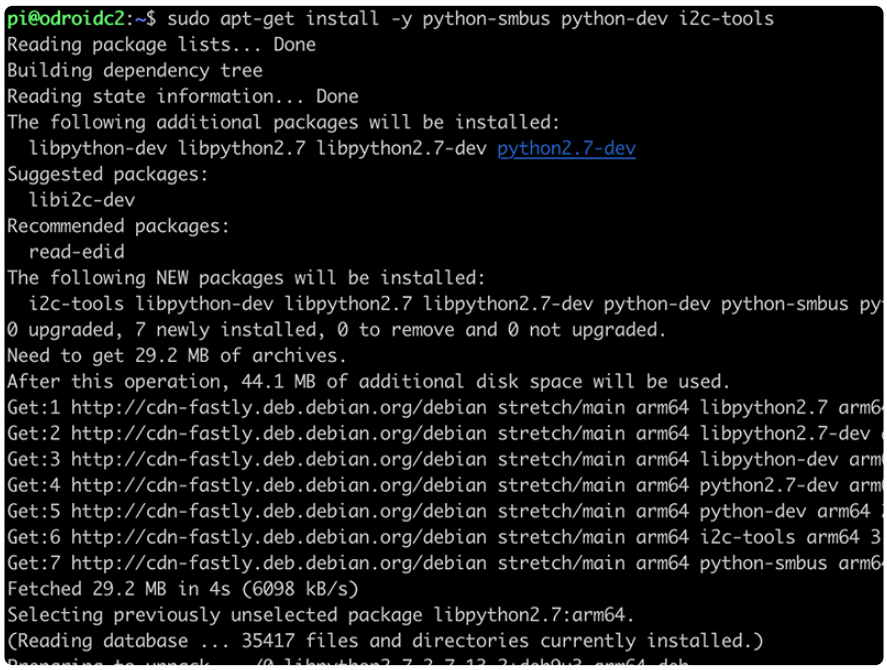
Enable UART, I2C and SPI

A vast number of our CircuitPython drivers use UART, I2C and SPI for interfacing, so you'll want to get those enabled.

You only have to do this once per board, unfortunately by default all three interfaces are disabled!

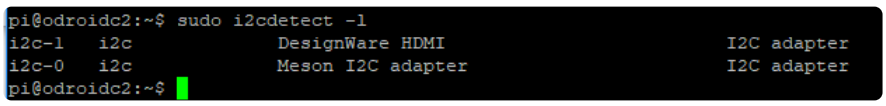
Install the support software with:

```
sudo apt-get install -y python3-smbus python3-dev i2c-tools
sudo adduser pi i2c
```



The ODROID C2 does not have a hardware peripheral, but I2C is enabled by default, so if you run `ls /dev/i2c*`

You should see at least one i2c device.



Because the ODROID C2 is a newer board, currently /dev/ttyAML1 isn't working properly.

The UART Serial Port on the ODROID C2 is connected to **/dev/ttyAML0**. To enable the GPIO UART, edit **/boot/armbianEnv.txt** and add this line to the end.

`overlays=uartA`

```
verbosity=1
overlay_prefix=meson
rootdev=UUID=ea050601-f7ba-49e6-8a99-2e32876a9d53
rootfstype=ext4
usbstoragequirks=0x2537:0x1066:u,0x2537:0x1068:u
overlays=uartA
```

After you have rebooted, verify that **/dev/ttyAML1** is now enabled by typing:

```
ls /dev/ttyA*
```

```
pi@odroidc2:~$ ls /dev/ttyA*
/dev/ttyAML0  /dev/ttyAML1
pi@odroidc2:~$
```

Even though the ODROID C2 has SPI, both of the hardware CS lines are in use, making it unavailable

Install Python Libraries

Now you're ready to install all the Python support.

Run the following command to install **adafruit_blinka**:

```
sudo pip3 install adafruit-blinka
```

```
pi@odroidc2:~$ sudo pip3 install adafruit-blinka
Collecting adafruit-blinka
Collecting sysv-ipc; platform_system != "Windows" (from adafruit-blinka)
  Using cached https://files.pythonhosted.org/packages/08/7d/a862f3045fa191eee
Collecting spidev; sys_platform == "linux" (from adafruit-blinka)
  Using cached https://files.pythonhosted.org/packages/fb/14/4c2e1640f0cb04862
Collecting Adafruit-PlatformDetect (from adafruit-blinka)
  Using cached https://files.pythonhosted.org/packages/b3/10/38ad70e947e65b929
z
Collecting Adafruit-PureIO (from adafruit-blinka)
  Using cached https://files.pythonhosted.org/packages/b9/34/e8e6b4ee910d3682d
Building wheels for collected packages: sysv-ipc, spidev, Adafruit-PlatformDet
  Running setup.py bdist_wheel for sysv-ipc ... done
  Stored in directory: /root/.cache/pip/wheels/ac/d6/50/727b88e350038cef49d927
  Running setup.py bdist_wheel for spidev ... done
  Stored in directory: /root/.cache/pip/wheels/10/d6/98/ba1f1999099e3e7adb3a01
  Running setup.py bdist_wheel for Adafruit-PlatformDetect ... done
  Stored in directory: /root/.cache/pip/wheels/3c/fc/26/e3f79b4bfafd5bcc9f3e17
  Running setup.py bdist_wheel for Adafruit-PureIO ... done
  Stored in directory: /root/.cache/pip/wheels/0d/fa/4e/e8b8870dda9c8a049290ed
Successfully built sysv-ipc spidev Adafruit-PlatformDetect Adafruit-PureIO
Installing collected packages: sysv-ipc, spidev, Adafruit-PlatformDetect, Adaf
Successfully installed Adafruit-PlatformDetect-1.0.4 Adafruit-PureIO-0.2.3 ada
pi@odroidc2:~$
```

The computer will install a few different libraries such as `adafruit-pureio` (our ioctl-only i2c library), `Adafruit-GPIO` (for detecting your board) and of course `adafruit-blinka`.

That's pretty much it! You're now ready to test.

Create a new file called **blinkatest.py** with **nano** or your favorite text editor and put the following in:

```
import board
import digitalio
import busio

print("Hello blinka!")

# Try to great a Digital input
pin = digitalio.DigitalInOut(board.D7)
print("Digital IO ok!")

# Try to create an I2C device
i2c = busio.I2C(board.SCL, board.SDA)
print("I2C ok!")

# Try to create an SPI device
#spi = busio.SPI(board.SCLK, board.MOSI, board.MISO)
#print("SPI ok!")

print("done!")
```

Save it and run at the command line with

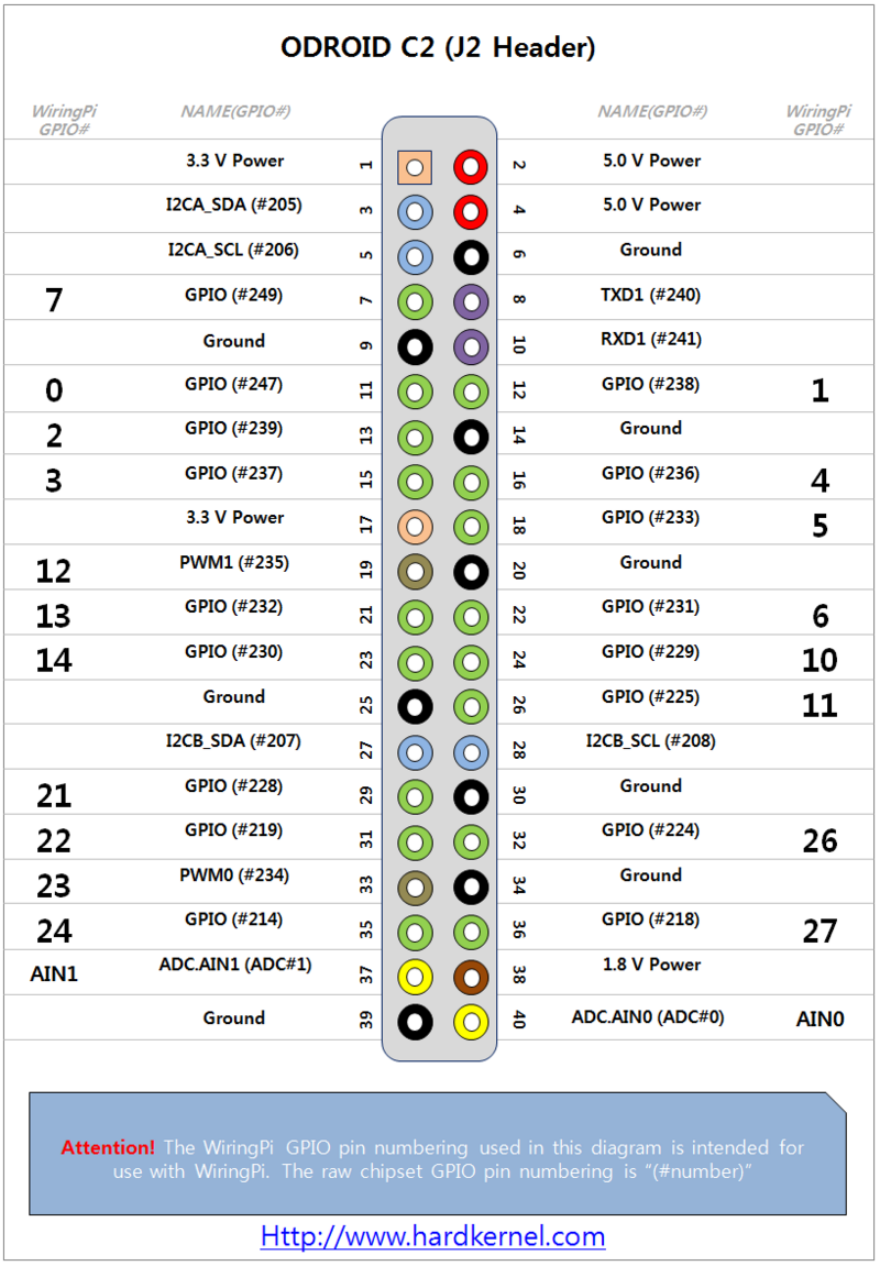
`sudo python3 blinkatest.py`

You should see the following, indicating digital i/o, I2C and SPI all worked

```
pi@odroidc2:~$ sudo python3 blinkatest.py
Hello blinka!
Digital IO ok!
I2C ok!
SPI ok!
done!
pi@odroidc2:~$
```

