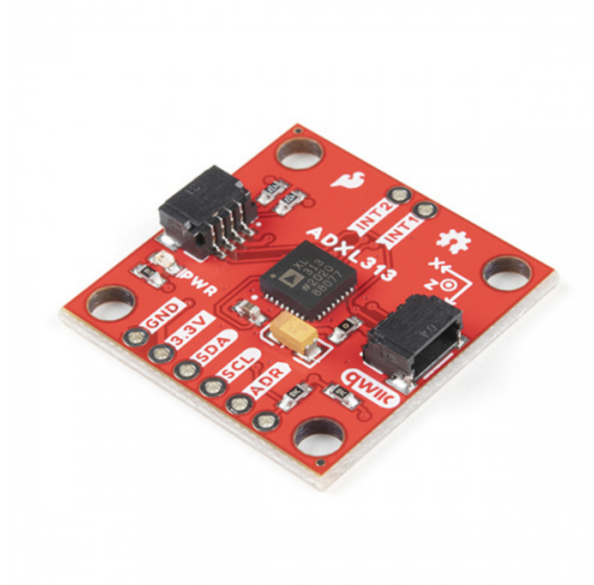
SparkFun Qwiic 3-Axis Accelerometer (ADXL313) Hookup Guide

Introduction

The SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic) is a Qwiic sensor that utilizes the ADXL313 accelerometer from Analog Devices. The ADXL313 is a low cost, low power, up to 13-bit resolution, 3-axis accelerometer with a 32-level FIFO stack capable of measuring up to ±4g.

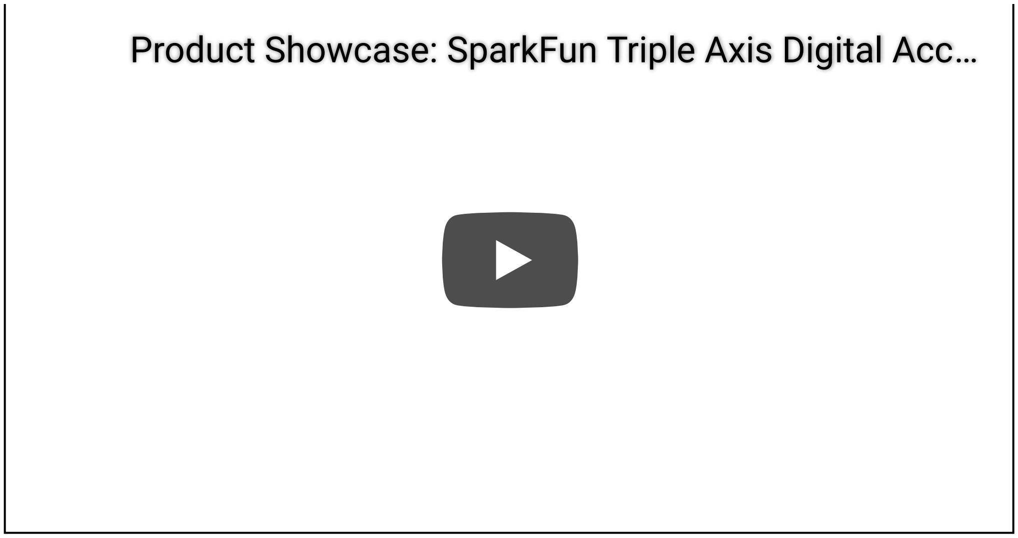


SparkFun Triple Axis Digital Accelerometer Breakout - ADXL313 (Qwiic)

SEN-17241

The ADXL313 can be used in applications like car alarms, hill start aid (HSA) systems, electronic parking brakes, and (black box) data recorders. Some of the specific features of the ADXL313 include:

- Embedded, patent pending FIFO technology minimizes host processor load
- Low noise performance
- Fixed 10-bit resolution for any g-range
- 10,000g survival rating
- Two configurable interrupt pins
    - Including, built-in motion detection functions for activity/inactivity monitoring
- Self-test capability



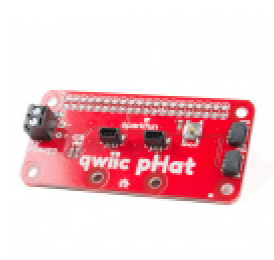
Required Materials

The Qwiic 3-Axis Accelerometer does need a few additional items for you to get started. The RedBoard Qwiic will be used for the Arduino examples. A single board computer and the Qwiic pHAT are required for the Python examples (see note below). You may already have a few of these items, including the required Qwiic cable, so feel free to modify your cart based on your needs. Additionally, there are also alternative parts options that are available as well (*click button below to toggle options*).

SparkFun Qwiic Cable Kit
KIT-15081

SparkFun RedBoard Qwiic
DEV-15123

USB micro-B Cable - 6 Foot
CAB-10215



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

ALTERNATIVE PARTS (TOGGLE)

Python Example: If you don't already have them, you will need an SBC (single board computer) such as a Raspberry Pi and standard peripherals or Jetson Nano and standard peripherals. An example setup is listed below.

