



## **SENSE User Guide:**

(Version 1.02)

Thank you for purchasing a SENSE board! This guide will help you get started using SENSE as quickly as possible.

Website: [www.nexuselectronics.tech](http://www.nexuselectronics.tech)

Github Library: <https://github.com/Nexus-Electronics>

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### **Important Notes:**

- **Only use 3.3V**
- To use microphone, the microcontroller must have PDM interface (SAMD21, RP2040)

### **Future Changes:**

- MicroPython Support

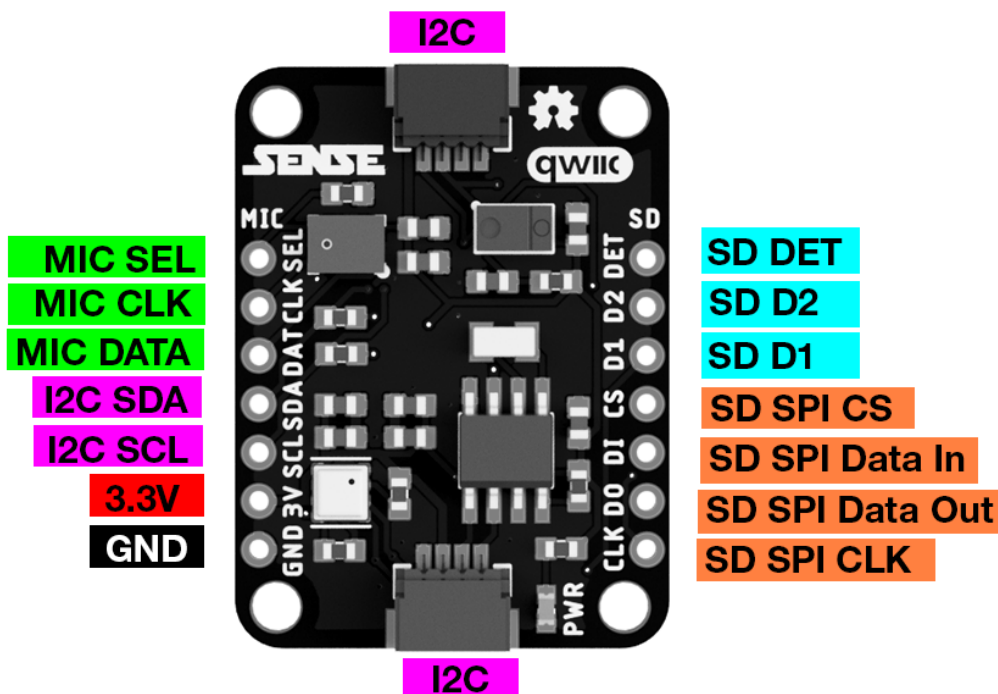
**About SENSE: \*\*\*Only works with 3.3V Do not use 5V power\*\*\***

SENSE is a tiny multipurpose sensor development board that integrates three sensors, a real-time-clock, and a micro sd card holder.

**What can each sensor/part do?**

- (I2C) **BME688**
  - Temperature, Humidity, Pressure, Air Quality (resistance value), Altitude
  - Using Bosch BSEC Library (Arduino Only)
    - IAQ, VOC, Equivalent CO2
  - For the most accurate results, we recommend that you run this sensor for 24-48 hours when you first receive it to "burn it in."
- (I2C) **APDS9960**
  - Proximity, RGB, Light, Gesture Sensing
- (I2C) **PCF8523** - Real Time Clock with backup battery
  - Keep track of time
- (PDM) **SPK0641HT4H** - PDM Microphone
  - Sound intensity, Decibel output
- (SPI/SDIO) **Micro SD Card Holder**
  - Log data onto micro SD card via an SPI bus or SDIO interface

**SENSE Pinout:**





## **SENSE Connections:**

The wiring connections are the same whether you are using an Arduino or Raspberry Pi. Onboard SENSE, there are three sensors that use I2C, a microphone that uses PDM, and a micro SD card holder that uses SPI or SDIO.