Digital I/O

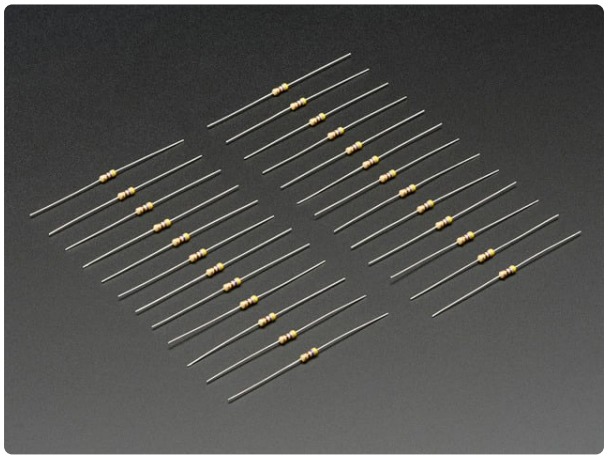
The first step with any new hardware is the 'hello world' of electronics - blinking an LED. This is very easy with CircuitPython and ODROID. We'll extend the example to also show how to wire up a button/switch.



Parts Used

Any old LED will work just fine as long as it's not an IR LED (you can't see those) and a 470 to 2.2K resistor

Diffused Blue 10mm LED (25 pack)
Need some big indicators? We are big fans of these huge diffused blue LEDs. They are really bright so they can be seen in daytime, and from any angle. They go easily into a breadboard...
https://www.adafruit.com/product/847

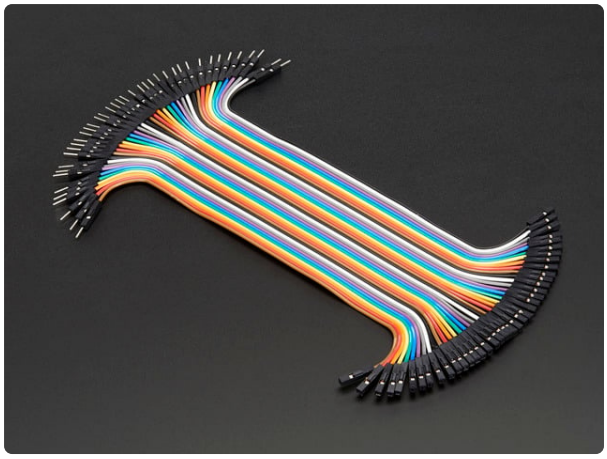


Through-Hole Resistors - 470 ohm 5% 1/4W - Pack of 25
ΩMG! You're not going to be able to resist these handy resistor packs! Well, axially, they do all of the resisting for you!This is a 25 Pack of...
https://www.adafruit.com/product/2781

Some tactile buttons or switches:

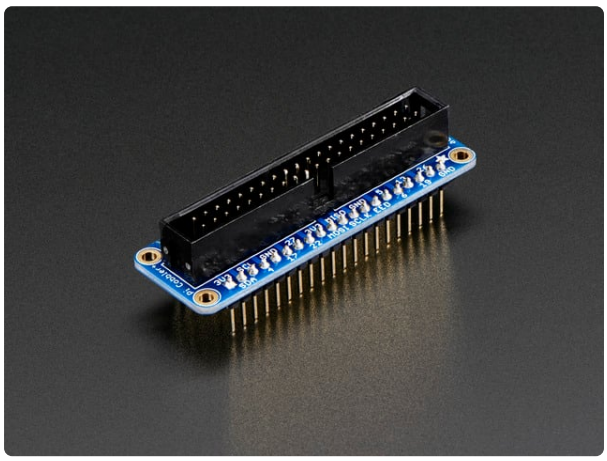
Tactile Switch Buttons (12mm square, 6mm tall) x 10 pack
Medium-sized clicky momentary switches are standard input "buttons" on electronic projects. These work best in a PCB but
https://www.adafruit.com/product/1119

We recommend using a breadboard and some female-male wires.

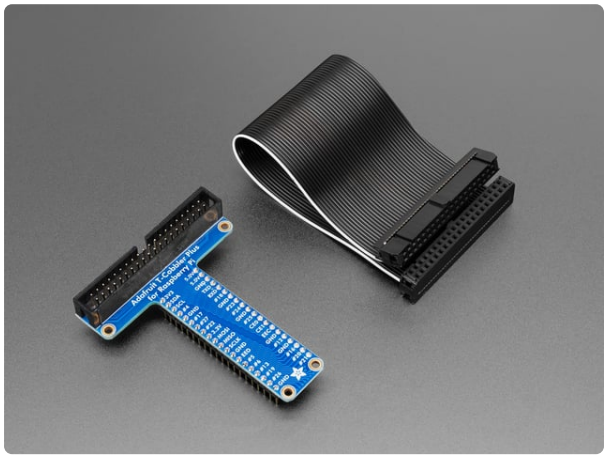


Premium Female/Male 'Extension' Jumper Wires - 40 x 6" (150mm)
Handy for making wire harnesses or jumpering between headers on PCB's. These premium jumper wires are 6" (150mm) long and come in a 'strip' of 40 (4 pieces of each of...
https://www.adafruit.com/product/826

You can use a Cobbler to make this a little easier, the pins will be labeled according to Raspberry Pi names so just check the ODROID name!



Adafruit Pi Cobbler + Kit- Breakout Cable for Pi B+/A+/Pi 2/Pi 3
The Raspberry Pi B+ has landed on the Maker World like a 40-GPIO pinned, quad-USB ported, credit card sized bomb of DIY joy. And while you can use most of our great Model B accessories...
https://www.adafruit.com/product/1990



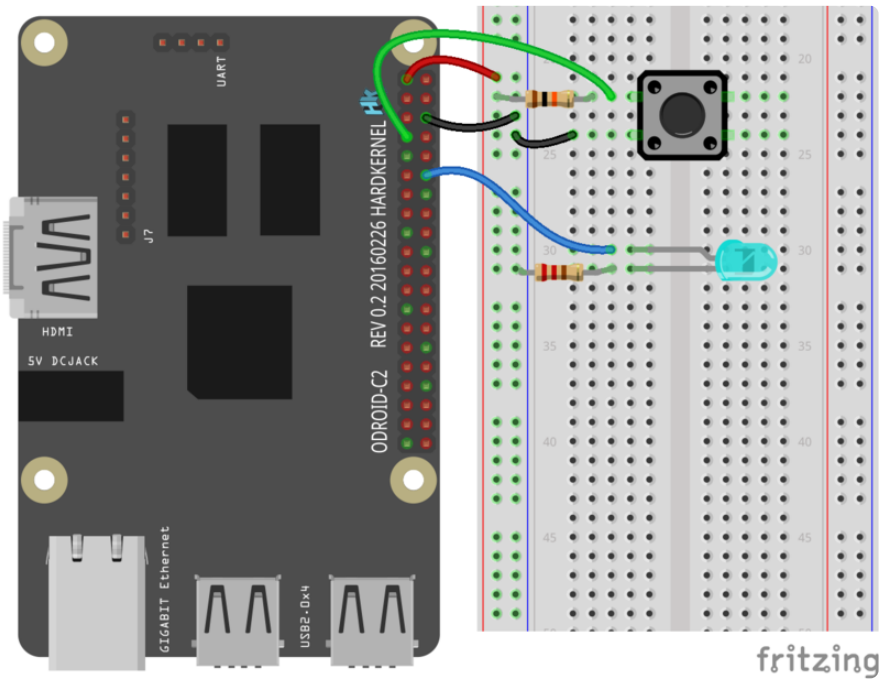
Assembled Pi T-Cobbler Plus - GPIO Breakout
This is the assembled version of the Pi T-Cobbler Plus. It only works with the Raspberry Pi Model Zero, A+, B+, Pi 2, Pi 3 & Pi 4! (Any Pi with 2x20...
https://www.adafruit.com/product/2028

Wiring

Connect the ODROID **Ground** pin to the **blue ground rail** on the breadboard.

- Connect one side of the tactile switch to ODROID **GPIO 249** which is also called **D7**
- Connect a ~10K pull up resistor from **D7** to **3.3V**

- Connect the other side of the tactile switch to the **ground** rail
- Connect the longer/positive pin of the LED to ODROID **GPIO 238** which is also called **D1**
- Connect the shorter/negative pin of the LED to a 470ohm to 2.2K resistor, the other side of the resistor goes to **ground** rail



odroid_digitalio.fzz

https://adafru.it/F1T

Double-check you have the right wires connected to the right location, it can be tough to keep track of GPIO pins as there are forty of them!

No additional libraries are needed so we can go straight on to the example code

However, we recommend running a pip3 update!

```
sudo pip3 install --upgrade adafruit_blinka
```

Blinky Time!

The finish line is right up ahead, lets start with an example that blinks the LED on and off once a second (half a second on, half a second off):

```
import time
import board
import digitalio

print("hello blinky!")

led = digitalio.DigitalInOut(board.D1)
```

```
led.direction = digitalio.Direction.OUTPUT

while True:
    led.value = True
    time.sleep(0.5)
    led.value = False
    time.sleep(0.5)
```

Verify the LED is blinking. If not, check that it's wired to **GPIO 238** or **D1**, the resistor is installed correctly, and you have a Ground wire to the ODROID.