SparkFun DLI Kit for Jetson Nano 2GB
KIT-17245

NVIDIA Jetson Nano Developer Kit (V3)
DEV-16271

SparkFun DLI Kit (without Jetson Nano)
KIT-16389

SparkFun Raspberry Pi 4 Basic Kit - 8GB
KIT-16831

pi-topCEED (Green)
KIT-14035

Multimedia Wireless Keyboard
WIG-14271

NVIDIA Jetson Nano 2GB Developer Kit
DEV-17244

Suggested Reading

If you're unfamiliar with serial terminals, jumper pads, or I^{2}C be sure to checkout some of these foundational tutorials.

Installing an Arduino Library
How do I install a custom Arduino library? It's easy! This tutorial will go over how to install an Arduino library using the Arduino Library Manager. For libraries not linked with the Arduino IDE, we will also go over manually installing an Arduino library.

Logic Levels
Learn the difference between 3.3V and 5V devices and logic levels.

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.

How to Work with Jumper Pads and PCB Traces

Handling PCB jumper pads and traces is an essential skill. Learn how to cut a PCB trace, add a solder jumper between pads to reroute connections, and repair a trace with the green wire method if a trace is damaged.

RedBoard Qwiic Hookup Guide

This tutorial covers the basic functionality of the RedBoard Qwiic. This tutorial also covers how to get started blinking an LED and using the Qwiic system.

Qwiic pHAT for Raspberry Pi Hookup Guide

Get started interfacing your Qwiic enabled boards with your Raspberry Pi. The Qwiic pHAT connects the I2C bus (GND, 3.3V, SDA, and SCL) on your Raspberry Pi to an array of Qwiic connectors.

Arduino Shields v2

An update to our classic Arduino Shields Tutorial! All things Arduino shields. What they are and how to assemble them.

Raspberry Pi SPI and I2C Tutorial

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.

Python Programming Tutorial: Getting Started with the Raspberry Pi

This guide will show you how to write programs on your Raspberry Pi using Python to control hardware.

Working with Qwiic on a Jetson Nano through Jupyter Notebooks

We created a few Jupyter Notebooks to make using our Qwiic boards with your Jetson Nano even easier!

The Qwiic ADXL313 Accelerometer utilizes the Qwiic connect system. We recommend familiarizing yourself with the **Logic Levels** and **I^{2}C** tutorials (above) before using it. Click on the banner above to learn more about our Qwiic products.

Note: First time Raspberry Pi users should also head over to the Raspberry Pi Foundation website and check out their quickstart guides:

- Blog Post: Getting started with your Raspberry Pi
- Raspberry Pi Foundation Getting Stared Guides:
    - Getting started with Raspberry Pi Tutorial
    - Setting up your Raspberry Pi Tutorial
- MagPi Books and Guides:
    - Article: Get started with your new Raspberry Pi
    - The Offical Raspberry Pi Beginner’s Book (*December 2017*)
    - Get Started with Raspberry Pi (*November 2019*)
    - The Offical Raspberry Pi Beginner’s Guide: How to use your new computer
      1st Edition (*December 2018*)
      2nd Edition (*June 2019*)
      3rd Edition (*November 2019*)

We have also listed a few additional resources for users to familiarize themselves with the Raspberry Pi:

- Using your Raspberry Pi Tutorial
- Documentation:
  Setup Documentation
  Installation Documentation
  Raspbian Documentation
  SD card Documentation

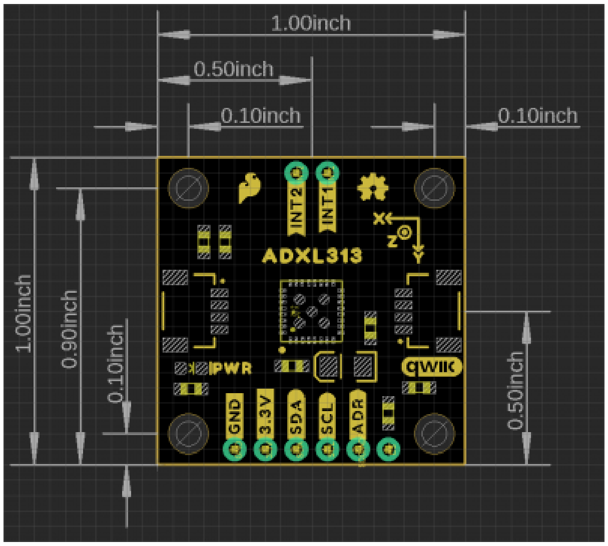
Note: First time Nvidia Jetson Nano users should also head over to the Nvidia website and check out their guides and tutorials:

- Jetson Nano Product Page
- Support Resources
  - Jetson Nano Getting Started Guide
    - Jetson Projects and Learning
      - Jetson Community Projects
      - Forum for Jetson Projects
  - Jetson Download Center
    - Jetson Download Center Archive
  - Nvidia Jetson Tutorials
    - Nvidia Embedded Computing
  - Jetpack Software Documentation
  - Jetson FAQ
  - Wiki: Nvidia Jetson
    - Wiki: Jetson Nano
  - Jetson GPIO Python Package
- User Manuals:
  - Jetson Nano Developer Kit: User Manual

