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# Qwiic pHAT for Raspberry Pi Hookup Guide

## Introduction

This Qwiic pHAT 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$^2$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!
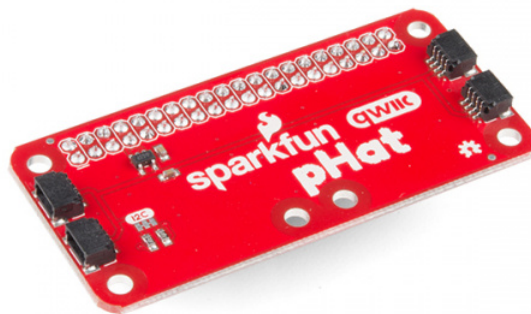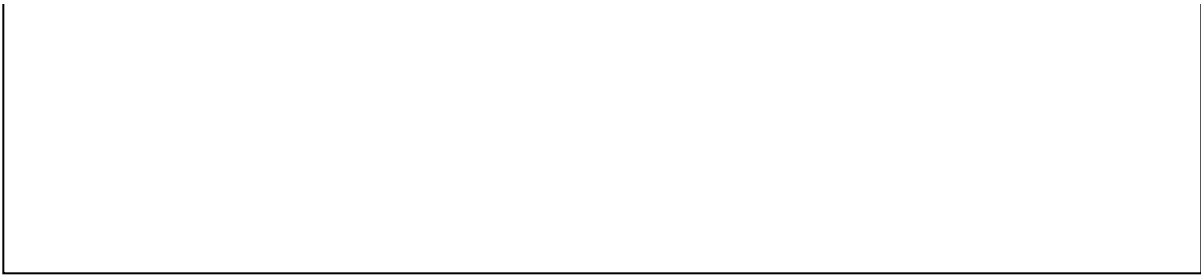


### SparkFun Qwiic pHAT for Raspberry Pi
◉ DEV-15351

Product Showcase: SparkFun Qwiic pHAT for Raspberry Pi

## 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.



**Raspberry Pi 3 B+**
◉ DEV-14643

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 footrpint.

NVIDIA Jetson Nano Developer Kit
○ DEV-15297

## 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 - 500mm**
⊖ PRT-14429



**Qwiic Cable - 200mm**
⊙ PRT-14428



**Qwiic Cable - 50mm**
⊙ PRT-14426

## 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

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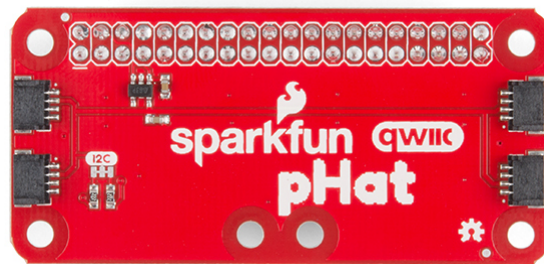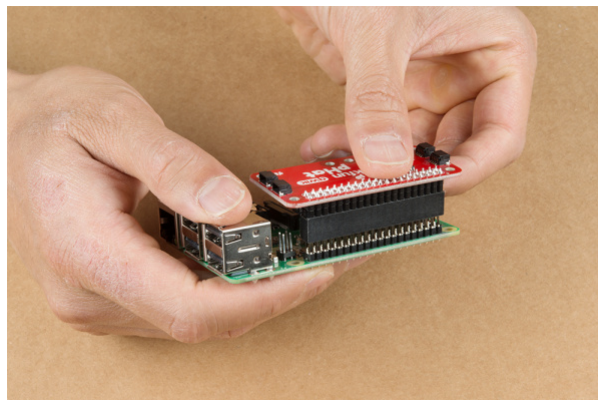


There are built-in pull-up resistors on board. If necessary, you can cut the traces to disable depending on the number of boards connected to the I$^2$C bus.
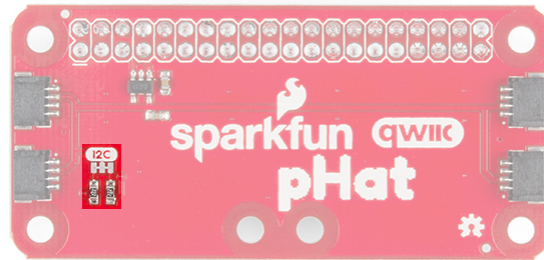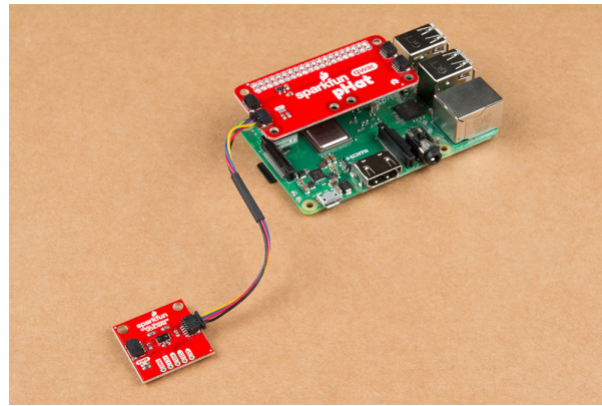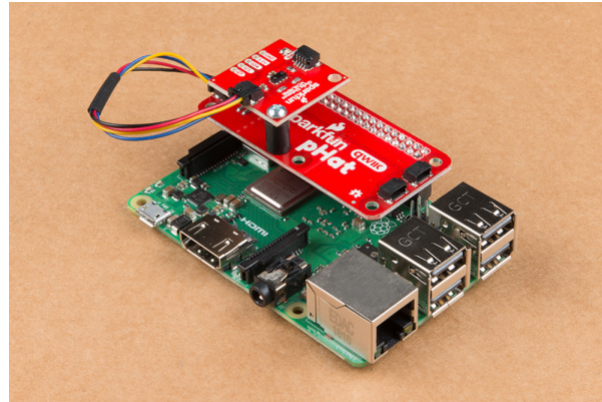


## Hardware Assembly

To get started with your Qwiic pHAT, simply plug it into the headers on the Raspberry Pi with the letters facing you.



Once the pHAT is plugged in, you can start plugging in any Qwiic enabled sensors you might have on either side.

Depending on your project, you can mount a qwiic enabled board on the mounting holes using standoffs.



**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.

| | |
|---|---|
|  |  |
| *Qwiic pHat on Jetson* | *Qwiic pHat on Google Coral* |

> **Note:** 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 stackable header 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.

**Note**: 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 stackable header for a secure connection depending on your 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 Rasbpian 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$^2$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:

- Schematic (PDF)
- Eagle Files (ZIP)
- 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.



Qwiic JST Connector - SMD 4-pin
◉ PRT-14417



Qwiic Cable - Grove Adapter (100mm)
◉ PRT-15109

SparkFun Edge Development Board - Apollo3
Blue
◉ DEV-15170



SparkFun Transparent Graphical OLED
Breakout (Qwiic)
◉ LCD-15173

## 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$^2$C boards for many years. This makes it possible to attach a Qwiic Adapter that will get your SparkFun I$^2$C sensor or actuator onto the Qwiic system.

Here is the list of the boards that have the standard I$^2$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

Check out this related 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.