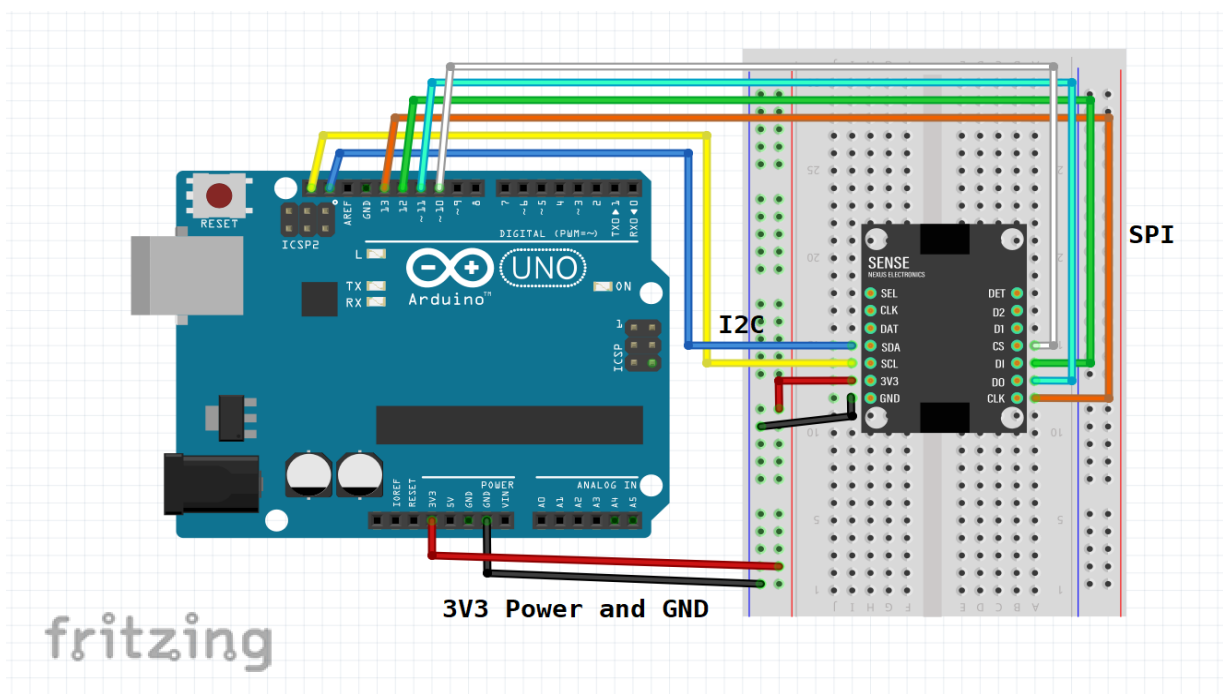
\*Consider using a Qwiic connector for fast I2C connection

- BME688 (I2C) (SDA and SCL)
- APDS9960 (I2C)
- PCF8523 (I2C)
- SPK0641HT4H (PDM) (DAT, CLK, SEL)
- Micro SD Card Holder (SPI or SDIO) (CLK, DO, DI, CS) + (D1 and D2 for SDIO)

