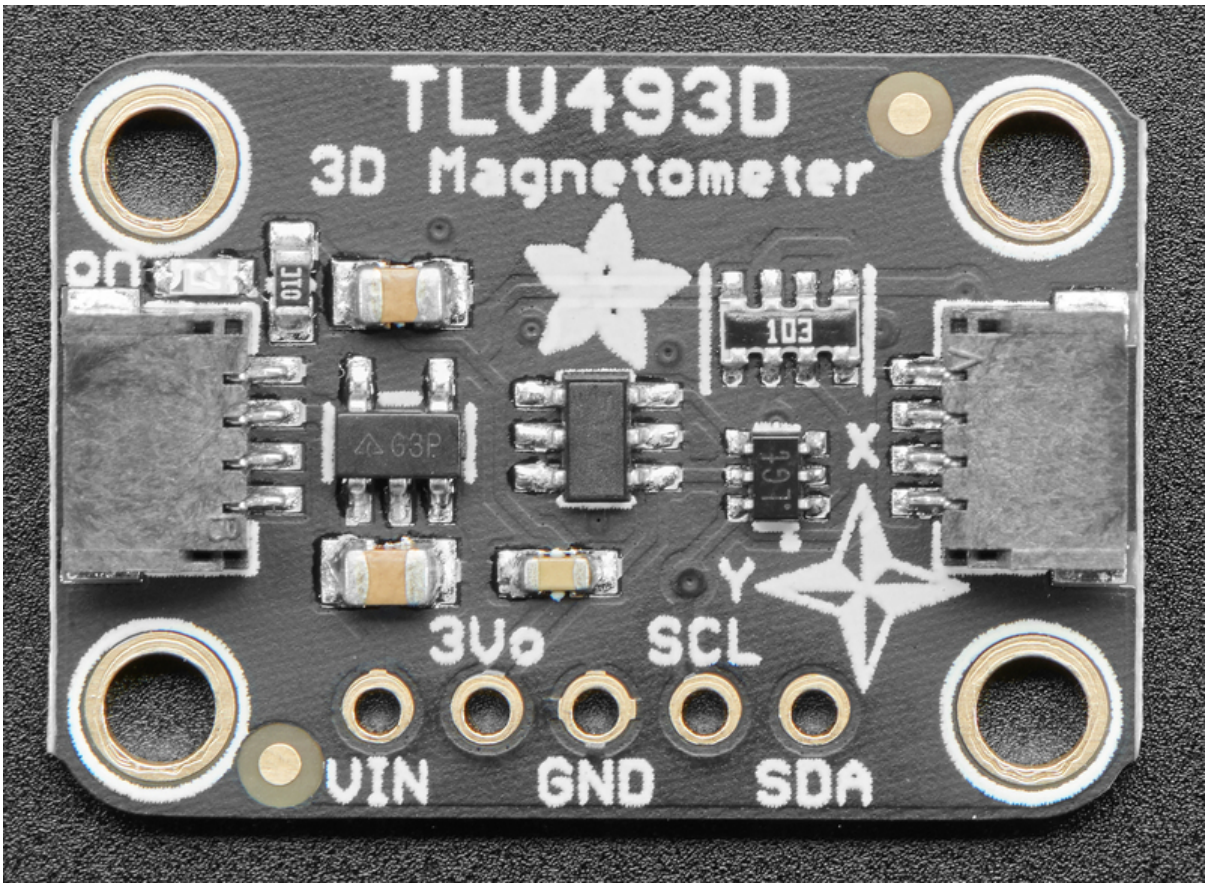
Adafruit TLV493 Triple-Axis Magnetometer

