



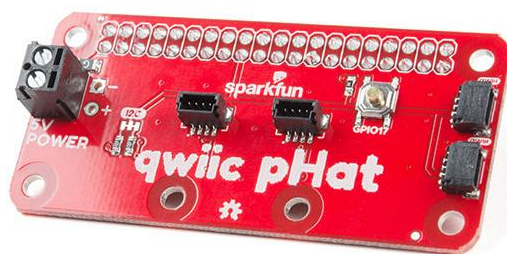


# Qwiic pHAT for Raspberry Pi Hookup Guide

CONTRIBUTORS:  [BBOYHO](#),  [ENGLANDSAURUS](#)

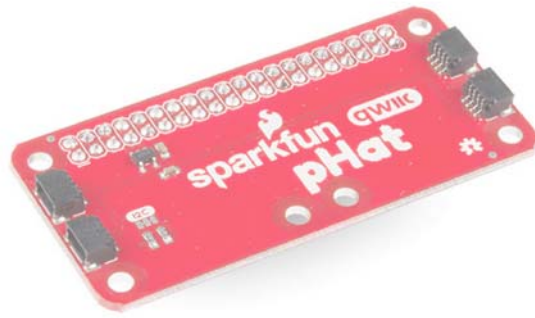
## Introduction

This Qwiic pHAT [v2.0 and v1.0] for Raspberry Pi is based on the [Qwiic Hat](#). The board is the quickest and easiest way to utilize SparkFun's Qwiic ecosystem while still using that Raspberry Pi that you've come to know and love. This Qwiic pHAT connects the I<sup>2</sup>C bus (GND, 3.3V, SDA, and SCL) on your Raspberry Pi to an array of Qwiic connectors. Since the Qwiic system allows for daisy chaining (as long as your devices are on different addresses), you can stack as many sensors as you'd like to create a tower of sensing power!



SparkFun Qwiic pHAT v2.0 for Raspberry Pi  
DEV-15945

**\$7.25**



SparkFun Qwiic pHAT for Raspberry Pi  
DEV-15351

**Retired**

Product Showcase: SparkFun Qwiic pHAT V2.0 for Raspberry Pi



## Product Showcase: SparkFun Qwiic pHAT for Raspberry Pi



*Click on the video's full screen button for a closer view.*

### Required Materials

To follow along with this tutorial, you will need the following materials. You may not need everything though depending on what you have. Add it to your cart, read through the guide, and adjust the cart as necessary.

#### SINGLE BOARD COMPUTER

You will need Raspberry Pi with 2x20 male headers installed. For those that are using an enclosure with the Raspberry Pi, you'll want to get two rows of 1x20 stackable headers in order to help extend the pins outside of the enclosure.



Raspberry Pi 3 B+  
DEV-14643  
**\$35.00**



Extended GPIO Female Header - 2x20  
Pin (13.5mm/9.80mm)  
PRT-16764  
**\$3.25**



### ESP32 Thing Stackable Header Set

PRT-14311

**\$2.50**

A Pi Zero W will also work but you will need to make sure to solder some male headers to it.



### GPIO Male Header - 2x20

PRT-14275

**\$1.10**



### Raspberry Pi Zero W

DEV-14277

**\$15.00**

Or you could stack it on any single board computer (like the NVIDIA Jetson Nano) that utilizes the 40-pin Raspberry Pi header footprint.



### NVIDIA Jetson Nano Developer Kit

DEV-15297

**Retired**



### Google Coral Development Board

DEV-15318

**Retired**

## QWIIIC BOARD

Now you probably didn't buy the Qwiic pHAT if you didn't have any Qwiic products to use with it, right? If you don't have any Qwiic products, the following might not be a bad place to start.



SparkFun GPS Breakout - XA1110 (Qwiic)  
GPS-14414  
**\$35.95**



SparkFun Qwiic Adapter  
DEV-14495  
**\$1.60**



SparkFun Spectral Sensor Breakout -  
AS7262 Visible (Qwiic)  
SEN-14347  
**\$28.50**



SparkFun Environmental Combo  
Breakout - CCS811/BME280 (Qwiic)  
SEN-14348  
**Retired**

Finally, you'll need our handy Qwiic cables to easily connect sensors to your Qwiic pHAT. Below are a few options.



