

# Qwiic pHAT for Raspberry Pi Hookup Guide

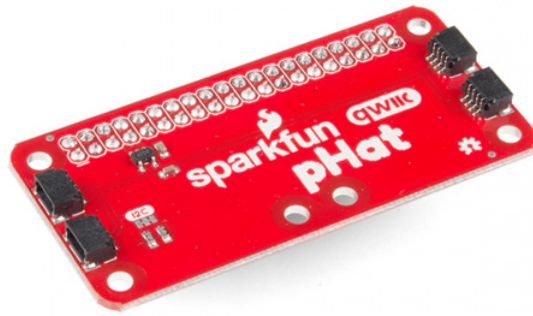
## Introduction

This Qwiic pHAT [v2.0 and v1.0] for Raspberry Pi is based on the Qwiic Hat. The board adds 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



SparkFun Qwiic pHAT for Raspberry Pi  
● DEV-15351

Product Showcase: SparkFun Qwiic pHAT V2.0 for R...



Product Showcase: SparkFun Qwiic pHAT for Raspb...





*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.

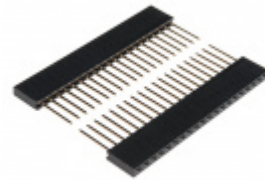
### Single Board Computer

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



ESP32 Thing Stackable Header Set

● PRT-14311

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



Raspberry Pi GPIO Male Header - 2x20

● PRT-14275



Raspberry Pi Zero W

○ DEV-14277

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



Google Coral Development Board  
● DEV-15318

## Qwiic 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 Environmental Combo Breakout - CCS811/BME280 (Qwiic)  
● SEN-14348



SparkFun GPS Breakout - XA1110 (Qwiic)  
○ GPS-14414



SparkFun Spectral Sensor Breakout - AS7262 Visible (Qwiic)  
● SEN-14347



SparkFun Qwiic Adapter  
● DEV-14495

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



Qwiic Cable - 200mm

○ PRT-14428



Qwiic Cable - 50mm

● PRT-14426



Qwiic Cable - 500mm

● PRT-14429

## 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

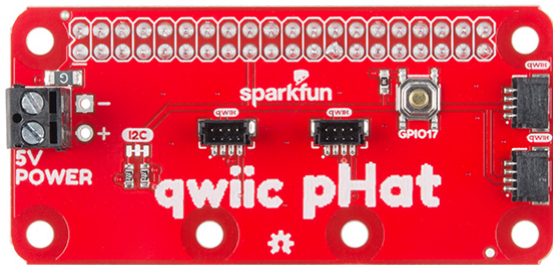
An introduction to I2C, one of the main embedded communications protocols in use today.

## 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.



*Qwiic pHAT v2.0*

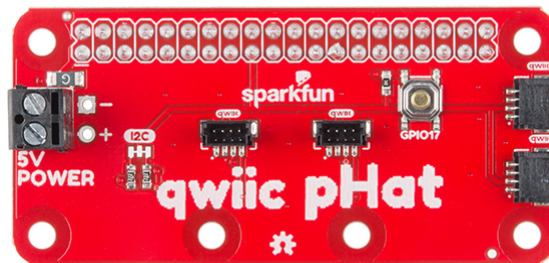


*Qwiic pHAT v1.0*

## Qwiic pHAT v2.0

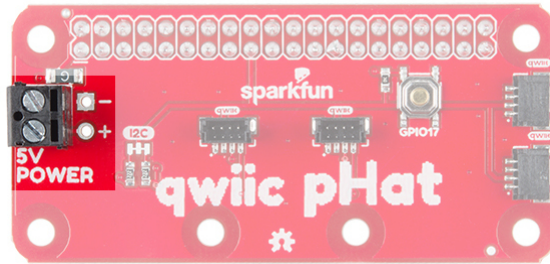
### I<sup>2</sup>C Pins

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.