Created by Bryan Siepert



https://learn.adafruit.com/adafruit-tlv493-triple-axis-magnetometer

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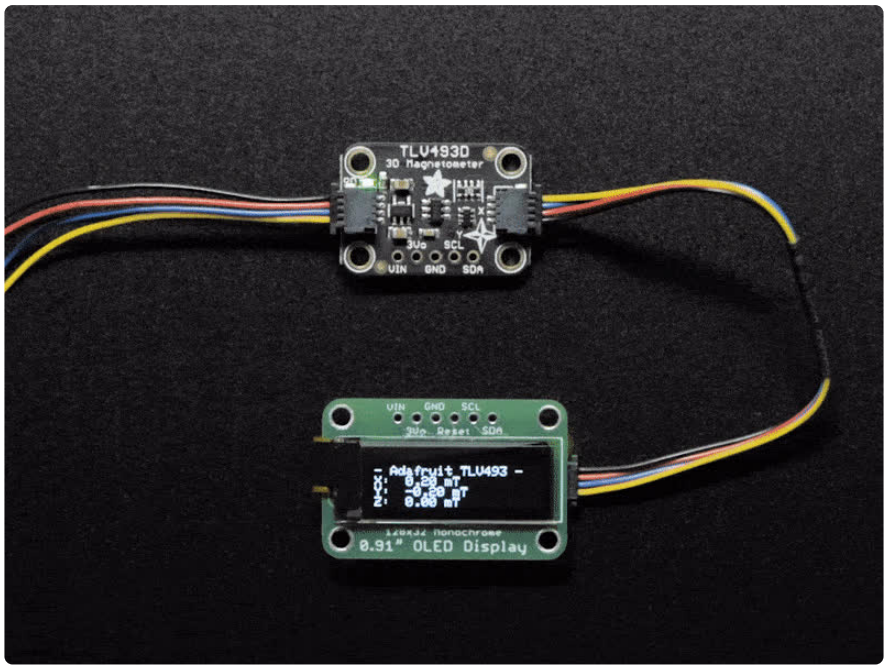
Overview

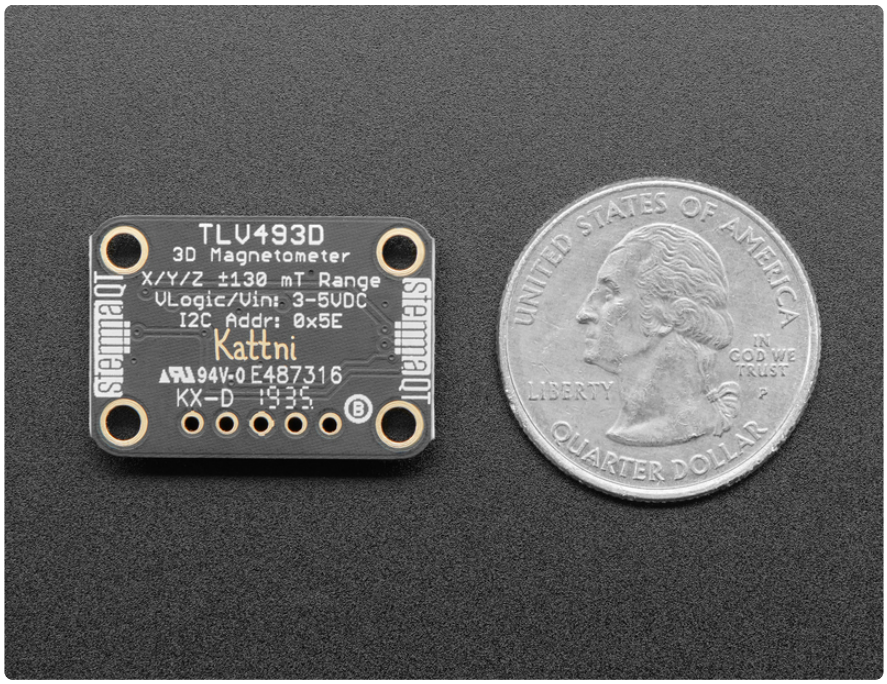


The TLV493D 3-axis magnetometer is a great little sensor for detecting magnets **in 3D**. (https://adafru.it/FN5) In fact, the manufacturer Infineon suggests it could be used to make a joystick! You could also use it for other cool things like detecting objects with magnets attached, like the lid of a box, or maybe a statue that unlocks your secret lair when placed on your mantle?