Qwiic Cable - 100mm  
PRT-14427  
**\$1.50**



Qwiic Cable - 50mm  
PRT-14426  
**Retired**



Qwiic Cable - 200mm  
PRT-14428  
**Retired**



Qwiic Cable - 500mm  
PRT-14429  
**Retired**

## Required Setup Tools

As a desktop, these devices are required:

- USB Mouse
- USB Keyboard
- HDMI monitor/TV/[adapted VGA](#)
- [5V Power Supply](#)

## Suggested Reading

If you aren't familiar with the Qwiic system, we recommend reading [here for an overview](#).



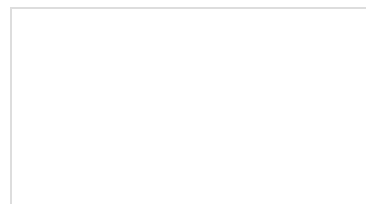
*Qwiic Connect System*

We would also recommend taking a look at the following tutorials if you aren't familiar with them.



### I2C

An introduction to I2C, one of the main embedded communications protocols in use today.

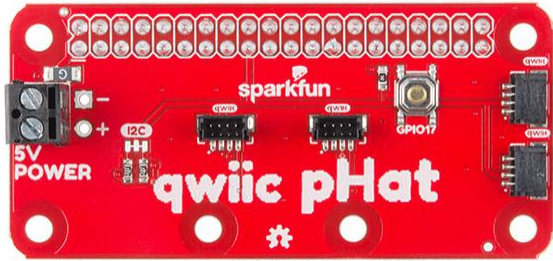



### Serial Terminal Basics

This tutorial will show you how to communicate with your serial devices using a variety of terminal emulator applications.

## Hardware Overview

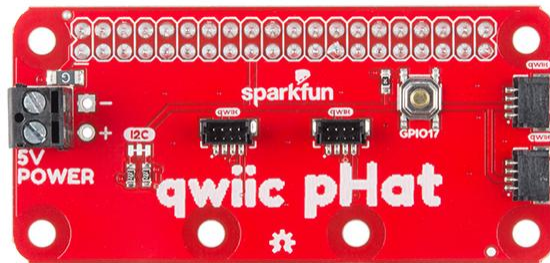
There are two pHAT versions out in the wild! Overall, they function the same to Qwiic-ly connect your I<sup>2</sup>C devices to your single board computer. However, there are small differences between the two boards. Click on one of the images below to explore the hardware for your respective Qwiic pHAT.

	
<i>Qwiic pHAT v2.0</i>	<i>Qwiic pHAT v1.0</i>

### Qwiic pHAT v2.0

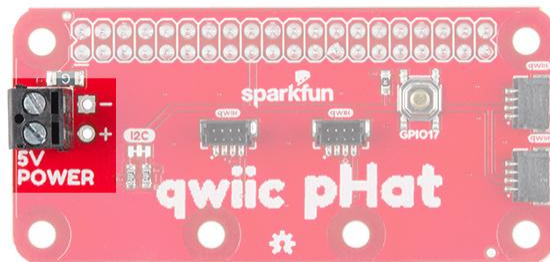
#### I<sup>2</sup>C PINS

The Qwiic pHAT has 4x Qwiic connect ports, all on the same I<sup>2</sup>C bus. There are two vertical Qwiic connectors located at the center and two horizontal connectors on the right side.



#### 5V POWER

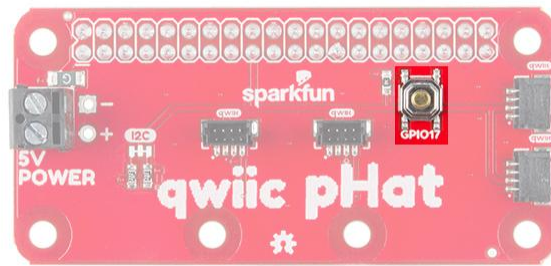
If you need to power a device with 5V, we have broken out the Raspberry Pi's 5V and GND pins on the side with a screw terminal. Depending on your project, you can also [solder to the PTH pads](#).