Hardware Overview

Board Dimensions

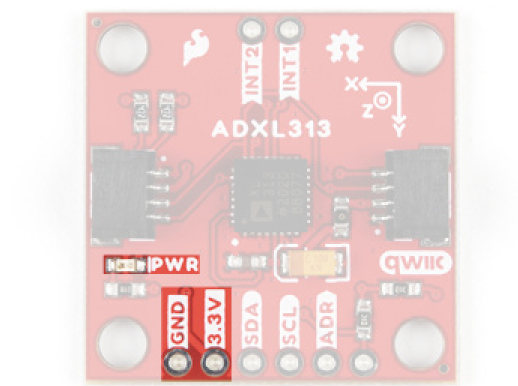
The SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic) is laid out on the standardized 1" x 1" (2.54 x 2.54 cm) Qwiic breakout board and includes the standard four 0.13" mounting holes, which are compatible with M3 screws.



Board dimensions. (Click to enlarge)

Power

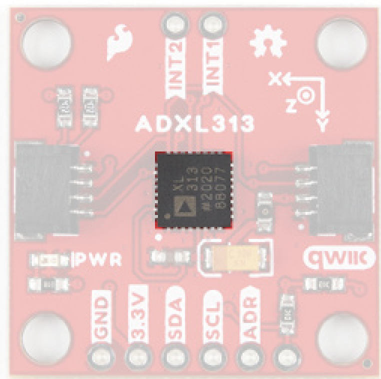
There is a power status LED to help make sure that your Qwiic ADXL313 Accelerometer is getting power. You can power the board either through the *polarized* **Qwiic connector** system or the **breakout pins** (**3.3V** and **GND**) provided. The Qwiic system is meant to run on **3.3V**, be sure that you are NOT using another voltage when using the Qwiic system. A jumper is available on the back of the board to remove power to the LED for low-power applications (*see **Jumpers** section below*).



Power LED and power breakout pins. (Click to enlarge)

ADXL313 Accelerometer

The ADXL313 accelerometer from Analog Devices is a low cost, low power, up to 13-bit resolution, 3-axis accelerometer with a 32-level FIFO stack capable of measuring up to ±4g. The shock rating for the sensor *(IC only, not board)* is up to 10,000g, which is great for data loggers like black boxes. The sensor also has automotive applications including car alarms, hill start aid (HSA) systems, and electronic parking brakes.



Analog Devices ADXL313 accelerometer. (Click to enlarge)

Theory of Operation

The sensor mechanism contains a polysilicon structure built above a silicon wafer. The polysilicon structure includes a central mass with springs to suspend it over the surface of the wafer. An acceleration creates a deflection of the structure, which is measured with differential capacitors, resulting in a sensor output whose amplitude is proportional to acceleration. Phase-sensitive demodulation is used to determine the magnitude and polarity of the acceleration.

For more details, check out these articles from Analog Devices:

- Dual Axis, Low g, Fully Integrated Accelerometers
- Sonic Nirvana: Using MEMS Accelerometers as Acoustic Pickups in Musical Instruments

Sensor Characteristics

Below, is a table of the characteristics of the accelerometer. For more details, please refer to the datasheet.

Characteristic	**Description**
Power	Supply Voltage: **2.0 - 3.6V** Supply Cuurent: • Data Rate > 100Hz: **100 - 300µA** • Data Rate < 10Hz: **30 - 110µA**
Measurement Range	±.5g, ±1g, ±2g, ±4g
Resolution	All Ranges: 10 bits **(Default)** ±.5g Range: 10 bits (Full Resolution) ±1g Range: 11 bits (Full Resolution) ±2g Range: 12 bits (Full Resolution) ±4g Range: 13 bits (Full Resolution)
FIFO Stack	32 levels
Data Rate	6.25 - 3200Hz

I2C Address (7-bit)	**0x1D (Default)**, 0x53
SPI Configuration	3-wire or 4-wire Operation

Power Modes

By default, with standard operation, the ADXL313 automatically modulates its power consumption based on the output data rate. For increased power savings, an optional low power mode is available for data rates below 400 Hz. The available power savings for the low power mode (V_S = 3.3V) is detailed in the table below. In addition, there are two power configurations for minimal power consumption. For more details, please refer to the datasheet.

Output Data Rate (Hz)	**Bandwidth (Hz)**	**Current Consumption *(at V_S = 3.3V)*: I_{DD} (µA)**	
		Std. Operation	**Low Power Mode**
3200	1600	170	---
1600	800	115	---
800	400	170	---
400	200	170	115
200	100	170	82
100	50	170	65
50	25	115	57
25	12.5	82	50
12.5	6.25	65	43
6.25	3.125	57	---

Autosleep Mode

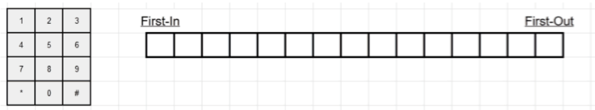
Autosleep mode provides additional power savings by automatically switching the ADXl313 into sleep mode during periods of inactivity. The inactivity level is determined by two factors, a threshold value and a time period. Based upon their configuration, if the sensor doesn't detect an acceleration in excess of the threshold value for the specified time period, the ADXL313 will automatically transition into sleep mode.