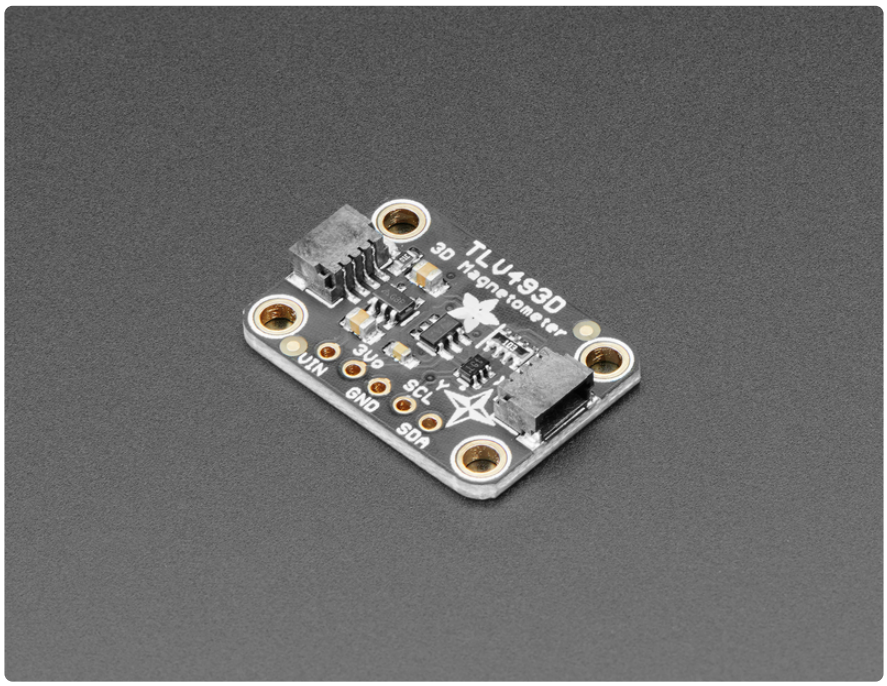
The TLD493D excels at measuring nearby magnetic fields in three dimensions. It's not going to make a good compass, it's not sensitive enough to pick up the Earth's magnetic field, but you can use it to track the movement of nearby magnets in three dimensions.

Here are a few specs:

- Digital output via 2-wire based standard I2C interface up to 1 MBit/sec
- 12-bit data resolution for each measurement direction
- Bx, By and Bz linear field measurement up to +130 mT (https://adafru.it/FMV)
- Excellent matching of X/Y measurement for accurate angle sensing



As we are wont to do, we've made the TLV easy to use by putting it on a breakout PCB along with the circuitry to support it. A voltage regulator and logic level shifting combine to make it usable with a range of microcontrollers with either 3.3V or 5V logic levels. We even give you a pin for you to use the excess 3.3V juice not needed by the TLV493D.