#### GENERAL PURPOSE BUTTON

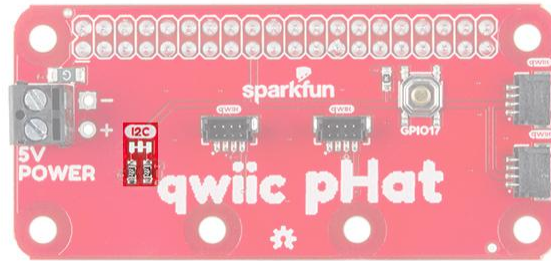
Included on the board is a general purpose button connected to GPIO17. You can use the button however you would like but we found it useful to shutdown or reboot a Raspberry Pi [with a Python script](#).





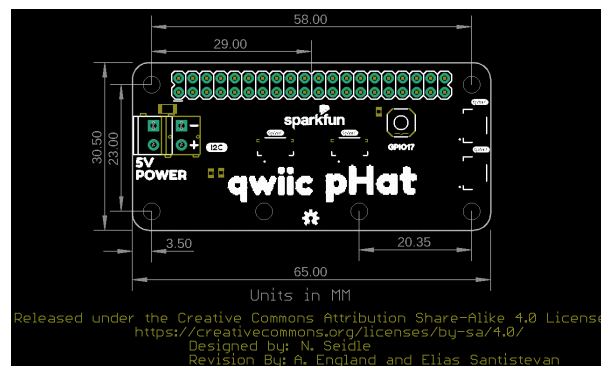
## JUMPERS

There are built-in pull-up resistors on board. If necessary, you can cut the traces to disable depending on the number of boards connected to the I<sup>2</sup>C bus.



## BOARD DIMENSIONS

The board is about 65.00mm x 30.50mm. There are six mounting holes on the board. Two pairs of mounting holes were optimized to easily mount Qwiic devices that have the standard 1.0"x1.0" sized board.



## Qwiic pHAT v1.0

### I<sup>2</sup>C PINS

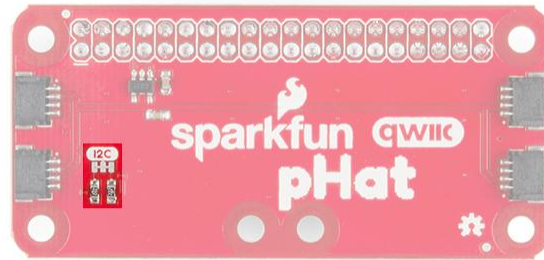
The Qwiic pHAT has 4x Qwiic connect ports, all on the same I<sup>2</sup>C bus. A **3.3V** regulator is included to regulate voltage down for any Qwiic boards connected.



## JUMPERS

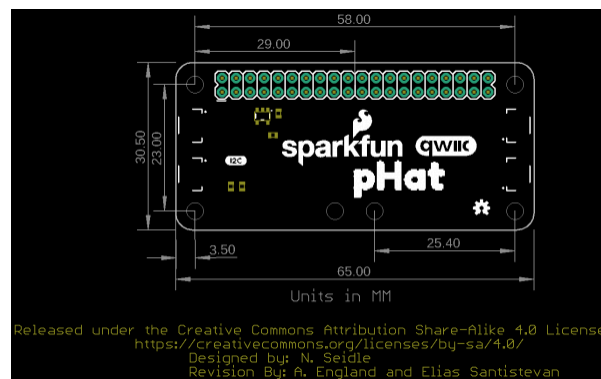


There are built-in pull-up resistors on board. If necessary, you can cut the traces to disable depending on the number of boards connected to the I<sup>2</sup>C bus.