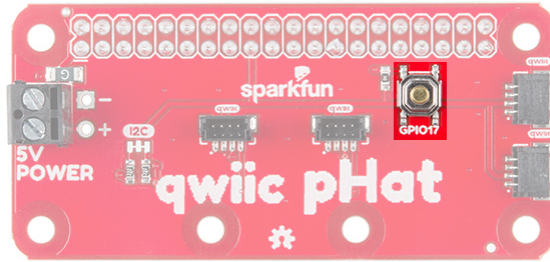
### 5V Power

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.



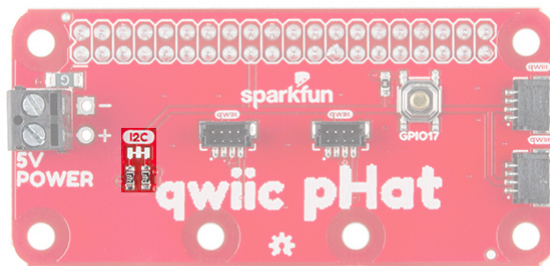
## General Purpose Button

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.



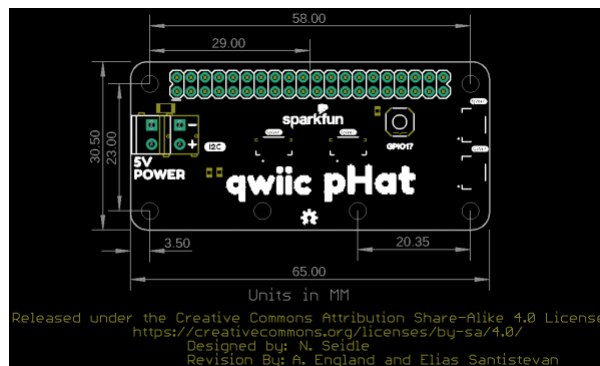
## Jumpers

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

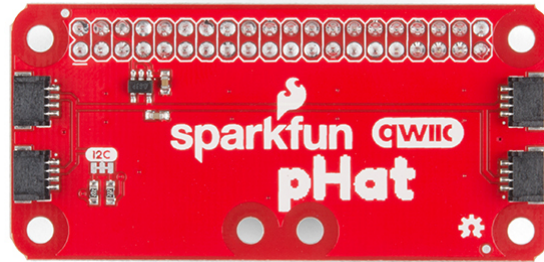
The board is about 65.00mm x 30.50mm. There are six mounting holes on the board. Two pairs of mounting holes were optimized to easily mount Qwiic devices that have the standard 1.0"x1.0" sized board.



## 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.



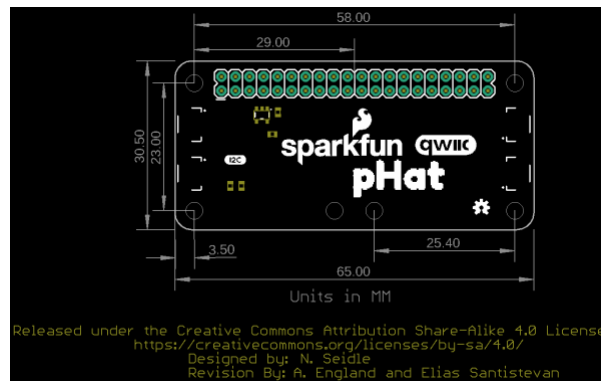
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## Board Dimensions