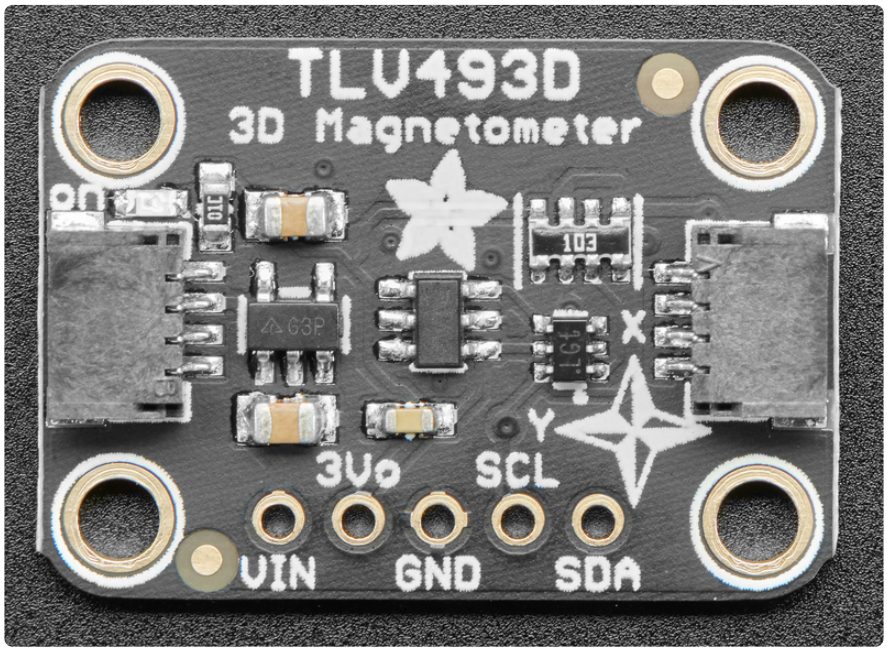


We've also outfitted the breakout with SparkFun Qwiic (https://adafru.it/Fpw) compatible **STEMMA QT** (https://adafru.it/Ft4) connectors to allow you to use it with other similarly equipped boards **without needing to solder.** Because the TLV394D "speaks" I2C, you only need two wires (in addition to power) to interface with your microcontroller, and you can share those pins with other I2C sensors. The

manufacturer Infineon was kind enough to provide a library to use the sensor with Arduino, and we've written one to use it with CircuitPython.

Read on and you'll be sensing magnets with 12-bit precision in no time!

Pinouts



Power Pins

- **Vin** - this is the power pin. Since the sensor chip uses 3.3 VDC, we have included a voltage regulator on board that will take 3-5VDC and safely convert it down. To power the board, give it the same power as the logic level of your microcontroller - e.g. for a 5V microcontroller like Arduino, use 5V
- **3Vo** - this is the 3.3V output from the voltage regulator, you can grab up to 100mA from this if you like
- **GND** - common ground for power and logic

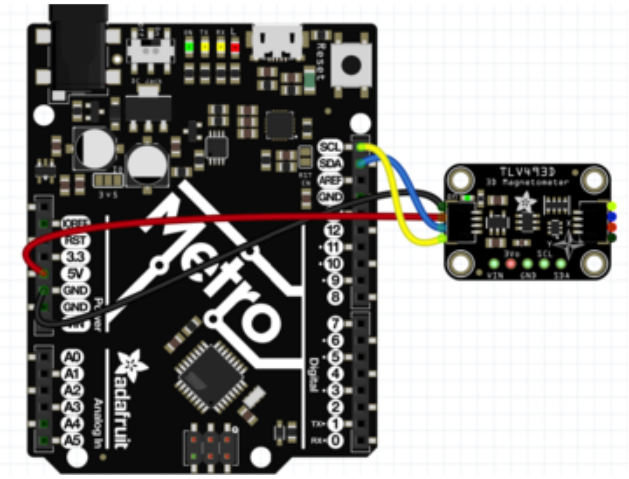
I2C Logic Pins

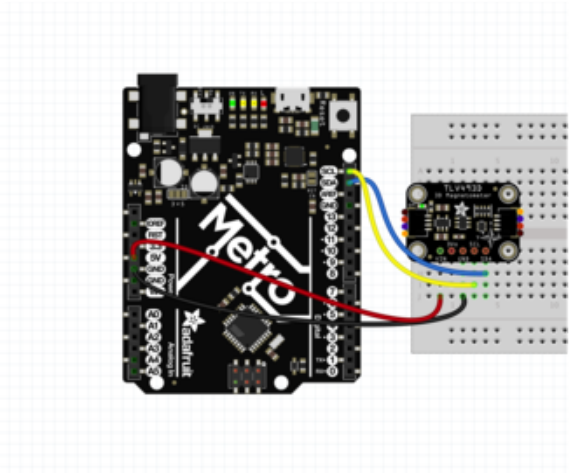
- **SCL** - this is the I2C clock pin, connect to your microcontroller's I2C clock line.
- **SDA** - this is the I2C data pin, connect to your microcontroller's I2C data line
- STEMMA QT **(https://adafru.it/Ft4) -** These connectors allow you to connectors to dev boards with **STEMMA QT** connectors or to other things with various associated accessories (https://adafru.it/Ft6)