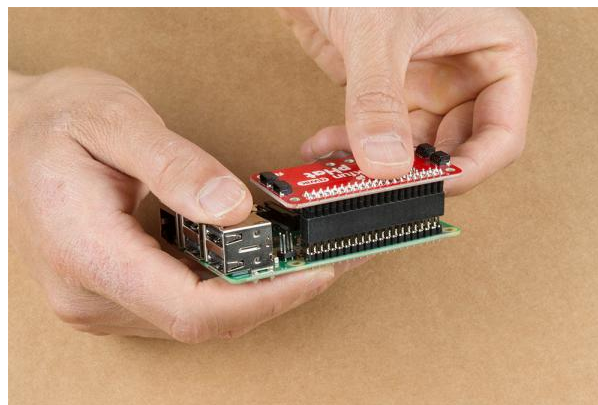
## BOARD DIMENSIONS

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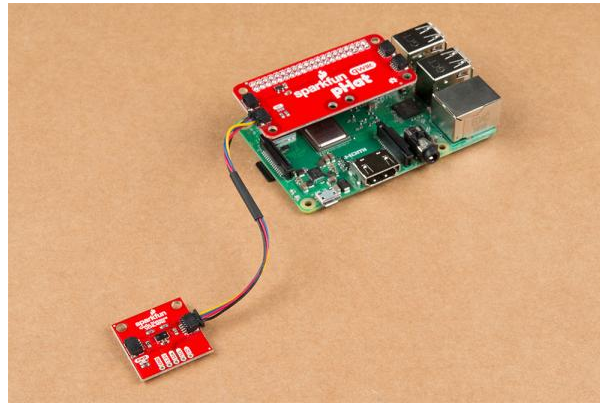


## Hardware Assembly

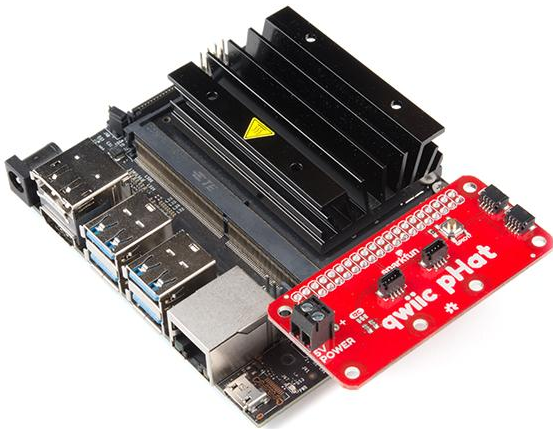
To get started with your Qwiic pHAT, simply plug it into the headers on the Raspberry Pi with the letters facing you. We'll use the Qwiic pHAT v1.0 in the following images to connect a Qwiic device.



Once the pHAT is plugged in, you can start plugging in any Qwiic enabled sensors.

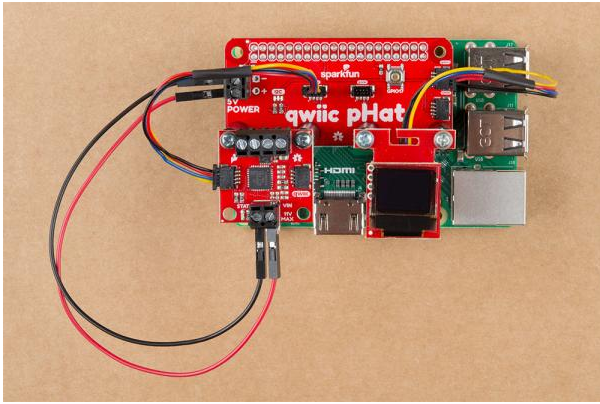


**Note:** The Qwiic pHat is also compatible with single board computers (like the [NVIDIA Jetson Nano](#) or the [Google Coral](#)) that utilize the 40-pin Raspberry Pi header footprint. Below are images of v2.0 and v1.0 stacked on the different single board computers.

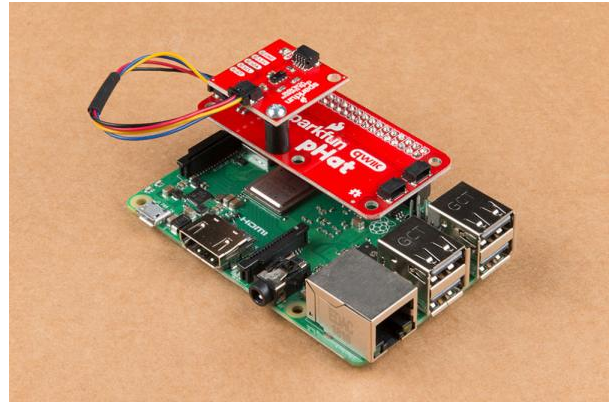


## Standoffs and Mounting Holes

Depending on your project, you can mount a qwiic enabled board on the mounting holes using [standoffs](#). Below are two images showing Qwiic devices mounted on each version of the Qwiic pHAT.