Type Control-C to quit

Button It Up

Now that you have the LED working, lets add code so the LED turns on whenever the button is pressed

```
import time
import board
import digitalio

print("press the button!")

led = digitalio.DigitalInOut(board.D1)
led.direction = digitalio.Direction.OUTPUT

button = digitalio.DigitalInOut(board.D7)
button.direction = digitalio.Direction.INPUT
# use an external pullup since we don't have internal PU's
#button.pull = digitalio.Pull.UP

while True:
    led.value = not button.value # light when button is pressed!
```

Press the button - see that the LED lights up!

Type Control-C to quit

I2C Sensors & Devices

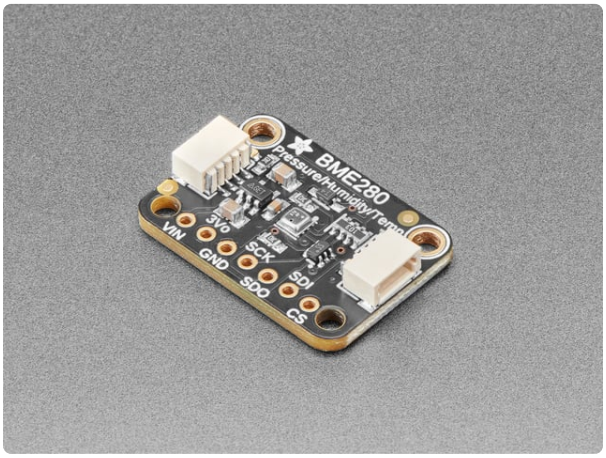
The most popular electronic sensors use I2C to communicate. This is a 'shared bus' 2 wire protocol, you can have multiple sensors connected to the two SDA and SCL pins as long as they have unique addresses (check this guide for a list of many popular devices and their addresses (https://adafru.it/BK0))

Lets show how to wire up a popular BME280. This sensor provides temperature, barometric pressure and humidity data over I2C

We're going to do this in a lot more depth than our guide pages for each sensor, but the overall technique is basically identical for any and all I2C sensors.

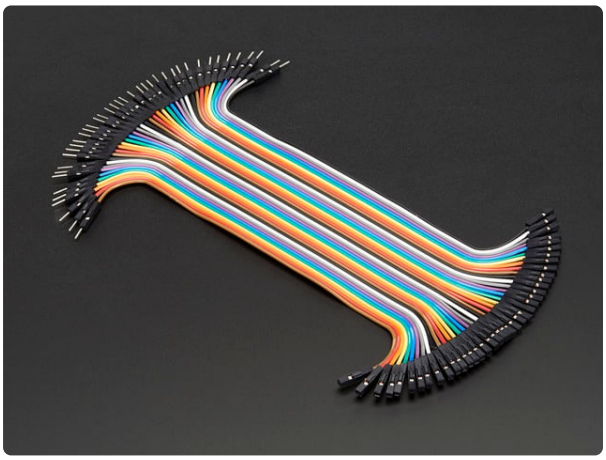
Honestly, the hardest part of using I2C devices is figuring out the I2C address (https://adafru.it/BK0) and which pin is SDA and which pin is SCL!

Parts Used



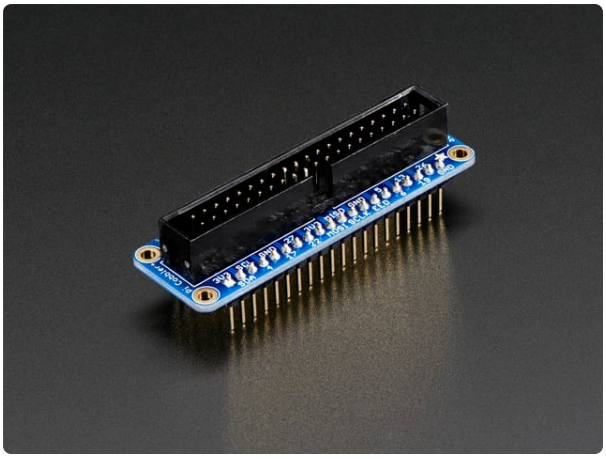
Adafruit BME280 I2C or SPI Temperature Humidity Pressure Sensor
Bosch has stepped up their game with their new BME280 sensor, an environmental sensor with temperature, barometric pressure and humidity! This sensor is great for all sorts...
https://www.adafruit.com/product/2652

We recommend using a breadboard and some female-male wires.

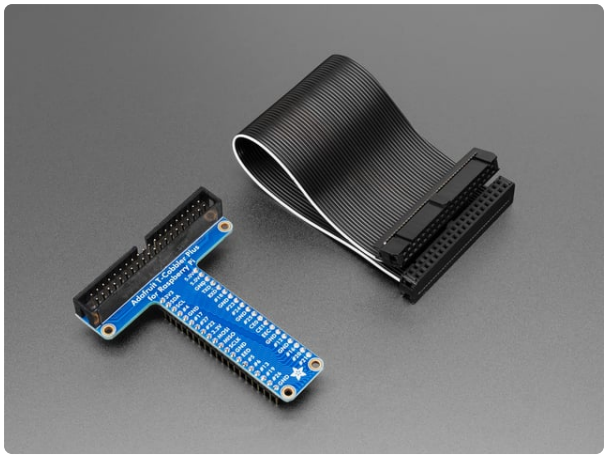


Premium Female/Male 'Extension' Jumper Wires - 40 x 6" (150mm)
Handy for making wire harnesses or jumpering between headers on PCB's. These premium jumper wires are 6" (150mm) long and come in a 'strip' of 40 (4 pieces of each of...
https://www.adafruit.com/product/826

You can use a Cobbler to make this a little easier, the pins are then labeled!



Adafruit Pi Cobbler + Kit- Breakout Cable for Pi B+/A+/Pi 2/Pi 3
The Raspberry Pi B+ has landed on the Maker World like a 40-GPIO pinned, quad-USB ported, credit card sized bomb of DIY joy. And while you can use most of our great Model B accessories...
https://www.adafruit.com/product/1990



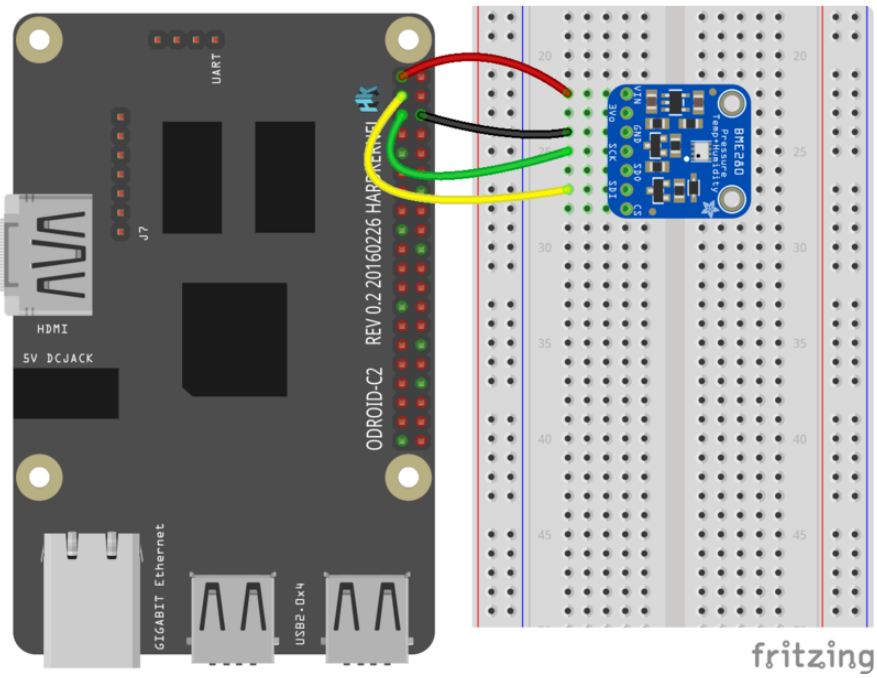
Assembled Pi T-Cobbler Plus - GPIO Breakout

This is the assembled version of the Pi T-Cobbler Plus. It only works with the Raspberry Pi Model Zero, A+, B+, Pi 2, Pi 3 & Pi 4! (Any Pi with 2x20...

https://www.adafruit.com/product/2028

Wiring

- Connect the ODROID **3.3V** power pin to **Vin**
- Connect the ODROID **GND** pin to **GND**
- Connect the Pi **SDA** pin to the BME280 **SDI**
- Connect the Pi **SCL** pin to to the BME280 **SCK**

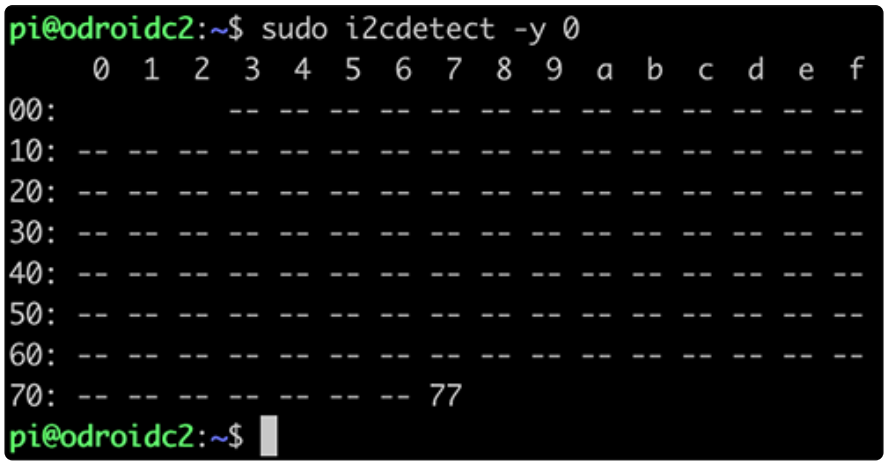


odroid_bme280.fzz

https://adafru.it/F1U

Double-check you have the right wires connected to the right location, it can be tough to keep track of Pi pins as there are forty of them!