Arduino

I2C Wiring

Wiring the TLV493D is easy, since it only requires power and two wires for an I2C connection. Additionally, the STEMMA QT connectors give you additional solderless options for wiring:

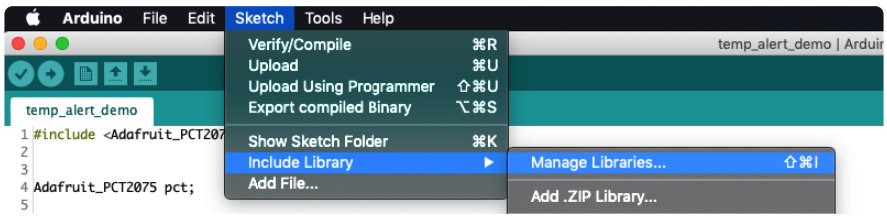




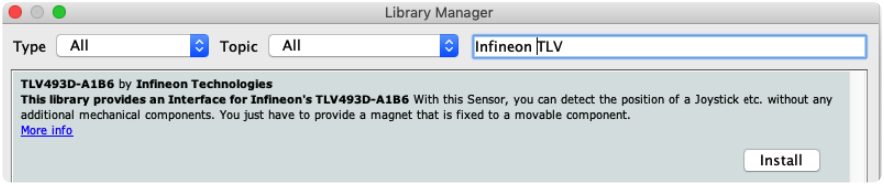
Connect **board VCC (red wire)** to **Arduino 5V** if you are running a **5V** board Arduino (Uno, etc.). If your board is **3V,** connect to that instead.
Connect **board GND (black wire)** to **Arduino GND**
Connect **board SCL (yellow wire)** to **Arduino SCL**
Connect **board SDA (blue wire)** to **Arduino SDA**

Arduino Library Installation

Fortunately Infineon have written a library for you for the TLV493D which you can install using the Arduino IDE's **Library Manager**:



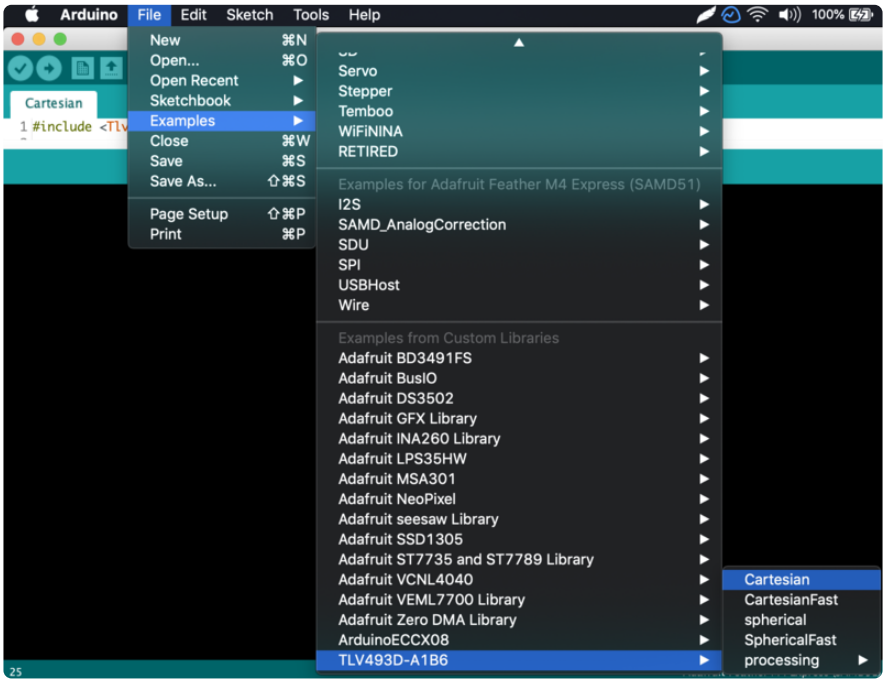
Click the **Manage Libraries ...** menu item, search for **Infineon TLV493**, and select the**TLV493D-A1B6** library:



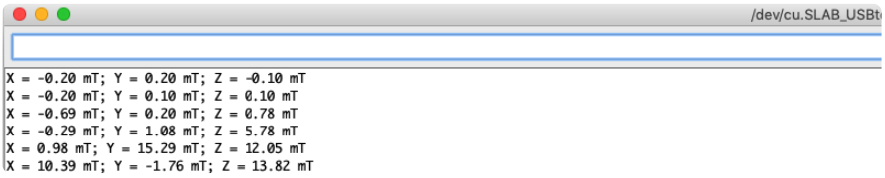
Cartesian Example

Infineon has provided a few examples, but the simplest example is the "Cartesian" example which reads the X, Y, and Z axis measurements in milli-teslas (**mT**) (https://adafru.it/FMV).

Open the example by navigating to the appropriate spot in the examples submenu:



Once you compile and upload the example to your Arduino compatible board of choice, open the serial monitor, verify that your baud rate setting matches the example, and you should see measurements for the three axes being printed. If you wave a magnet near the sensor you can see the values changing!



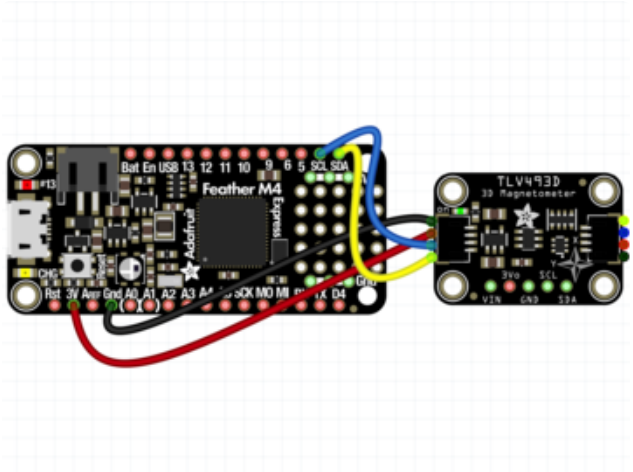
Python & CircuitPython

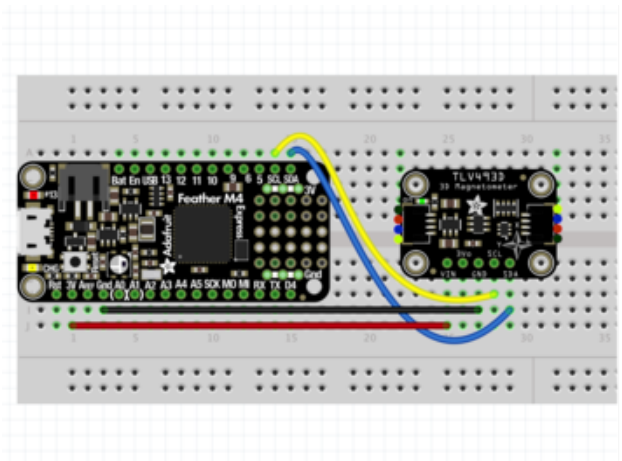
It's easy to use the TLD493D with CircuitPython and the Adafruit CircuitPython TLV493D (https://adafru.it/FMX) module. This module allows you to easily write Python code that reads the three-dimensional magnetic field measurements.

You can use this sensor with any CircuitPython microcontroller board or with a Linux single board computer that has GPIO and Python thanks to Adafruit_Blinka, our CircuitPython-for-Python compatibility library (https://adafru.it/BSN).