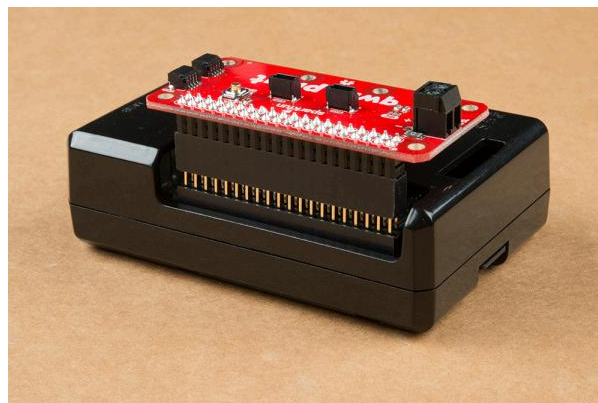
*Qwiic Devices Mounted on v2.0*



*Qwiic Device Mounted on v1.0*

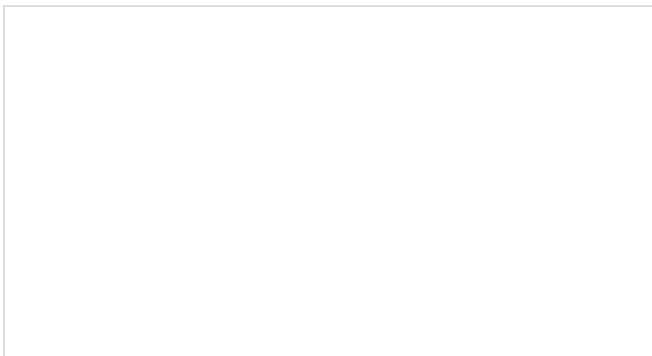
## Stackable Headers

When placing a Raspberry Pi and the pHat in an enclosure (like the Pi Tin), we noticed that the pHat was not fully inserted in Pi's header pins. You will need an additional pair of stackable headers for a secure connection depending on your enclosure. Otherwise, the original Qwiic HAT would be better if you need to using the boards in an enclosure.



## Getting an OS

We recommend checking out the Raspberry Pi 4 Hookup Guide to install the operating system to flash the image to your microSD card for detailed instructions.



Raspberry Pi 4 Kit Hookup Guide  
MARCH 14, 2020

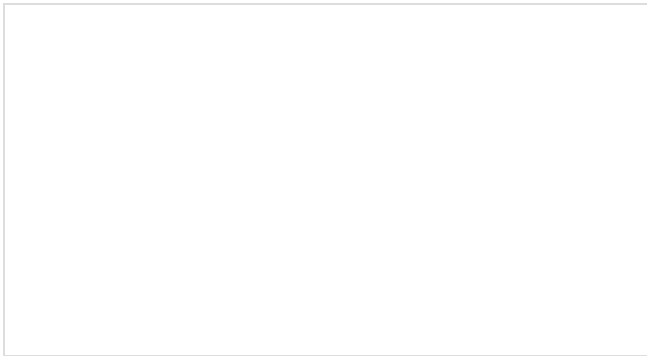
Guide for hooking up your Raspberry Pi 4 Model B basic, desktop, or hardware starter kit together.

If you're starting from scratch with a blank microSD card, you'll want to install Raspbian. If you've already got a working Raspbian system, skip ahead to the next section. Be patient — each of these steps can take a while depending on the speed of your microSD card.

1. **Download an Image** — Download your favorite Linux distribution. For beginners, we recommend getting [NOOBS](#) image.
2. **Flashing the Image** — Follow the instructions from the [Raspberry Pi 4 Kit Hookup Guide](#) to flash your [microSD card](#). You can also follow the official Raspberry Pi [installation instructions](#).