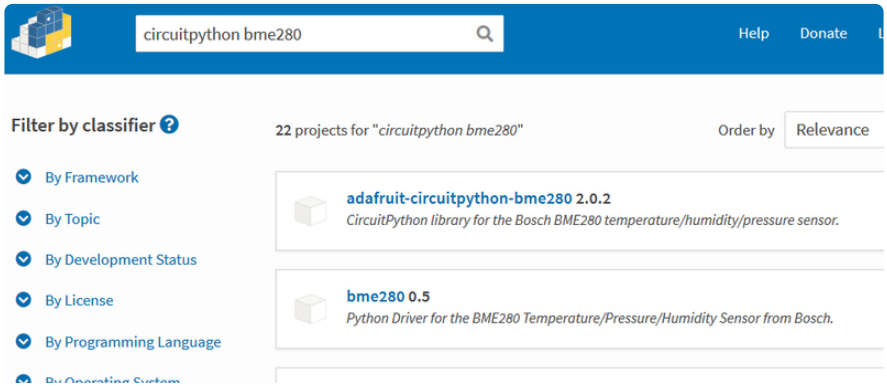
After wiring, we recommend running I2C detection with `sudo i2cdetect -y 0` to verify that you see the device, in this case its address **77**



Install the CircuitPython BME280 Library

OK onto the good stuff, you can now install the Adafruit BME280 CircuitPython library.

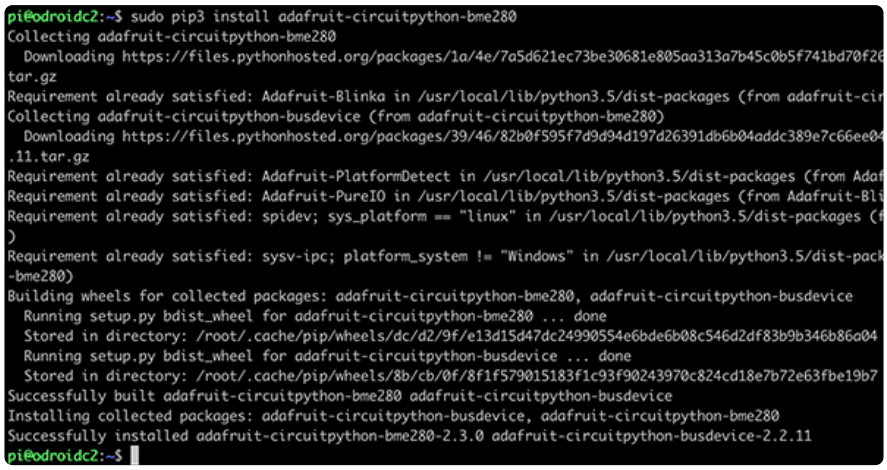
As of this writing, not all libraries are up on PyPI so you may want to search before trying to install. Look for **circuitpython** and then the driver you want.



(If you don't see it [you can open up a github issue on circuitpython to remind us (https://adafru.it/tB7)](https://adafru.it/tB7)!)

Once you know the name, install it with

```
sudo pip3 install adafruit-circuitpython-bme280
```



You'll notice we also installed a dependancy called **adafruit-circuitpython-busdevice**. This is a great thing about pip, if you have other required libraries they'll get installed too!

We also recommend an adafruit-blinka update in case we've fixed bugs:

```
sudo pip3 install --upgrade adafruit_blinka
```

Run that code!

The finish line is right up ahead. You can now run one of the (many in some cases) example scripts we've written for you.

Check out the examples for your library by visiting the repository for the library and looking in the example folder. In this case, it would be https://github.com/adafruit/Adafruit_CircuitPython_BME280/tree/master/examples (https://adafru.it/BK1)

As of this writing there's only two examples. Here's the first one:

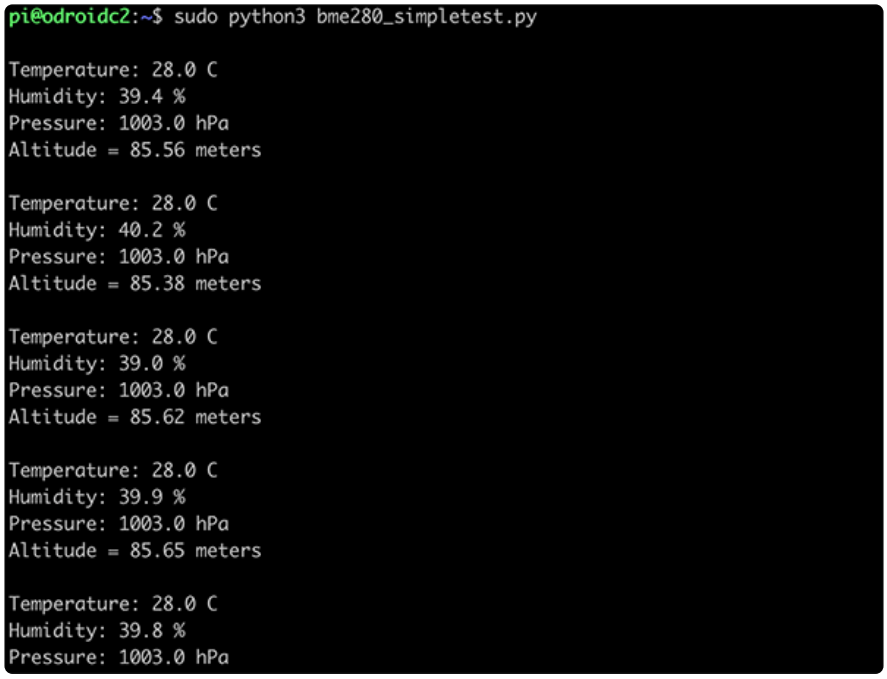
```
import time

import board
import busio
import adafruit_bme280

# Create library object using our Bus I2C port
i2c = busio.I2C(board.SCL, board.SDA)
bme280 = adafruit_bme280.Adafruit_BME280_I2C(i2c)

# OR create library object using our Bus SPI port
#spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
#bme_cs = digitalio.DigitalInOut(board.D10)
#bme280 = adafruit_bme280.Adafruit_BME280_SPI(spi, bme_cs)

# change this to match the location's pressure (hPa) at sea level
bme280.sea_level_pressure = 1013.25

while True:
    print("\nTemperature: %0.1f C" % bme280.temperature)
    print("Humidity: %0.1f %%" % bme280.humidity)
    print("Pressure: %0.1f hPa" % bme280.pressure)
```

```
    print("Altitude = %0.2f meters" % bme280.altitude)
    time.sleep(2)
```

Save this code to your ODROID by copying and pasting it into a text file, downloading it directly from the ODROID, etc.

Then in your command line run

`sudo python3 bme280_simpletest.py`



The code will loop with the sensor data until you quit with a Control-C

Here's the second example:

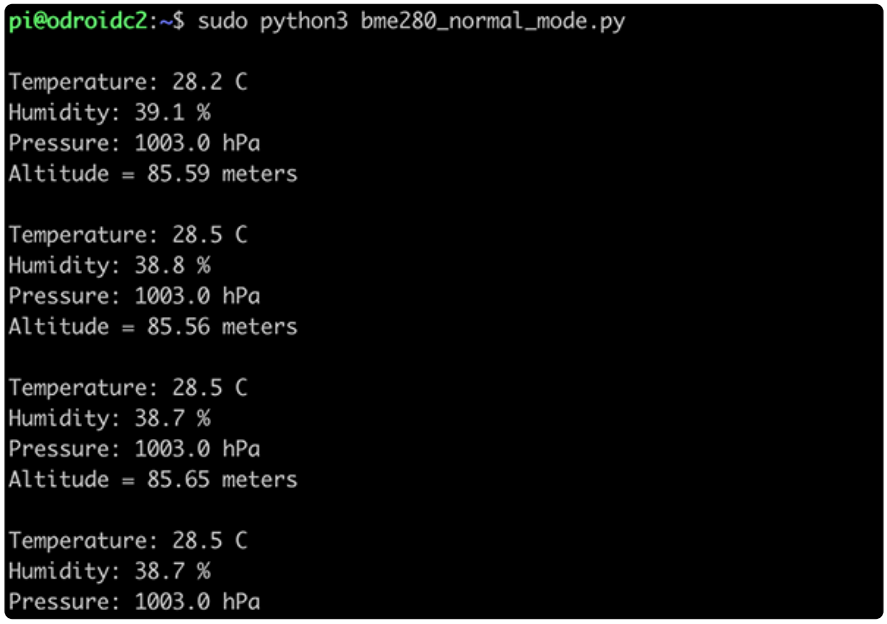
```
"""
Example showing how the BME280 library can be used to set the various
parameters supported by the sensor.
Refer to the BME280 datasheet to understand what these parameters do
"""
import time

import board
import busio
import adafruit_bme280

# Create library object using our Bus I2C port
i2c = busio.I2C(board.SCL, board.SDA)
bme280 = adafruit_bme280.Adafruit_BME280_I2C(i2c)

# OR create library object using our Bus SPI port
#spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
#bme_cs = digitalio.DigitalInOut(board.D10)
#bme280 = adafruit_bme280.Adafruit_BME280_SPI(spi, bme_cs)

# change this to match the location's pressure (hPa) at sea level
bme280.sea_level_pressure = 1013.25
bme280.mode = adafruit_bme280.MODE_NORMAL
bme280.standby_period = adafruit_bme280.STANDBY_TC_500
```

```
bme280.iir_filter = adafruit_bme280.IIR_FILTER_X16
bme280.overscan_pressure = adafruit_bme280.OVERSCAN_X16
bme280.overscan_humidity = adafruit_bme280.OVERSCAN_X1
bme280.overscan_temperature = adafruit_bme280.OVERSCAN_X2
#The sensor will need a moment to gather inital readings
time.sleep(1)

while True:
    print("\nTemperature: %0.1f C" % bme280.temperature)
    print("Humidity: %0.1f %%" % bme280.humidity)
    print("Pressure: %0.1f hPa" % bme280.pressure)
    print("Altitude = %0.2f meters" % bme280.altitude)
    time.sleep(2)
```

Save this code to your ODROID by copying and pasting it into a text file, downloading it directly from the ODROID, etc.