CircuitPython Microcontroller Wiring

Wiring the TLV493D is easy, since it only requires power and two wires for an I2C connection. Additionally, the STEMMA QT connectors give you additional solderless options for wiring:



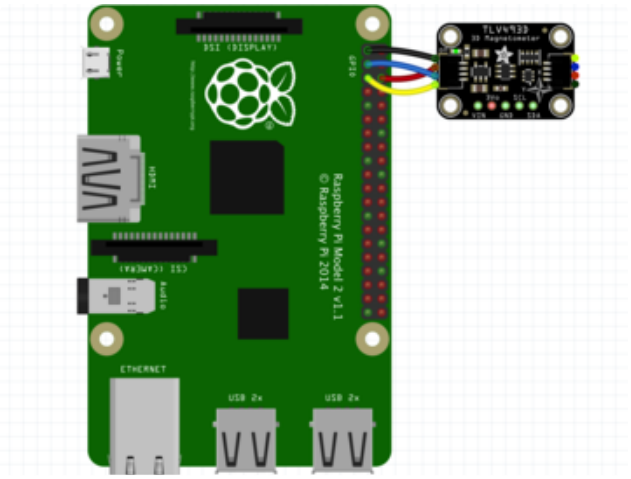


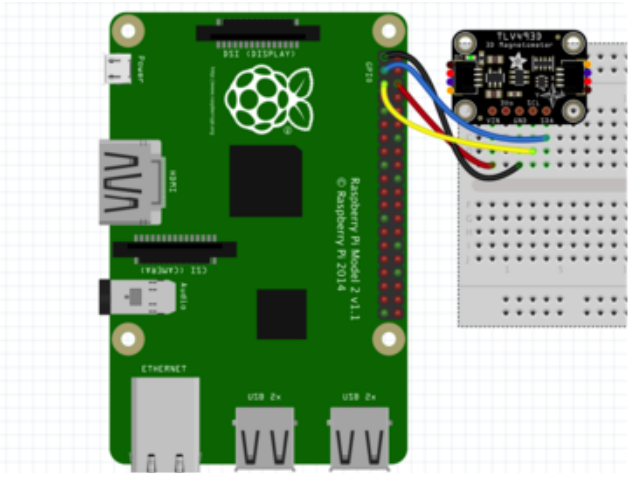
Board 3V to **sensor VIN (red wire)**
Board GND to **sensor GND (black wire)**
Board SCL to **sensor SCL (yellow wire)**
Board SDA to **sensor SDA (blue wire)**

Python Computer Wiring

Since there's dozens of Linux computers/boards you can use we will show wiring for Raspberry Pi (http://adafru.it/3055). For other platforms, please visit the guide for CircuitPython on Linux to see whether your platform is supported (https://adafru.it/BSN).

Here's the Raspberry Pi wired with I2C:





Pi 3V to **sensor VIN (red wire)**
Pi GND to **sensor GND (black wire)**
Pi SCL to **sensor SCL (yellow wire)**
Pi SDA to **sensor SDA (blue wire)**

CircuitPython Installation of the TLV493D Library

You'll need to install the Adafruit CircuitPython TLV394D (https://adafru.it/FMX) library on your CircuitPython board.

First make sure you are running the latest version of Adafruit CircuitPython (https://adafru.it/Amd) for your board.

Next you'll need to install the necessary libraries to use the hardware--carefully follow the steps to find and install these libraries from Adafruit's CircuitPython library

bundle (https://adafru.it/uap). Our CircuitPython starter guide has a great page on how to install the library bundle (https://adafru.it/ABU).

For non-express boards like the Trinket M0 or Gemma M0, you'll need to manually install the necessary libraries from the bundle:

- **adafruit_tlv493d.mpy**
- **adafruit_bus_device**

Before continuing make sure your board's **lib** folder or root filesystem has the **adafruit_tlv493d.mpy** and **adafruit_bus_device** files and folders copied over.

Next connect to the board's serial REPL (https://adafru.it/Awz)so you are at the CircuitPython `>>>` prompt.

Python Installation of TLV493D Library

You'll need to install the **Adafruit_Blinka** library that provides the CircuitPython support in Python. This may also require enabling I2C on your platform and verifying you are running Python 3. Since each platform is a little different, and Linux changes often, please visit the CircuitPython on Linux guide to get your computer ready (https://adafru.it/BSN)!