Standby Mode

Placing the ADXL313 into standby mode discontinues any measurements, preserves the contents of the FIFO stack, and reduces current consumption down to 0.1 µA.

FIFO Operation

The ADXL313 includes a 32-level FIFO stack management system that is utilized to minimize the burden on the host microcontroller. The buffer has four different modes of operation: Bypass, FIFO, Stream, and Trigger. For more details, please refer to the datasheet.

> **Note:** For users unfamiliar with how a FIFO typically operates, check out this example from the Qwiic Keypad hookup guide.
>
> 
>
>
> *Demonstration of the FIFO: (1) Filling the FIFO stack with inputs, (2) overwriting old inputs, and (3) incrementing & reading the FIFO.*

Bypass Mode

The FIFO is bypassed and no values are stored.

FIFO Mode

The FIFO collects up to 32 values and then stops collecting data and triggers the watermark interrupt, collecting new data only when FIFO is not full. The accelerometer will continue to operate after the FIFO is full, so that features such as activity detection can still be utilized. The watermark interrupt will continue to trigger until the number of samples in FIFO is less than the threshold.

Stream Mode

The FIFO holds the latest 32 data values. When FIFO is full, the oldest data is overwritten with newer data and the watermark interrupt will trigger. The watermark interrupt will continue to trigger until the number of samples in FIFO is less than the threshold.

Trigger Mode

When triggered by the trigger bit, FIFO holds the last data samples before the trigger event and then continues to collect data until full. New data is collected only when FIFO is not full. Additional trigger events will not function in this mode until the trigger mode is cleared.

Self Test Operation

A unique feature of the ADXL313 is the self test operation, which can test the sensor's mechanical and electronic systems simultaneously. When enabled, an electrostatic force is exerted on the mechanical sensor and moves the mechanical sensing element in the same manner as an acceleration would. This creates an additive acceleration that is proportional to V_S^2. For more details, please refer to the datasheet.

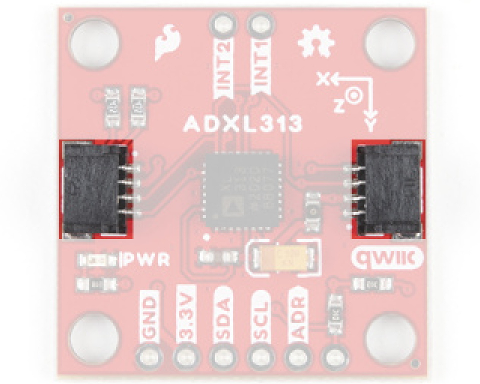
Qwiic and I^2C

I^2C Address

The Qwiic ADXL313 Accelerometer's I^2C address, **0x1D** (7-bit), is factory set. An alternate I^2C address of **0x53** (7-bit) can be configured by modifying the `ADDR` jumper or by pulling the `ADR` pin low.

Qwiic Connectors

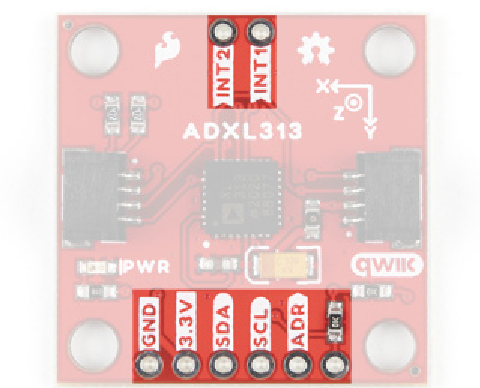
The simplest way to use the Qwiic ADXL313 Accelerometer is through the Qwiic connect system. The connectors are polarized for the I^2C connection and power. (**They are tied to the corresponding power and I^2C breakout pins.*)



Qwiic connectors. (Click to enlarge)

Breakout Pins

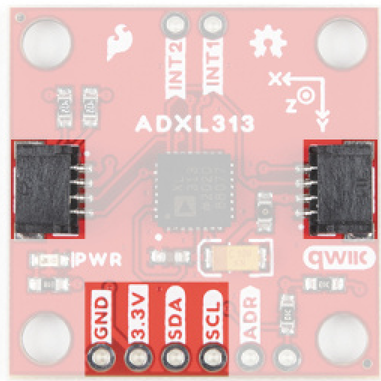
The board also provides eight labeled breakout pins.