Then in your command line run

`sudo python3 bme280_normal_mode.py`



The code will loop with the sensor data until you quit with a Control-C

That's it! Now if you want to read the documentation on the library, what each function does in depth, visit our readthedocs documentation at

https://circuitpython.readthedocs.io/projects/bme280/en/latest/ (https://adafru.it/BK2)

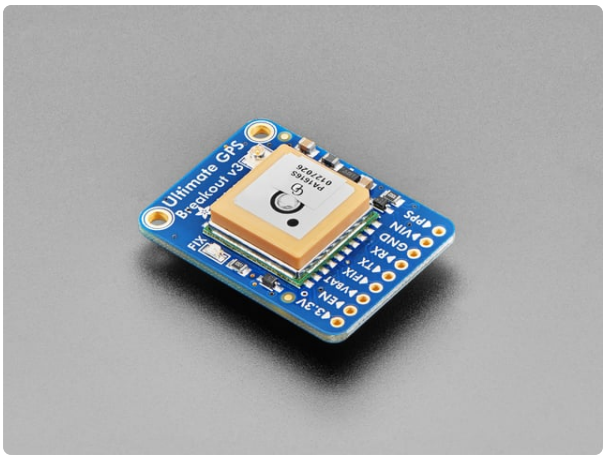
UART / Serial

After I2C and SPI, the third most popular "bus" protocol used is serial (also sometimes referred to as 'UART'). This is a non-shared two-wire protocol with an RX line, a TX line and a fixed baudrate. The most common devices that use UART are GPS units, MIDI interfaces, fingerprint sensors, thermal printers, and a scattering of sensors.

One thing you'll notice fast is that most linux computers have minimal UARTs, often only 1 hardware port. And that hardware port may be shared with a console.

There are two ways to connect UART / Serial devices to your ODROID. The easy way, and the hard way.

We'll demonstrate wiring up & using an Ultimate GPS with both methods



Adafruit Ultimate GPS Breakout - 66 channel w/10 Hz updates
We carry a few different GPS modules here in the Adafruit shop, but none that satisfied our every desire - that's why we designed this little GPS breakout board. We believe this is...
https://www.adafruit.com/product/746

The Easy Way - An External USB-Serial Converter

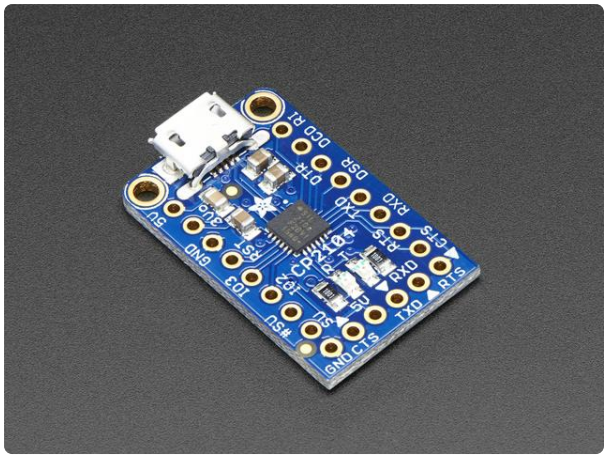
By far the easiest way to add a serial port is to use a USB to serial converter cable or breakout. They're not expensive, and you simply plug it into the USB port. On the other end are wires or pins that provide power, ground, RX, TX and maybe some other control pads or extras.

Here are some options, they have varying chipsets and physical designs but all will do the job. We'll list them in order of recommendation.

The first cable is easy to use and even has little plugs that you can arrange however you like, it contains a CP2102

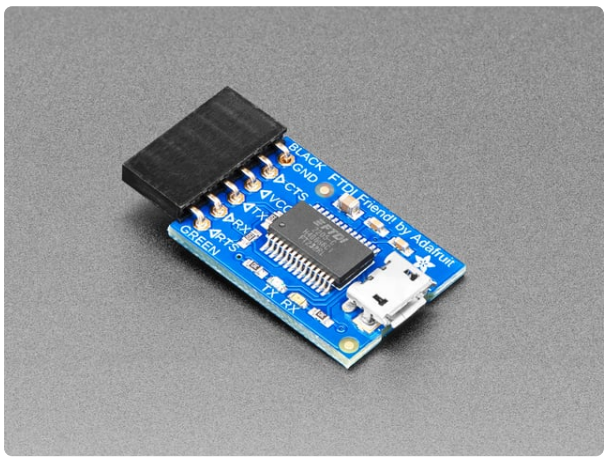
USB to TTL Serial Cable - Debug / Console Cable for Raspberry Pi
The cable is easiest way ever to connect to your microcontroller/Raspberry Pi/WiFi router serial console port. Inside the big USB plug is a USB<->Serial conversion chip and at...
https://www.adafruit.com/product/954

The CP2104 Friend is low cost, easy to use, but requires a little soldering, it has an '6-pin FTDI compatible' connector on the end, but all pins are broken out the sides



[Adafruit CP2104 Friend - USB to Serial Converter]
Discontinued - you can grab Adafruit CP2102N Friend - USB to Serial Converter instead! Long gone are...
https://www.adafruit.com/product/3309

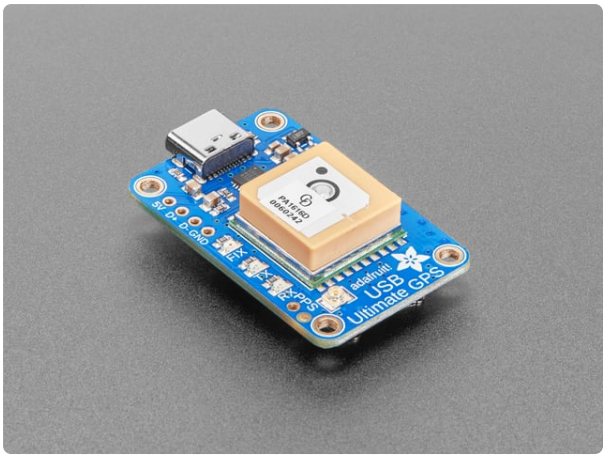
Both the FTDI friend and cable use classic FTDI chips, these are more expensive than the CP2104 or PL2303 but sometimes people like them!



[FTDI Friend with Micro USB Port + extras]
Long gone are the days of parallel ports and serial ports. Now the USB port reigns supreme! But USB is hard, and you just want to transfer your every-day serial data from a...
https://www.adafruit.com/product/284

[FTDI Serial TTL-232 USB Cable]
Just about all electronics use TTL serial for debugging, bootloading, programming, serial output, etc. But it's rare for a computer to have a serial port anymore. This is a USB to...
https://www.adafruit.com/product/70

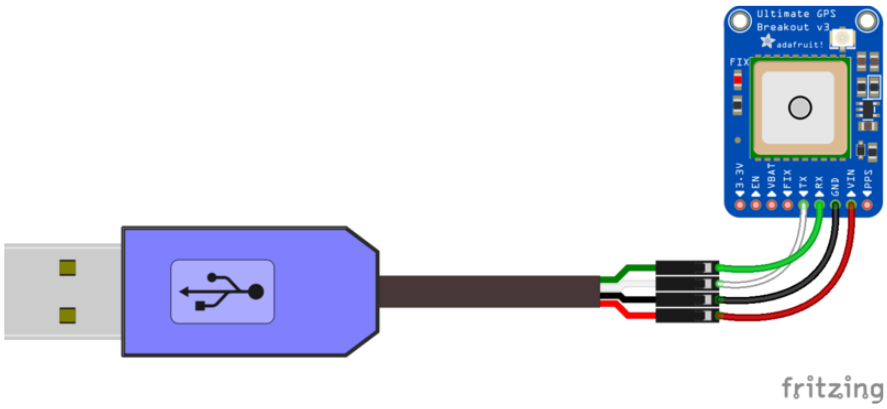
There is also a GPS module with integrated serial available which works like the GPS breakout connected to the USB to TTL Serial cable.