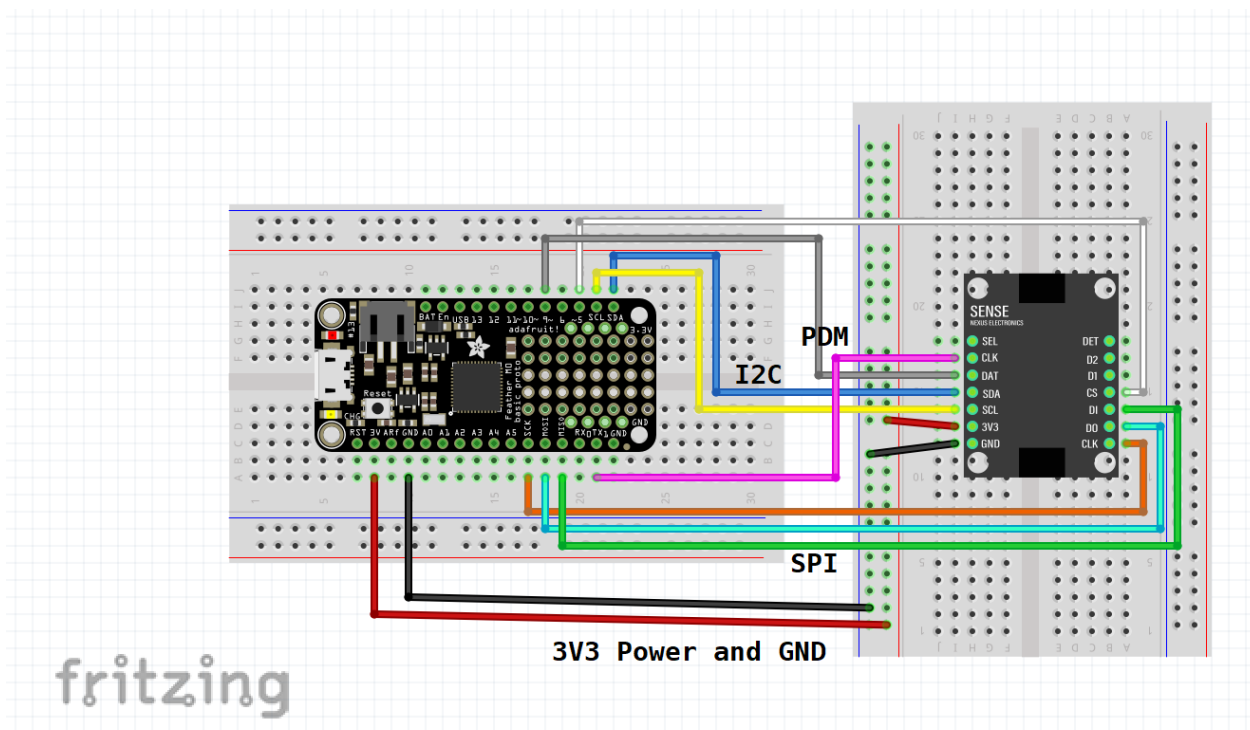
## **Arduino Wiring:**

Arduino/ESP32/RP2040	SENSE Board
3.3V Power	3.3V Power
GND	GND
SCL	SCL
SDA	SDA
SCK	CLK
MISO	DI
MOSI	DO
CS	CS
PDM Data Pin	DAT
PDM Bit Clock Pin	CLK
PDM Word Select Pin	SEL

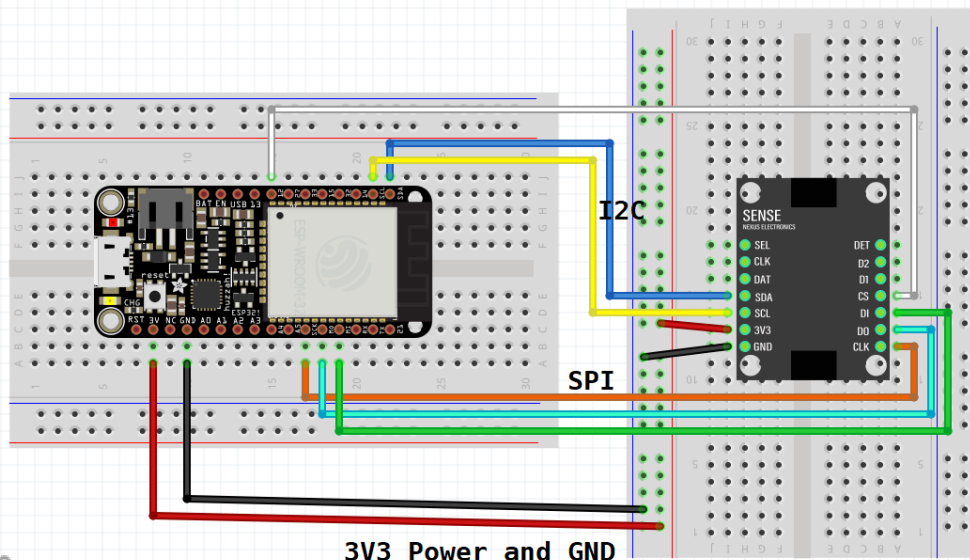
## Arduino UNO:



## Adafruit Feather M0: (supports PDM)

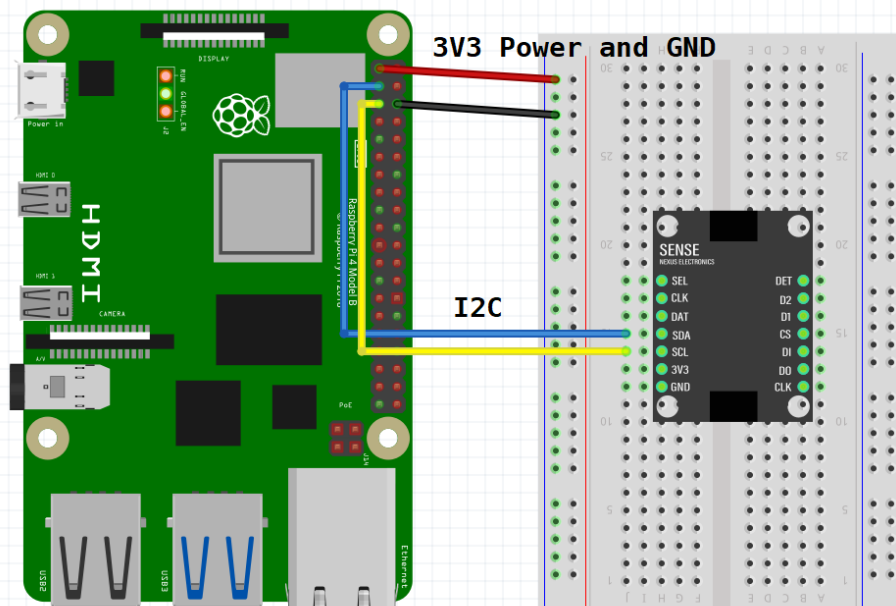


## ESP32:



fritzing

Raspberry Pi Wiring:



fritzing

### Getting Started with Arduino IDE:

1. Install the Arduino IDE



- a. <https://www.arduino.cc/en/software>
2. Download Nexus Electronics SENSE Library
  - a. <https://github.com/Nexus-Electronics/SENSE-Arduino-Library>
  - b. Open Arduino IDE -> Sketch -> Include Library -> Add .ZIP Library -> "SENSE-Arduino-Library"