Breakout pins. (Click to enlarge)

I^{2}C

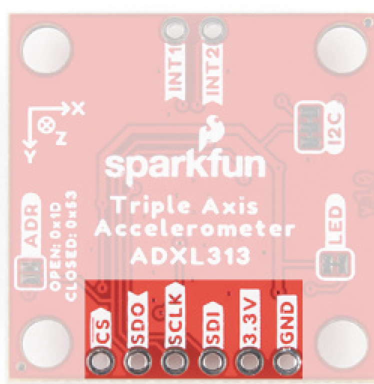
You can connect these lines to the I^{2}C bus of your microcontroller and power pins (**3.3V** and **GND**), if it doesn't have a Qwiic connector. The interrupt pins are also broken out to use for triggered events.



I²C Connections- The pins are tied to the Qwiic connectors.

SPI

You can connect these lines to the SPI bus of your microcontroller and power pins (**3.3V** and **GND**); the sensor can operate in either a 3-wire or 4-wire configuration. The interrupt pins are also broken out to use for triggered events.



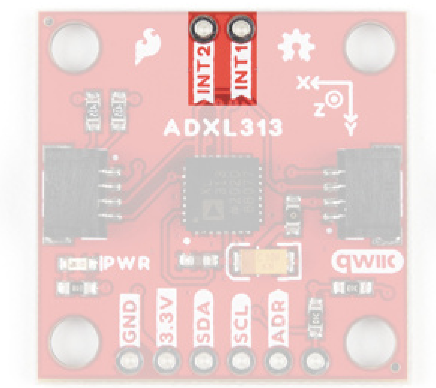
SPI breakout pins. (Click to enlarge)

Interrupt Pins

The interrupt pins (*active high*) are used to indicate various states of the ADXL313, depending on how they are configured and if they are enabled. The interrupt pins can be configured for the following modes:

- Activity - Triggers when the acceleration is greater than a stored threshold.
- Inactivity - Triggers when the acceleration is lower than a store threshold for a specified amount of time (up to 255 seconds).
- Watermark - Triggers when the number of samples stored in the FIFO reaches a specific value.
- Overrun - Triggers when the FIFO is overrun (new data replaces unread data in the stack).

Additionally, the interrupts can be used to trigger measurements into the FIFO, when the FIFO is configured for *Trigger Mode*.



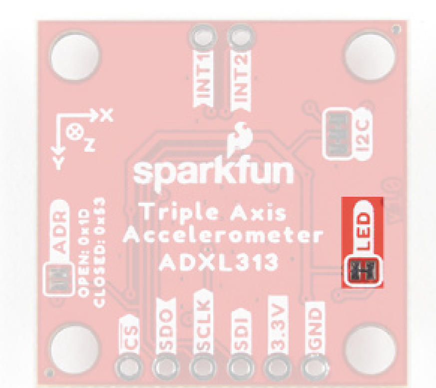
Interrupt breakout pins. (Click to enlarge)

Jumpers

There are three jumpers on the board. Not sure how to cut or modify a jumper? Read here!

Power LED

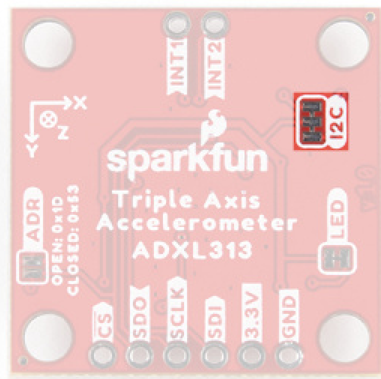
Cutting the **LED** jumper will remove the **1kΩ** resistors and `PWR` LED from the **3.3V** power. This is useful for low power applications.



Power LED jumper. (Click to enlarge)

I^{2}C Pull-Up

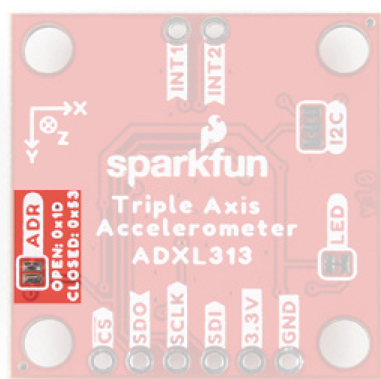
Cutting the **I^{2}C** jumper will remove the **4.7kΩ** pull-up resistors from the I^{2}C bus. If you have many devices on your I^{2}C bus you may want to remove these jumpers.



I^{2}C pull-up resistor jumper. (Click to enlarge)

Address Pull-up

Soldering the **ADR** jumper connect a **10kΩ** pull-up resistor to the `SDO` / `ADR` pin. This can be used to configure the default I^{2}C address of the device to **0x53** (7-bit) on power up.