[Adafruit Ultimate GPS GNSS with USB - 99 channel w/10 Hz updates](https://www.adafruit.com/product/4279)
The Ultimate GPS module you know and love has a glow-up to let it be easily used with any computer, not just microcontrollers! With the built-in USB-to-Serial converter, you...
https://www.adafruit.com/product/4279

You can wire up the GPS by connecting the following

- **GPS Vin** to **USB 5V** or **3V** (red wire on USB console cable)
- **GPS Ground** to **USB Ground** (black wire)
- **GPS RX** to **USB TX** (green wire)
- **GPS TX** to **USB RX** (white wire)



Once the USB adapter is plugged in, you'll need to figure out what the serial port name is. You can figure it out by unplugging-replugging in the USB and then typing `dmesg | tail -10` (or just `dmesg`) and looking for text like this:

```
pi@odroidc2:~$ dmesg | tail -10
[ 3252.783684] usb 1-1.1: new full-speed USB device number 5 using dwc2
[ 3252.885849] usb 1-1.1: New USB device found, idVendor=10c4, idProduct=ea60, bcdDevice= 1.00
[ 3252.885866] usb 1-1.1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[ 3252.885877] usb 1-1.1: Product: CP2102 USB to UART Bridge Controller
[ 3252.885886] usb 1-1.1: Manufacturer: Silicon Labs
[ 3252.885903] usb 1-1.1: SerialNumber: 0001
[ 3252.913564] usbcore: registered new interface driver cp210x
[ 3252.913651] usbserial: USB Serial support registered for cp210x
[ 3252.913777] cp210x 1-1.1:1.0: cp210x converter detected
[ 3252.916501] usb 1-1.1: cp210x converter now attached to ttyUSB0
pi@odroidc2:~$
```

At the bottom, you'll see the 'name' of the attached device, in this case its `ttyUSB0`, that means our serial port device is available at `/dev/ttyUSB0`

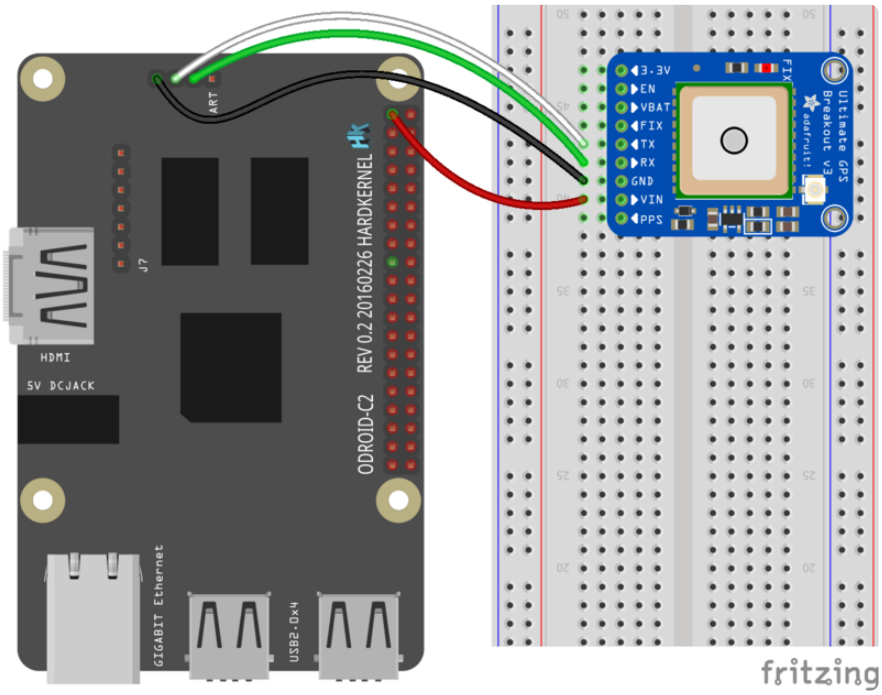
The Hard Way - Using Built-in UART

As of this writing, there is an issue in the current armbian distribution with /dev/ttyAML1 not exchanging data properly. However, if using SSH, you can use the UART Serial port and /dev/ttyAML0 as a workaround.

If you don't want to plug in external hardware to the ODROID you can use the built in UART on the RX/TX pins.

You can use the serial console UART via `/dev/ttyAML0`

Wire the GPS as follows:



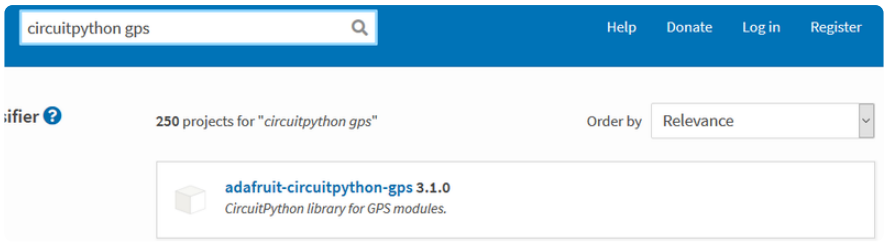
odroid_uartgps.fzz

https://adafru.it/F1V

Install the CircuitPython GPS Library

OK onto the good stuff, you can now install the Adafruit GPS CircuitPython library.

As of this writing, not all libraries are up on PyPI so you may want to search before trying to install. Look for **circuitpython** and then the driver you want.



(If you don't see it [you can open up a github issue on circuitpython to remind us (https://adafru.it/tB7)](https://adafru.it/tB7)!)

Once you know the name, install it with

```
sudo pip3 install pyserial adafruit-circuitpython-gps
```

You'll notice we also installed a dependancy called **pyserial**. This is a great thing about pip, if you have other required libraries they'll get installed too!

We also recommend an adafruit-blinka update in case we've fixed bugs:

```
sudo pip3 install --upgrade adafruit_blinka
```

Run that code!

The finish line is right up ahead. You can now run one of the (many in some cases) example scripts we've written for you.

Check out the examples for your library by visiting the repository for the library and looking in the example folder. In this case, it would be [https://github.com/adafruit/Adafruit_CircuitPython_GPS/tree/master/examples (https://adafru.it/Ca9)](https://github.com/adafruit/Adafruit_CircuitPython_GPS/tree/master/examples)

Lets start with the simplest, the echo example

```
# SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
# SPDX-License-Identifier: MIT

# Simple GPS module demonstration.
# Will print NMEA sentences received from the GPS, great for testing connection
# Uses the GPS to send some commands, then reads directly from the GPS
import time

import board
import busio

import adafruit_gps

# Create a serial connection for the GPS connection using default speed and
# a slightly higher timeout (GPS modules typically update once a second).
# These are the defaults you should use for the GPS FeatherWing.
# For other boards set RX = GPS module TX, and TX = GPS module RX pins.
uart = busio.UART(board.TX, board.RX, baudrate=9600, timeout=10)

# for a computer, use the pyserial library for uart access
# import serial
# uart = serial.Serial("/dev/ttyUSB0", baudrate=9600, timeout=10)
```

```
# If using I2C, we'll create an I2C interface to talk to using default pins
# i2c = board.I2C()  # uses board.SCL and board.SDA
# i2c = board.STEMMA_I2C()  # For using the built-in STEMMA QT connector on a
microcontroller

# Create a GPS module instance.
gps = adafruit_gps.GPS(uart)  # Use UART/pyserial
# gps = adafruit_gps.GPS_GtopI2C(i2c)  # Use I2C interface

# Initialize the GPS module by changing what data it sends and at what rate.
# These are NMEA extensions for PMTK_314_SET_NMEA_OUTPUT and
# PMTK_220_SET_NMEA_UPDATERATE but you can send anything from here to adjust
# the GPS module behavior:
#   https://cdn-shop.adafruit.com/datasheets/PMTK_A11.pdf

# Turn on the basic GGA and RMC info (what you typically want)
gps.send_command(b"PMTK314,0,1,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0")
# Turn on just minimum info (RMC only, location):
# gps.send_command(b'PMTK314,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0')
# Turn off everything:
# gps.send_command(b'PMTK314,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0')
# Tuen on everything (not all of it is parsed!)
# gps.send_command(b'PMTK314,1,1,1,1,1,1,0,0,0,0,0,0,0,0,0,0,0,0')

# Set update rate to once a second (1hz) which is what you typically want.
gps.send_command(b"PMTK220,1000")
# Or decrease to once every two seconds by doubling the millisecond value.
# Be sure to also increase your UART timeout above!
# gps.send_command(b'PMTK220,2000')
# You can also speed up the rate, but don't go too fast or else you can lose
# data during parsing.  This would be twice a second (2hz, 500ms delay):
# gps.send_command(b'PMTK220,500')

# Main loop runs forever printing data as it comes in
timestamp = time.monotonic()
while True:
    data = gps.read(32)  # read up to 32 bytes
    # print(data)  # this is a bytearray type

    if data is not None:
        # convert bytearray to string
        data_string = "".join([chr(b) for b in data])
        print(data_string, end="")

    if time.monotonic() - timestamp > 5:
        # every 5 seconds...
        gps.send_command(b"PMTK605")  # request firmware version
        timestamp = time.monotonic()
```

We'll need to configure this code to work with our UART port name.

- If you're using a USB-to-serial converter, the device name is probably `/dev/ttyUSB0` - but check `dmesg` to make sure
- If you're using the built-in UART on the ODROID, the device name is `/dev/ttyAML0`

Comment out the lines that reference `board.TX`, `board.RX` and `busio.uart` and uncomment the lines that `import serial` and define the `serial` device, like so:

```
# Define RX and TX pins for the board's serial port connected to the GPS.
# These are the defaults you should use for the GPS FeatherWing.
# For other boards set RX = GPS module TX, and TX = GPS module RX pins.
#RX = board.RX
#TX = board.TX

# Create a serial connection for the GPS connection using default speed and
# a slightly higher timeout (GPS modules typically update once a second).
#uart = busio.UART(TX, RX, baudrate=9600, timeout=3000)

# for a computer, use the pyserial library for uart access
import serial
uart = serial.Serial("/dev/ttyUSB0", baudrate=9600, timeout=3000)
```

And update the `"/dev/ttyUSB0"` device name if necessary to match your USB interface

Whichever method you use, you should see output like this, with **$GP** "NMEA sentences" - there probably wont be actual location data because you haven't gotten a GPS fix. As long as you see those **$GP** strings sorta like the below, you've got it working!

```
pi@odroidc2:~$ sudo python3 gps_simpletest.py
$PMTK001,314,3*36
$PMTK001,220,3*30
$GPGGA,182130.900,,,,,0,00,,,M,,M,,*78
$GPRMC,182130.900,V,,,,,0.00,0.00,130619,,,N*41
$GPGGA,182131.900,,,,,0,00,,,M,,M,,*79
$GPRMC,182131.900,V,,,,,0.00,0.00,130619,,,N*40
$GPGGA,182132.900,,,,,0,00,,,M,,M,,*7A
$GPRMC,182132.900,V,,,,,0.00,0.00,130619,,,N*43
$GPGGA,182133.900,,,,,0,00,,,M,,M,,*7B
$GPRMC,182133.900,V,,,,,0.00,0.00,130619,,,N*42
$GPGGA,182134.900,,,,,0,00,,,M,,M,,*7C
```

More To Come!