## Configuring the Pi

The peripherals are not turned on by default. For those using Qwiic-enabled devices, you will want to enable I2C port. There are two methods to adjust the settings. This is outlined in our [Raspberry Pi I2C tutorial](#).



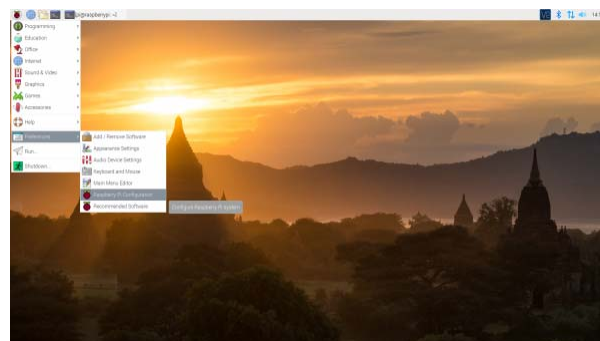
### Raspberry Pi SPI and I2C Tutorial OCTOBER 29, 2015

Learn how to use serial I2C and SPI buses on your Raspberry Pi using the wiringPi I/O library for C/C++ and spidev/smbus for Python.

We've included the following instructions from the tutorial. To enable it, follow the steps below.

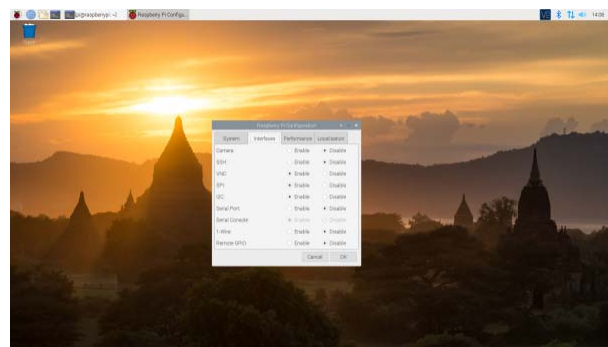
#### **RASPBERRY PI CONFIGURATION** VIA DESKTOP GUI

You can use the Desktop GUI by heading to the **Pi Start Menu > Preferences > Raspberry Pi Configuration**.




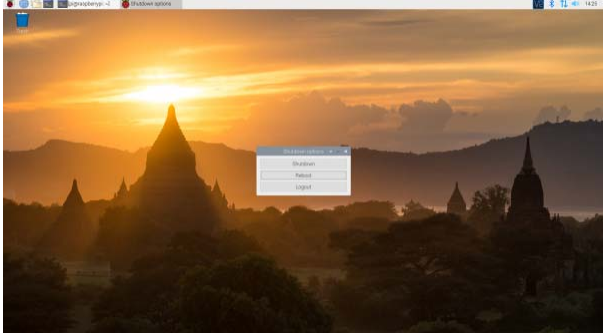
*Click on image for a closer view.*

A window will pop up with different tabs to adjust settings. What we are interested is the **Interfaces** tab. Click on the tab and select **Enable** for **I2C**. At this point, you can enable additional interfaces depending on your project needs. Click on the **OK** button to same.



Click on image for a closer view.

We recommend restarting your Pi to ensure that the changes to take effect. Click on the **Pi Start Menu > Preferences > Shutdown**. Since we just need to restart, click on the **Restart** button.

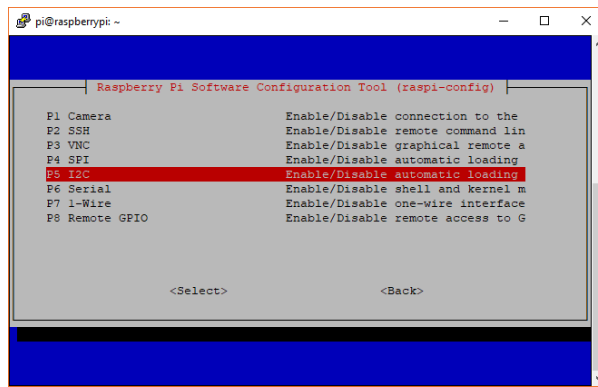
	
Shutdown	Turn Off, Restart, Log Off

Click on images for a closer view.