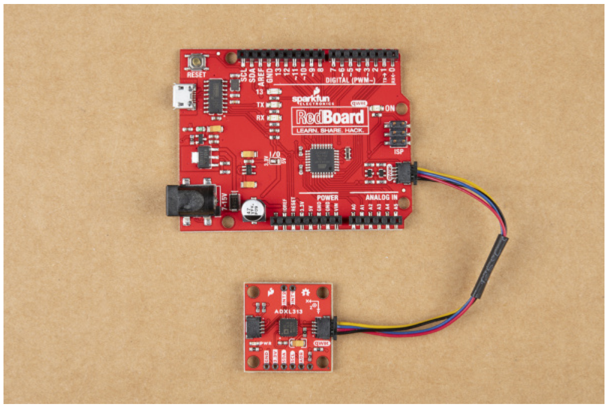


Address jumper. (Click to enlarge)

Hardware Assembly

Arduino Examples

With the Qwiic connector system, assembling the hardware is simple. All you need to do is connect your SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic) to the RedBoard Qwiic with a Qwiic cable. Otherwise, you can use the I^{2}C pins of your microcontroller; just be aware of logic levels.



RedBoard Qwiic connected the Qwiic ADXL313 Accelerometer with a Qwiic cable.

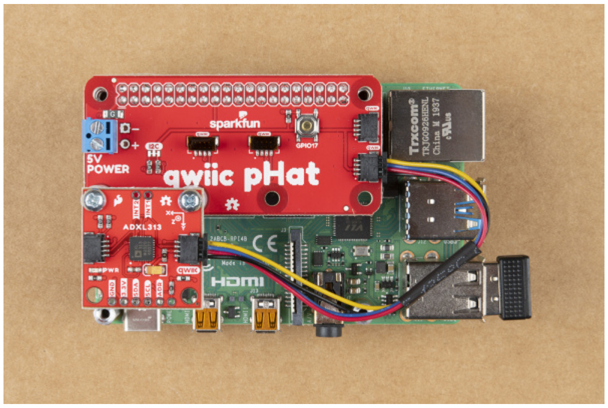
Note: This tutorial assumes users are familiar with Arduino products and are using the latest stable version of the Arduino IDE on your desktop. If this is your first time using the Arduino IDE, please review our tutorial on installing the Arduino IDE.

Python Examples

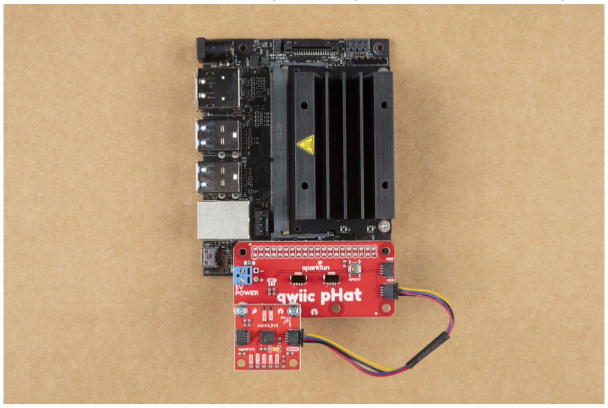
With the Qwiic connector system, assembling the hardware is simple. In addition to the SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic), you will need: a Qwiic cable, a SparkFun Qwiic pHAT for Raspberry Pi, single board computer, monitor, and standard peripherals. (**If you are unfamiliar with the Qwiic pHAT, you can find the Hookup Guide here*.)

There are two single board computer (SBC) options that we have tested on:

- Raspberry Pi setup with the Raspbian OS
- Jetson Nano running Nvidia's L4T image



Raspberry Pi 4 (with Qwiic pHAT) connected the Qwiic ADXL313 Accelerometer.



Jetson connected to the Qwiic ADXL313 Accelerometer.

Note: Don't forget to connect any necessary peripherals, such as a monitor, keyboard and mouse, and power supply to the single board computer.

Note: This tutorial assumes users are familiar with using a Raspberry Pi and have the latest version of Raspbian OS (full... with recommended software) your Raspberry Pi. You can download the latest version of the Raspbian OS from the Raspberry Pi Foundation website.

If this is your first time using a Raspberry Pi, please head over to the Raspberry Pi Foundation website to use their quickstart guides. We have listed a few of them here:

1. Setting up your Raspberry Pi
2. Using your Raspberry Pi
3. Documentation:
   Setup Documentation
   Installation Documentation
   Raspbian Documentation
   SD card Documentation

Note: This tutorial assumes users are familiar with using a Jetson Nano and you have the latest version of L4T OS your Jetson Nano. You can download the latest version of the L4T OS from the Jetson Download Center on Nvidia's website.

If this is your first time using a Jetson Nano, please head over to the Nvidia website to use their quickstart guides. We have listed a few of them here:

1. Getting Started With Jetson Nano Developer Kit
2. Jetson Nano Developer Kit User Guide
3. Documentation:
   Jetson Nano Getting Started Guide
   Jetson Download Center
   Wiki: Jetson Nano
   Jetpack Software Documentation
   Nvidia Jetson Tutorials

Arduino Library

Note: This example assumes you are using the latest version of the Arduino IDE on your desktop. If this is your first time using Arduino, please review our tutorial on installing the Arduino IDE. If you have not previously installed an Arduino library, please check out our installation guide.