That's just a taste of what we've got working so far

We're adding more support constantly, so please hold tight and visit the adafruit_blinka github repo (https://adafru.it/BJX) to share your feedback and perhaps even submit some improvements!

If you'd like to contribute, but aren't sure where to start, check out the following guides:

- Adding a Single Board Computer to PlatformDetect for Blinka (https://adafru.it/JFy)
- Adding a Single Board Computer to Blinka (https://adafru.it/KEF)

FAQ & Troubleshooting

There's a few oddities when running Blinka/CircuitPython on Linux. Here's a list of stuff to watch for that we know of!

This FAQ covers all the various platforms and hardware setups you can run Blinka on. Therefore, some of the information may not apply to your specific setup.

Update Blinka/Platform Libraries

Most issues can be solved by forcing Python to upgrade to the latest `blinka` / `platform-detect` libraries. Try running

```
sudo python3 -m pip install --upgrade --force-reinstall adafruit-blinka Adafruit-PlatformDetect
```

Getting an error message about 'board' not found or 'board' has no attribute

Somehow you have ended up with either the wrong **board** module or no **board** module at all.

DO NOT try to fix this by manually installing a library named `board`. There is one out there (https://adafru.it/NCE) and it has nothing to do with Blinka. You will break things if you install that library!

The easiest way to recover is to simply force a reinstall of Blinka with: `python3 -m pip install --upgrade --force-reinstall adafruit-blinka`

Additionally, and especially if you are using a more recent version of Python, you may run into this error if you either do not have a Virtual Environment active or setup. See the Python Virtual Environment Usage on Raspberry Pi (https://adafru.it/19a5) guide for more information or check out the guide's Installation page.

Mixed SPI mode devices

Due to the way we share an SPI peripheral, you cannot have two SPI devices with different 'mode/polarity' on the same SPI bus - you'll get weird data

95% of SPI devices are mode 0, check the driver to see mode or polarity settings. For example:

- LSM9DS1 is mode 1 (https://adafru.it/NCF), please use in I2C mode instead of SPI
- MAX31865 is phase 1 (https://adafru.it/NCG), try using this on a separate SPI device, or read data twice.

Why am I getting AttributeError: 'SpiDev' object has no attribute 'writebytes2'?

This is due to having an older version of spidev (https://adafru.it/JEi). You need at least version 3.4. This should have been taken care of (https://adafru.it/NCH) when you installed Blinka, but in some cases it does not seem to happen.

To check what version of spidev Python is using:

```
$ python3
Python 3.6.8 (default, Oct 7 2019, 12:59:55)
[GCC 8.3.0] on linux
Type "help", "copyright", "credits" or "license"
for more information.
>>> import spidev
>>> spidev.__version__
'3.4'
>>>
```

If you see a version lower then 3.4 reported, then try a force upgrade of spidev with (back at command line):

```
sudo python3 -m pip install --upgrade --force-reinstall
spidev
```

No Pullup/Pulldown support on some Linux boards or MCP2221

Some Linux boards, for example, AllWinner-based, do not have support to set pull up or pull down on their GPIO. Use an external resistor instead!

Getting OSError: read error with MCP2221

If you are getting a stack trace that ends with something like:

```
return self._hid.read(64)
File "hid.pyx", line 122, in hid.device.read
OSError: read error
```

Try setting an environment variable named **BLINKA_MCP2221_RESET_DELAY** to a value of **0.5 or higher**.

Windows:

```
set BLINKA_MCP2221_RESET_DELAY=0.5
```

Linux:

```
export BLINKA_MCP2221_RESET_DELAY=0.5
```

This is a value in seconds to wait between resetting the MCP2221 and the attempt to reopen it. The reset is seen by the operating system as a hardware disconnect/reconnect. Different operating systems can need different amounts of time to wait after the reconnect before the attempt to reopen. Setting the above environment variable will override the default reset delay time, allowing it to be increased as needed for different setups.

Using FT232H with other FTDI devices.

Blinka uses the libusbk driver to talk to the FT232H directly. If you have other FTDI devices installed that are using the FTDI VCP drivers, you may run into issues. See here for a possible workaround:

https://forums.adafruit.com/viewtopic.php?f=19&t=166999 (https://adafru.it/doW)

Getting "no backend available" with pyusb on Windows

This is probably only an issue for older versions of Windows. If you run into something like this, see this issue thread:

https://github.com/pyusb/pyusb/issues/120 (https://adafru.it/Uao)

which describes copying the 32bit and 64bit DLLs into specific folders. (example for Win7 (https://adafru.it/Uao))

Getting "no backend available" or other problems with pyusb on Mac

Check out this issue thread:

https://github.com/pyusb/pyusb/issues/355 (https://adafru.it/19fh)

which has **lots** of discussion. It is probably worth reading through it all to determine what applies for your setup. Most solutions seem to rely on setting the **DYLD_LIBRARY_PATH** environment variable.

This issue thread has further information:

https://github.com/orgs/Homebrew/discussions/3424 (https://adafru.it/19fi)

I can't get neopixel, analogio, audioio, rotaryio, displayio or pulseio to work!

Some CircuitPython modules like may not be supported.

- Most SBCs do not have analog inputs so there is no `analogio`
- Few SBCs have `neopixel` support so that is only available on Raspberry Pi (and any others that have low level neopixel protocol writing
- Rotary encoders (`rotaryio`) is handled by interrupts on microcontrollers, and is not supported on SBCs at this time
- Likewise `pulseio` PWM support is not supported on many SBCs, and if it is, it will not support a carrier wave (Infrared transmission)
- For display usage, we suggest using python `Pillow` library or `Pygame`, we do not have `displayio` support

We aim to have, at a minimum, `digitalio` and `busio` (I2C/SPI). This lets you use the vast number of driver libraries

For analog inputs, the MCP3xxx library (https://adafru.it/CPN) will give you `AnalogIn` objects. For PWM outputs, try the PCA9685 (https://adafru.it/tZF). For audio, use pygame or other Python3 libraries to play audio.

Some libraries, like Adafruit_CircuitPython_DHT (https://adafru.it/Beq) will try to bit-bang if pulsein isn't available. Slow linux boards (<700MHz) may not be able to read the pins fast enough), you'll just have to try!

Help, I'm getting the message "error while loading shared libraries: libgpiod.so.2: cannot open shared object file: No such file or directory"

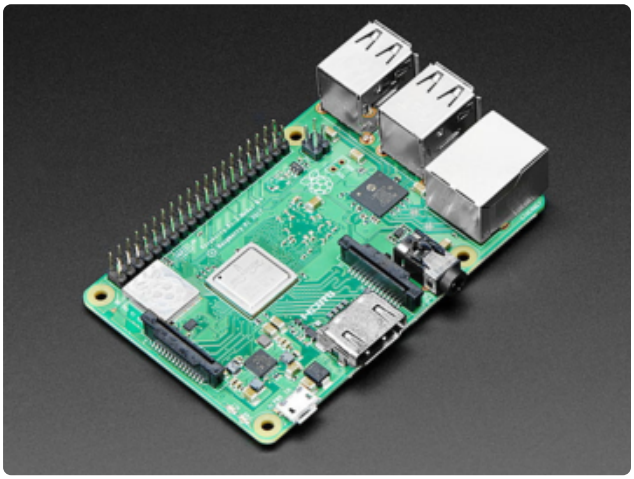
It looks like **libgpiod** may not be installed on your board.

Try running the command: `sudo apt-get install libgpiod2`

= v5.5.0""> When running the libgpiod script, I see the message: configure: error: "libgpiod needs linux headers version >= v5.5.0"

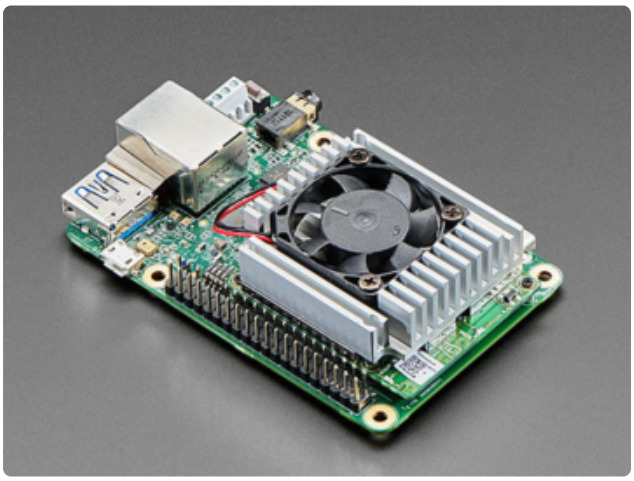
Be sure you have the latest libgpiod.py script and run it with the `-l` or `--legacy` flag:

```
sudo python3 libgpiod.py --legacy
```



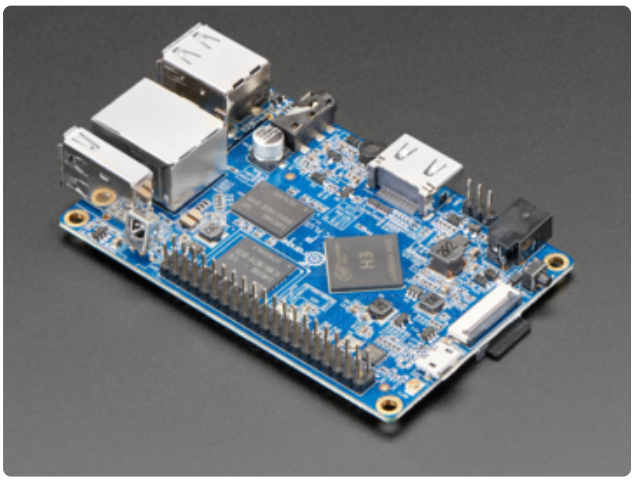
All Raspberry Pi Computers Have:

1 x I2C port with **busio** (but clock stretching is not supported in hardware, so you must set the I2C bus speed to 10KHz to 'fix it')
2 x SPI ports with **busio**
1 x UART port with **serial** - note this is shared with the hardware console
pulseio.pulseIn using gpiod
neopixel support on a few pins
No AnalogIn support (Use an MCP3008 or similar to add ADC)
No PWM support (Use a PCA9685 or similar to add PWM)



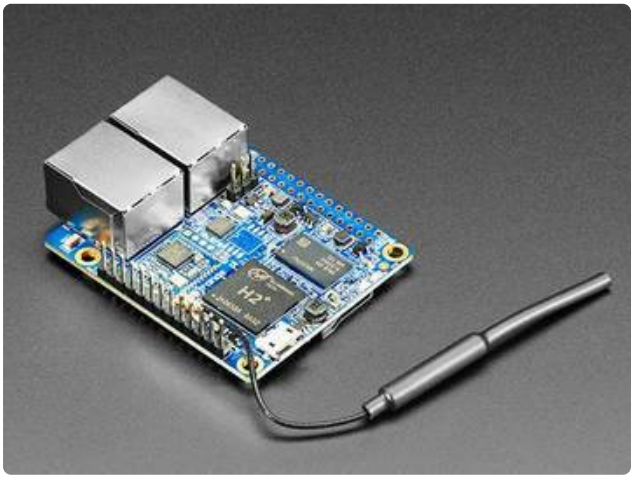
Google Coral TPU Dev Boards Have:

1 x I2C port with **busio**
1 x SPI ports with **busio**
1 x UART port with **serial** - note this is shared with the hardware console
3 x PWMOut support
No NeoPixel support
No AnalogIn support (Use an MCP3008 or similar to add ADC)



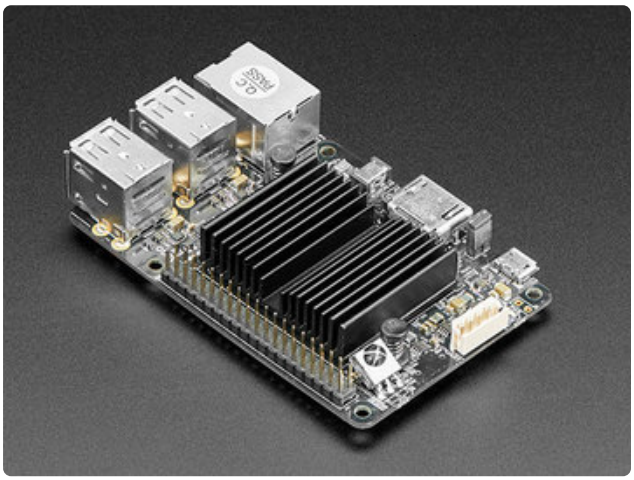
Orange Pi PC Plus Boards Have:

1 x I2C port with **busio**
1 x SPI ports with **busio**
1 x UART port with **serial**
No NeoPixel support
No AnalogIn support (Use an MCP3008 or similar to add ADC)
No PWM support (Use a PCA9685 or similar to add PWM)



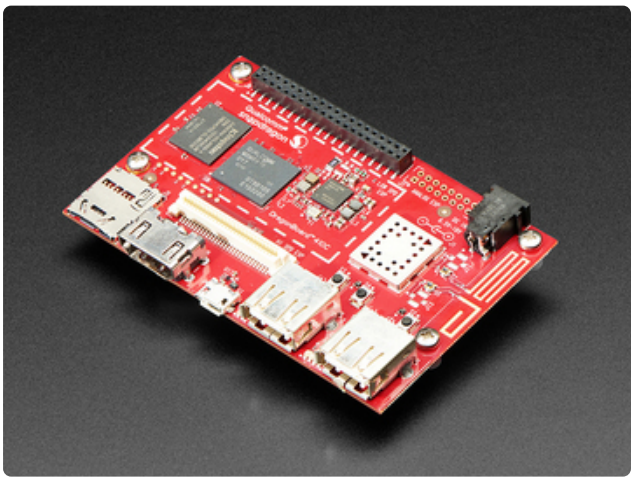
Orange Pi R1 Boards Have:

1 x I2C port with **busio**
1 x SPI port with **busio**
1 x UART port with **serial**
No NeoPixel support
No AnalogIn support (Use an MCP3008 or similar to add ADC)
No PWM support (Use a PCA9685 or similar to add PWM)



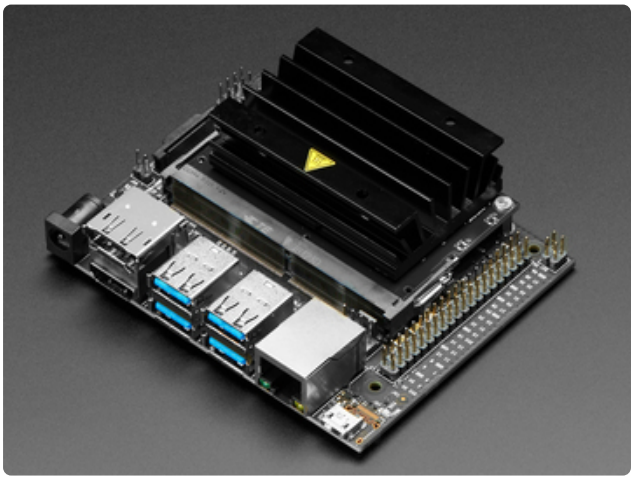
ODROID C2 Boards Have:

1 x I2C port with **busio**
No SPI support
1 x UART port with **serial** - note this is shared with the hardware console
No NeoPixel support
No AnalogIn support (Use an MCP3008 or similar to add ADC)
No PWM support (Use a PCA9685 or similar to add PWM)



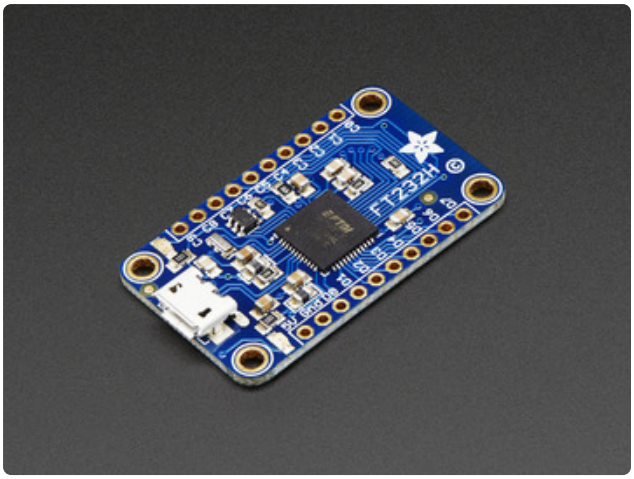
DragonBoard 410c Boards Have:

2 x I2C port with **busio**
1 x SPI port with **busio**
1 x UART port with **serial**
No NeoPixel support
No AnalogIn support (Use an MCP3008 or similar to add ADC)
No PWM support (Use a PCA9685 or similar to add PWM)



NVIDIA Jetson Nano Boards Have:

2 x I2C port with **busio**
2 x SPI ports with **busio**
2 x UART port with **serial** - note one of these is shared with the hardware console
No NeoPixel support
No AnalogIn support (Use an MCP3008 or similar to add ADC)
No PWM support (Use a PCA9685 or similar to add PWM)

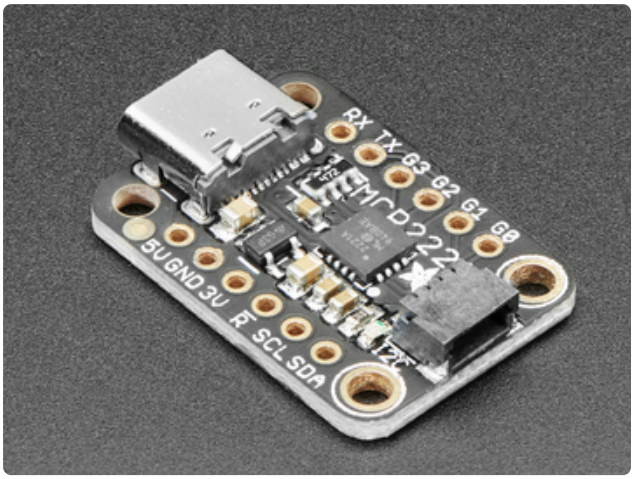


FT232H Breakouts Have:

1x I2C port **OR** SPI port with **busio**
12x GPIO pins with **digitalio**
No UART
No AnalogIn support
No AnalogOut support
No PWM support

If you are using Blinka in FT232H mode (https://adafru.it/FWD), then keep in mind these basic limitations.

SPI and I2C can not be used at the same time since they share the same pins.
GPIO speed is not super fast, so trying to do arbitrary bit bang like things may run into speed issues.
There are no ADCs.
There are no DACs.
UART is not available (its a different FTDI mode)



MCP2221 Breakouts Have:

1x I2C port with **busio**
4x GPIO pins with **digitalio**
3x AnalogIn with **analogio**
1x AnalogOut with **analogio**
1x UART with **pyserial**
No PWM support
No hardware SPI support

If you are using Blinka in MCP2221 mode, then keep in mind these basic limitations.

GPIO speed is not super fast, so trying to do arbitrary bit bang like things may run into speed issues.
UART is available via `pyserial`, the serial COM port shows up as a second USB device during enumeration