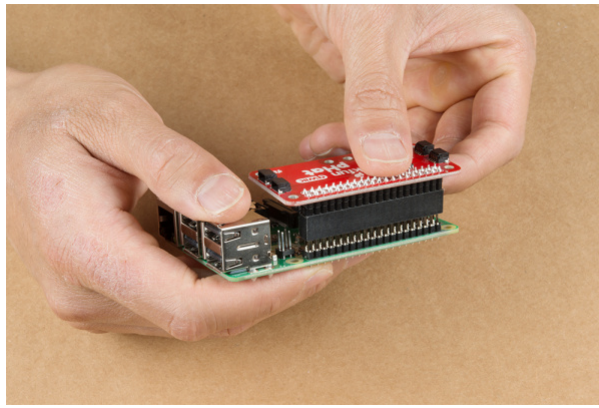
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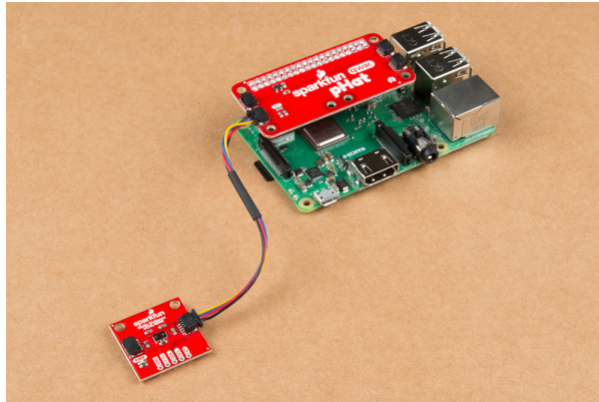
## Hardware Assembly

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.

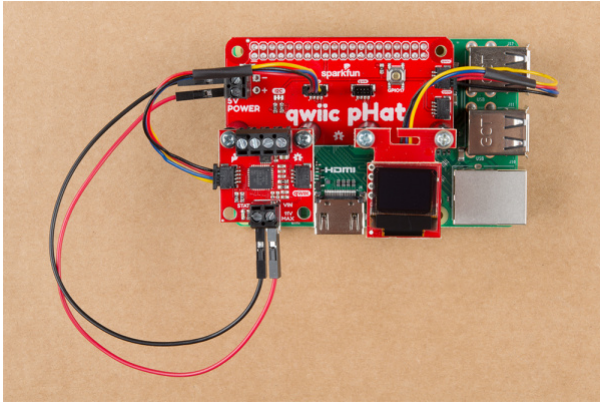


**Note:** The Qwiic pHat is also compatible with single board computers (like the NVIDIA Jetson Nano or the Google Coral) that utilize the 40-pin Raspberry Pi header footprint. Below are images of v2.0 and v1.0 stacked on the different single board computers.

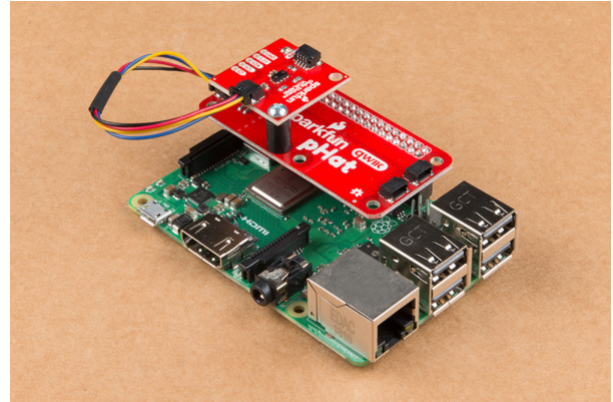


Standoffs and Mounting Holes

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.



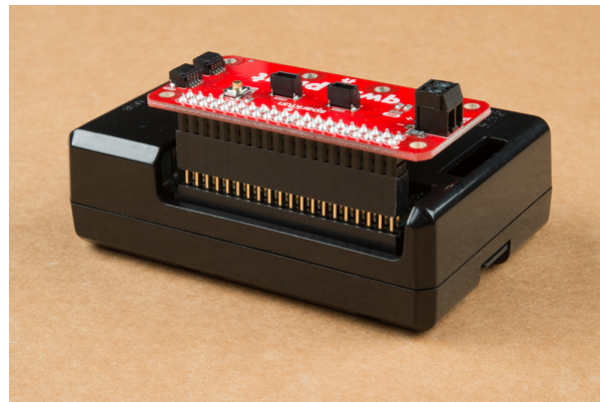
*Qwiic Devices Mounted on v2.0*



*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.



## I2C on Raspberry Pi

### OS and Library Install

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 step 3.

1. Download the NOOBS image. As of this writing, it's at version 2.4.4.
2. Follow the official installation instructions.
3. Follow the Wiring Pi Instructions to get *git*, update and upgrade your Raspbian packages, then install WiringPi.