We've written a library to easily get setup and take readings from the SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic). However, before we jump into getting data from the sensor, let's take a closer look at the available functions in the library. You can install this library through the Arduino Library Manager. Search for **SparkFun ADXL313 Arduino Library** and you should be able to install the latest version. If you prefer manually downloading the libraries from the GitHub repository, you can grab them here:

DOWNLOAD THE SPARKFUN ADXL313 ARDUINO LIBRARY

Let's get started by looking at the functions that set up the Qwiic Atmospheric Sensor:

Class

In the global scope, construct your sensor object (such as `mySensor`) without arguments.

```
ADXL313 mySensor;
```

Object Parameters and setup()

Rather that passing a bunch of data to the constructor, configuration is accomplished by setting the values of the ADXL313 type in the `setup()` function. They are exposed by being `public:` so use the `myName.aVariable = someValue;` syntax.

- Initialize Sensor
  - .begin() or .begin(i2caddr, Wire) - Initializes the sensor with basic settings and returns false if sensor is not detected.
    - .isConnected() - Returns true if I2C device ack's
  - .beginSPI(CS_pin) - Initializes the sensor with basic settings via SPI and returns false if sensor is not detected.
  - .checkPartId() - Returns true if device's part ID register is correct.
  - .dataReady() - Checks the `dataReady` bit
  - .updateIntSourceStatuses()
  - .standby() - Clears the measure bit, putting decive in standby mode, ready for configuration
  - .measureModeOn() - Sets the measure bit, putting decive in measure mode, ready for reading data
  - .softReset() - Soft reset clears all settings, and puts it in standby mode
  - .printAllRegister() - Print Register Values to Serial Output.
    - Can be used to Manually Check the Current Configuration of Device
- Reading Acceleration
  - .readAccel() - Reads acceleration data from ADXL313 into three class variables: x, y, and z.
- Sensor Configuration
  - Range Setting
    - .setRange(range)
      - 0.5g, 1g, 2g, or 4g
    - .getRange()
  - Autosleep Bit
    - .autosleepOn() - Sets the autosleep bit
      - Note, prior to calling this, you will need to set `THRESH_INACT` and `TIME_INACT`.
    - .autosleepOff() - Clears the autosleep bit
  - Self-Test Bit
    - .setSelfTestBit(selfTestBit)
      - `1` - Self-Test Applied. Electrostatic Force exerted on the sensor causing a shift in the output data.
      - `0` - Self-Test Disabled.

        - .getSelfTestBit()
    - `SPI` Bit State
        - .setSpiBit(spiBit)
            - `1` - Puts Device in 3-wire Mode
            - `0` - Puts Device in 4-wire SPI Mode
        - .getSpiBit()
    - `INT_INVERT` Bit State
        - .setInterruptLevelBit(interruptLevelBit)
            - `0` - Sets the Interrupts to Active HIGH
            - `1` - Sets the Interrupts to Active LOW
        - .getInterruptLevelBit()
    - `FULL_RES` Bit State
        - .setFullResBit(fullResBit)
            - `1` - Device is in Full Resolution Mode: Output Resolution Increase with G Range set by the Range Bits to Maintain a 4mg/LSB Scale Factor
            - `0` - Device is in 10-bit Mode: Range Bits Determine Maximum G Range and Scale Factor
        - .getFullResBit()
    - `JUSTIFY` Bit State
        - .setJustifyBit(justifyBit)
            - `1` - Selects the Left Justified Mode
            - `0` - Selects Right Justified Mode with Sign Extension
        - .getJustifyBit()
    - Gain -Gains for each axis in g's/count
        - .setAxisGains(_gains)
        - .getAxisGains(_gains)
    - `OFSX` , `OFSY` , and `OFSZ` Bytes - User Offset Adjustments in Twos Complement Format. Scale Factor of 15.6mg/LSB.
        - .setAxisOffset(x, y, z)
        - .getAxisOffset(x, y, z)
    - `THRESH_ACT` Register - Holds the Threshold Value for Detecting Activity.
        - .setActivityThreshold(activityThreshold)
            - Data Format is Unsigned, so the Magnitude of the Activity Event is compared with the Value is Compared with the Value in the `THRESH_ACT` Register.
            - The Scale Factor is 62.5mg/LSB.
            - Value of 0 may Result in Undesirable Behavior if the Activity Interrupt Enabled.
            - It Accepts a Maximum Value of 255.
        - .getActivityThreshold() - Gets the THRESH_ACT byte
    - `THRESH_INACT` Register - Holds the Threshold Value for Detecting Inactivity.
        - .setInactivityThreshold(inactivityThreshold)
            - The Data Format is Unsigned, so the Magnitude of the Inactivity Event is compared with the value in the `THRESH_INACT` Register.
            - Scale Factor is 62.5mg/LSB.
            - Value of 0 May Result in Undesirable Behavior if the Inactivity Interrupt Enabled.
            - It Accepts a Maximum Value of 255.
        - .getInactivityThreshold()
    - `TIME_INACT` Register
        - .setTimeInactivity(timeInactivity)