Once that's done, from your command line run the following command:

- `sudo pip3 install adafruit-circuitpython-tlv493d`

If your default Python is version 3 you may need to run 'pip' instead. Just make sure you aren't trying to use CircuitPython on Python 2.x, it isn't supported!

CircuitPython & Python Usage

To demonstrate the usage of the sensor we'll initialize it and read the magnetic measurements from the board's Python REPL.

Run the following code to import the necessary modules and initialize the I2C connection with the sensor:

```
Press any key to enter the REPL. Use CTRL-D to reload.
Adafruit CircuitPython 4.1.0 on 2019-08-03; Adafruit Metro M4 Express with samd51j19
>>> import time
>>> import board
>>> import busio
>>> import adafruit_tlv493d
>>> i2c = busio.I2C(board.SCL, board.SDA)
>>> tlv = adafruit_tlv493d.TLV493D(i2c)
>>> |
```

Now you're ready to read the **magnetic** values from the sensor using the property provided by the library.

Here is an example showing how to print the magnetic values:

```
>>> print("X: %s, Y: %s, Z: %s mT"%tlv.magnetic)
X: 0.098, Y: -0.098, Z: 0.0 mT
```

You can find more details about what the library allows by reading the library documentation (https://adafru.it/FJD).

That's it! Using the TLD493D 3-axis magnetometer with CircuitPython makes it easy to get started.

Example Code

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

import time
import board
import adafruit_tlv493d

i2c = board.I2C()  # uses board.SCL and board.SDA
# i2c = board.STEMMA_I2C()  # For using the built-in STEMMA QT connector on a
microcontroller
tlv = adafruit_tlv493d.TLV493D(i2c)

while True:
    print("X: %s, Y: %s, Z: %s uT" % tlv.magnetic)
    time.sleep(1)
```

Python Docs

Python Docs (https://adafru.it/FJD)

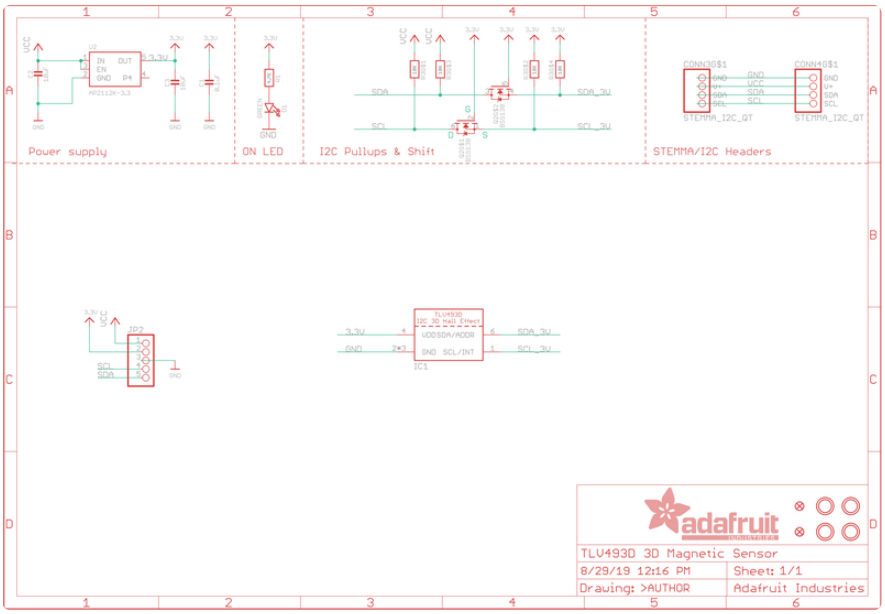
Downloads

Files

- TLV493D Datasheet (https://adafru.it/FMY)

- TLV493D User Manual (https://adafru.it/FMZ)
- EagleCAD files on GitHub (https://adafru.it/FM-)
- Fritzing object in Adafruit Fritzing Library (https://adafru.it/FN0)

Schematic



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