### **SENSE Library Examples:**

- BME688
  - bme680test (prints temperature, pressure, humidity, gas, and altitude)
    - The BME688 temperature does not come calibrated from the factory so it may require to be offset in order to get more accurate results
      - The easiest solution is to subtract 5 degrees celsius from the temperature reading
- APDS9960
  - color\_sensor (prints red, blue, green, and clear light)
  - gesture\_sensor (detects up/down/left/right gestures)
  - proximity\_sensor (returns distance value between 0 and 255) (100mm range)
- PCF8523
  - pcf8523 (uncomment line 28 to set time) (prints current time)
- PDM Microphone (SAMD support only) (change PDM pin declarations on line 18)
  - sound intensity (prints sound intensity) and decibel output (uses sound intensity and trend line to approximate decibel level)
  - pdm\_analogoutput (echos audio data to A0) (listen with headphones or watch with oscilloscope)

\*\*\*For using the **micro SD card holder**, go to File -> Examples -> SD \*\*\*  
(SD Library is already included in Arduino IDE)

- Just make sure to change CS pin

### **Installing the BSEC Arduino Library:** (additional functionality)

- a. <https://github.com/BoschSensortec/BSEC-Arduino-library>
- b. Open Arduino IDE -> Sketch -> Include Library -> Add .ZIP Library -> "BSEC-Arduino-Library"
- c. Change line: `aqSensor.begin(BME680_I2C_ADDR_PRIMARY, Wire);`  
To: `iaqSensor.begin(BME680_I2C_ADDR_SECONDARY, Wire);`

### **Getting Started with Circuit Python:**



1. Setting up Circuit Python (Follow Adafruit Guide) (You can skip this step if you already know how to use Circuit Python)
  - a. <https://learn.adafruit.com/welcome-to-circuitpython>
2. Install SENSE Circuit Python Library
  - a. Download Library
    - i. <https://github.com/Nexus-Electronics/SENSE-Circuit-Python-Library>
  - b. Unzip folder and navigate to “lib”
  - c. Copy all files to “lib” folder on CIRCUITPY drive
3. Open Python Editor
  - a. Mu is a great IDE for beginners
    - i. <https://codewith.mu/>

### **Library Examples**

- BME688
  - bme688.py (print temperature, pressure, humidity, gas, and altitude)
- APDS9960
  - adps9960\_color.py (print red, green, blue, and clear light)
  - adps9960\_gesture.py (detect up/down/left/right hand gestures)
  - adps9960\_proximity.py (print distance value to sensor)
- PCF8523
  - pcf8523.py (set time and date) (print time and date)
- PDM Microphone
  - microphone.py (sound intensity)
- Micro SD Card
  - sd\_card.py (change CS pin for your SPI bus)
  - How to use SDIO:
    - <https://learn.adafruit.com/adafruit-microsd-spi-sdio/using-sdioio>

### **Getting Started with Raspberry Pi**

1. Install Blinka to use Circuit Python on Raspberry Pi



- a. <https://learn.adafruit.com/circuitpython-on-raspberrypi-linux/installing-circuitpython-on-raspberrypi>
2. Download SENSE Raspberry Pi Examples
  - a. <https://github.com/Nexus-Electronics/SENSE-Raspberry-Pi-Library>
3. Install Libraries
  - a. BME688 Library - <https://pypi.org/project/adafruit-circuitpython-bme680/>
  - b. APDS9960 Library - <https://pypi.org/project/adafruit-circuitpython-apds9960/>
  - c. PCF8523 Library - <https://pypi.org/project/adafruit-circuitpython-pcf8523/>

### Library Examples

- BME688
  - bme688.py (print temperature, pressure, humidity, gas, and altitude)
- APDS9960
  - adps9960\_color.py (print red, green, blue, and clear light)
  - adps9960\_gesture.py (detect up/down/left/right hand gestures)
  - adps9960\_proximity.py (print distance value to sensor)
- PCF8523
  - pcf8523.py (set time and date) (print time and date)
- PDM Microphone
  - Record audio (advanced -> coming soon)
- Micro SD Card (advanced workaround)
  - [https://ralimtek.com/posts/2016/2016-12-10-raspberry\\_pi\\_secondary\\_sd\\_card/](https://ralimtek.com/posts/2016/2016-12-10-raspberry_pi_secondary_sd_card/)

### Frequently Asked Questions and Troubleshooting:





1. Temperature reading too high?
  - a. The BME688 does not come calibrated from the factory so it may require to be offset
    - i. The easiest practice is to subtract 5 degrees celsius from reading (this practice is already implemented in Circuit Python example)