**RASPI-CONFIG TOOL VIA TERMINAL**

Again, we can use `raspi-config` to enable it.

- 1. Run `sudo raspi-config` .
- 2. Use the down arrow to select 5 Interfacing Options
- 3. Arrow down to P5 I2C .
- 4. Select yes when it asks you to enable I2C
- 5. Also select yes if it asks about automatically loading the kernel module.
- 6. Use the right arrow to select the <Finish> button.
- 7. Select yes when it asks to reboot.



### *Raspi-config for I2C*

The system will reboot. When it comes back up, log in and enter the following command

```
ls /dev/*i2c*
```

The Pi should respond with

```
/dev/i2c-1
```

Which represents the user-mode I2C interface.

## Scanning for I2C Devices

The best place to start would be to scan for an I<sup>2</sup>C device on the bus.

### Configuration

Like the SPI peripheral, I2C is not turned on by default. Again, we can use `raspi-config` to enable it.

1. Run `sudo raspi-config`.
2. Use the down arrow to select 5 Interfacing Options
3. Arrow down to P5 I2C.
4. Select `yes` when it asks you to enable I2C
5. Select `ok` and then `Finish`

Once you return to terminal, enter this command:

```
ls /dev/*i2c*
```

The Pi should respond with:

```
/dev/i2c-1
```

Which represents the user-mode I2C interface.

## Utilities

There is a set of command-line utility programs that can help get an I<sup>2</sup>C interface working. You can get them with the apt package manager. Enter the following command.

```
sudo apt-get install -y i2c-tools
```

In particular, the `i2cdetect` program will probe all the addresses on a bus, and report whether any devices are present. Enter the following command in the command line. The `-y` flag will disable interactive mode so that you do not have to wait for confirmation. The `1` indicates that we are scanning for I<sup>2</sup>C devices on I<sup>2</sup>C bus 1 (e.g. i2c-1).

```
i2cdetect -y 1
```

You will get an output from your Raspberry Pi similar to the output below.

```
pi@raspberrypi:~/$ i2cdetect -y 1
    0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:                -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: 60 -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
```

This map indicates that there is a peripheral at address **0x60**. Your address may vary depending on what is connected to the I<sup>2</sup>C bus. For advanced users, you can try to read and write its registers using the `i2cget`, `i2cset` and `i2cdump` commands.

## Resources and Going Further

For more information, check out the resources below:

- Qwiic pHAT V2.0
  - [Schematic \(PDF\)](#)
  - [Eagle Files \(ZIP\)](#)
  - [Board Dimensions \(PNG\)](#)
  - [GitHub Repo](#)
  - [SFE Product Showcase](#)
- Qwiic pHAT V1.0
  - [Schematic \(PDF\)](#)
  - [Eagle Files \(ZIP\)](#)
  - [Board Dimensions \(PNG\)](#)



- [GitHub Repo](#)
- [SFE Product Showcase](#)

Now that you have your Qwiic pHAT ready to go, it's time to check out some of Qwiic enabled products.



SparkFun Qwiic Joystick  
COM-15168  
**\$12.50**



SparkFun GPS Breakout - NEO-M9N,  
U.FL (Qwiic)  
GPS-15712  
**\$70.95**



SparkFun Qwiic LED Stick - APA102C  
COM-18354  
**\$12.50**



SparkFun Qwiic Pocket Development  
Board - ESP32-C6  
DEV-22925  
**\$19.95**

## But I Already Have Sensors!

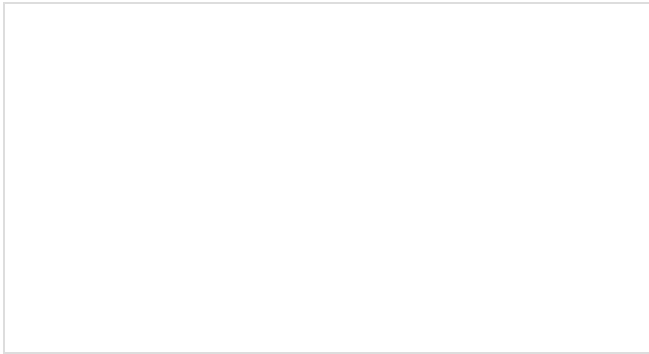
If you already have a handful of SparkFun sensors and parts? SparkFun has been putting our standard GND/VCC/SDA/SCL pinout on all our I<sup>2</sup>C boards for many years. This makes it possible to attach a Qwiic Adapter that will get your SparkFun I<sup>2</sup>C sensor or actuator onto the Qwiic system.