Be patient -- each of these steps takes a while.

Once you've got wiringPi installed, run the `gpio` commands shown below.

```
>gpio -v
>gpio readall
```

It should respond with some information about the wiringPi version and the Pi that its running on, then draw a table illustrating the configuration for the pins in the 40-pin connector.

## 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 I2C interface working. You can get them with the `apt` package manager.

```
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. Call `i2cdetect -y 1` to probe the first I<sup>2</sup>C bus, which is what the Qwiic pHAT is connected to.

```
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**. We can read and write its registers using the `i2cget`, `i2cset` and `i2cdump` commands.

## Resources and Going Further

For more information, check out the resources below:

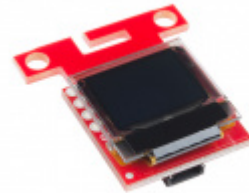
- Qwiic pHAT V2.0
  - Schematic (PDF)
  - Eagle Files (ZIP)
  - Board Dimensions (PNG)
  - GitHub Repo
  - SFE Product Showcase
- Qwiic pHAT V1.0
  - Schematic (PDF)
  - Eagle Files (ZIP)
  - Board Dimensions (PNG)
  - GitHub Repo
  - SFE Product Showcase

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



SparkFun RedBoard Edge

● DEV-14525



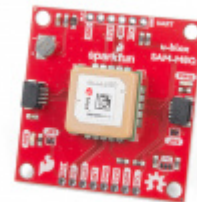
SparkFun Micro OLED Breakout (Qwiic)

● LCD-14532



SparkFun Triad Spectroscopy Sensor - AS7265x (Qwiic)

● SEN-15050



SparkFun GPS Breakout - Chip Antenna, SAM-M8Q (Qwiic)

● GPS-15210

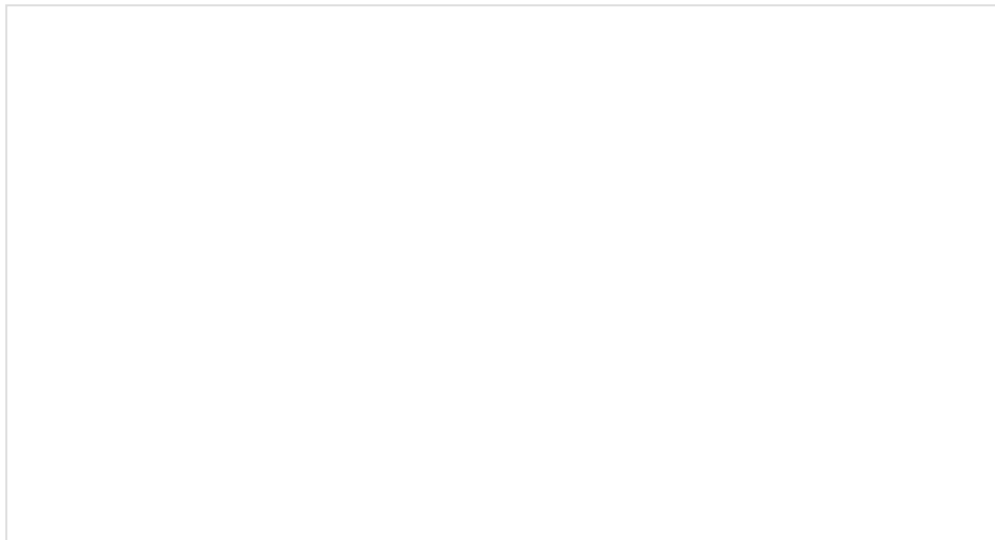
## But I Already Have Sensors!

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.





# Qwiic Kit for Raspberry Pi Hookup Guide

JULY 4, 2019

Get started with the CCS811, BME280, VCNL4040, and microOLED via I2C using the Qwiic system and Python on a Raspberry Pi! Take sensor readings from the environment and display them on the microOLED, serial terminal, or the cloud with Cayenne!