Here is the list of the boards that have the standard I<sup>2</sup>C pinout and will work with the [Qwiic adapter board](#):

- [9DoF Stick IMU - LSM9DS1](#)
- [9DoF IMU - MPU-9250](#)
- [6DoF IMU - LSM303C](#)
- [6DoF IMU - LSM6DS3](#)
- [Triple Axis Accelerometer - LIS3DH](#)
- [Triple Axis Magnetometer - MAG3110](#)
- [Triple Axis Magnetometer - MLX90393](#)
- [Compass Module - HMC6343](#)
- [Atmospheric Sensor - BME280](#)

- [Barometric Pressure Sensor - MS5803-14BA](#)
- [Barometric Pressure Sensor - T5403](#)
- [Humidity and Temperature Sensor - Si7021](#)
- [Digital Temperature Sensor - TMP102](#)
- [Particle Sensor - MAX30105](#)
- [Air Quality Sensor - CCS811](#)
- [ToF Range Finder - VL6180](#)
- [Haptic Motor Driver - DRV2605L](#)
- [Micro OLED Display](#)
- [RGB and Gesture Sensor - APDS-9960](#)
- [RGB Light Sensor - ISL29125](#)
- [LED Driver - LP55231](#)
- [DAC Breakout - MCP4725](#)
- [16 Output I/O Expander - SX1509](#)
- [Battery Babysitter - BQ24075](#)

Looking for inspiration? Check out this related tutorials to use I<sup>2</sup>C devices on a Raspberry Pi:

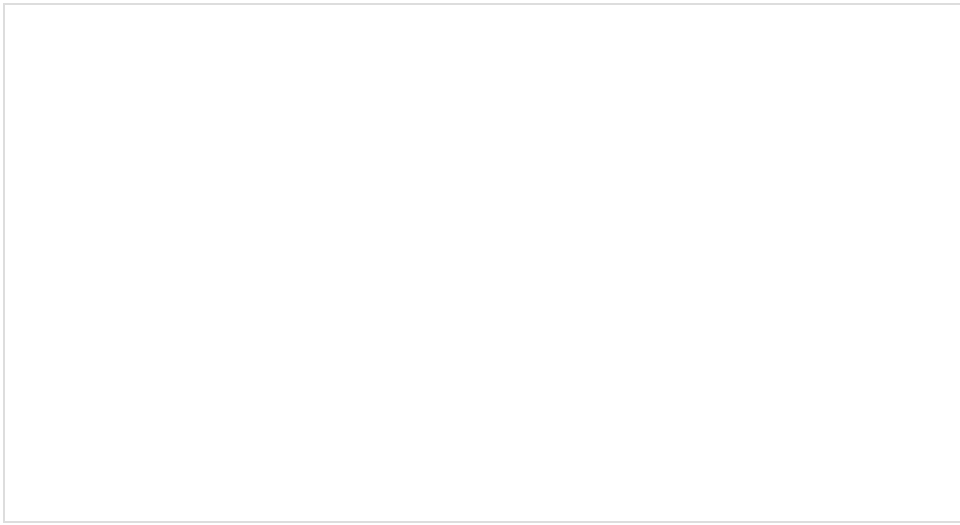


## Raspberry Pi SPI and I2C Tutorial

### OCTOBER 29, 2015

Learn how to use serial I2C and SPI buses on your Raspberry Pi using the wiringPi I/O library for C/C++ and spidev/smbus for Python.

Or try taking advantage of the general purpose button on the Qwiic pHAT v2.0!



## Raspberry Pi Safe Reboot and Shutdown Button

APRIL 20, 2020

Safely reboot or shutdown your Raspberry Pi to avoid corrupting the microSD card using the built-in general purpose button on the Qwiic pHAT v2.0!