        - Contains an Unsigned Time Value Representing the Amount of Time that Acceleration must be Less Than the Value in the `THRESH_INACT` Register for Inactivity to be Declared.
        - Uses Filtered Output Data unlike other Interrupt Functions
        - Scale Factor is 1sec/LSB.
        - Value Must Be Between 0 and 255.
    - .getTimeInactivity()
- Activity Bits
    - Enabled
        - .isActivityXEnabled()
        - .isActivityYEnabled()
        - .isActivityZEnabled()
        - .isInactivityXEnabled()
        - .isInactivityYEnabled()
        - .isInactivityZEnabled()
    - State
        - .setActivityX(state)
        - .setActivityY(state)
        - .setActivityZ(state)
        - .setActivityXYZ(stateX, stateY, stateZ)
        - .setInactivityX(state)
        - .setInactivityY(state)
        - .setInactivityZ(state)
        - .setInactivityXYZ(stateX, stateY, stateZ)
    - Active
        - .isActivityAc()
        - .isInactivityAc()
        - .setActivityAc(state)
        - .setInactivityAc(state)
- Low Power Bit
    - .isLowPower()
    - .lowPowerOn()
    - .lowPowerOff()
- Rate Bits
    - .getRate()
    - .setRate(rate)
- Bandwidth
    - .setBandwidth(bw)
    - .getBandwidth()
- Trigger Check - Check if Action was Triggered in Interrupts
    - .triggered(interrupts, mask)
    - .getInterruptSource()
    - .getInterruptSource(interruptBit)
    - .getInterruptMapping(interruptBit)
- Interrupt Mapping - Set the Mapping of an Interrupt to `pin1` or `pin2`
    - .setInterruptMapping(interruptBit, interruptPin)
    - .isInterruptEnabled(interruptBit)
    - .setInterrupt(interruptBit, state)
    - .ActivityINT(status)
    - .InactivityINT(status)

- .DataReadyINT(status)
- .WatermarkINT(status)
- .OverrunINT(status)
- FIFO Mode Setting
  - .getFifoMode()
  - .setFifoMode(mode)
  - .getFifoSamplesThreshhold()
  - .setFifoSamplesThreshhold(samples)
  - .getFifoEntriesAmount()
  - .clearFifo()

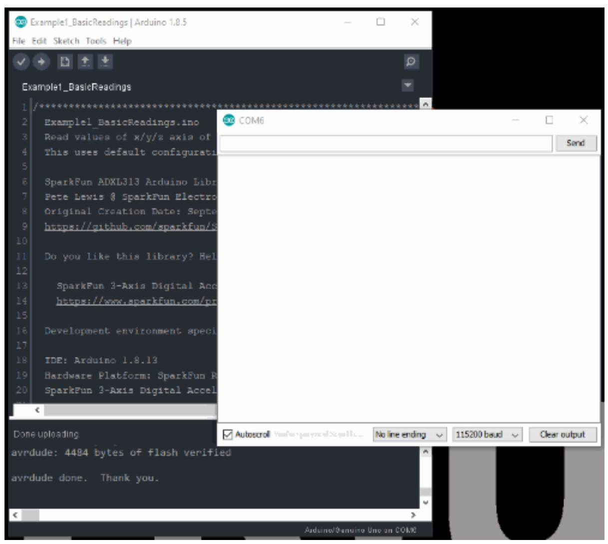
Arduino Examples

Example 1: Basic Readings

Once you've got the library installed, open the **Example1 Basic Readings** sketch. You can find it under

```
File > Examples > SparkFun ADXL313 Arduino Library > Examples
```

Then load it onto your RedBoard or Uno. Open your favorite Serial Terminal to see the printed values.



Raw data readings for ADXL313. (Click to enlarge)

This example outputs the raw acceleration values read by the sensor. To convert the values, use the following equation.

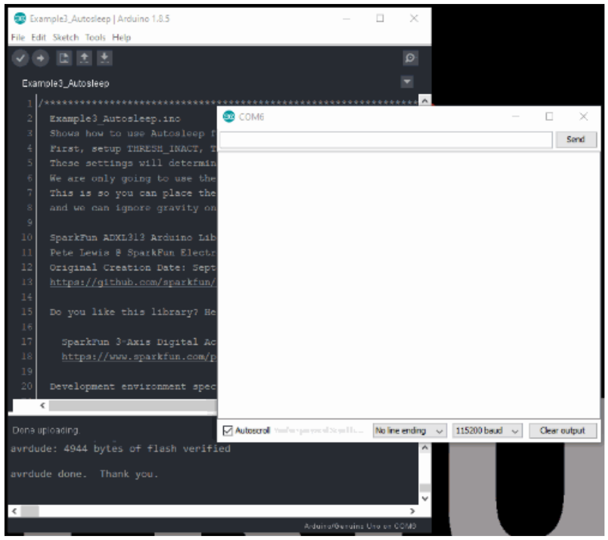
$$\text{g-value} = \frac{\text{g-range} \cdot \text{raw value}}{\text{resolution}}$$

In this example, `g-range` = 2 and the `resolution` = 10-bits = 1024; therefore the measured acceleration (g's):

$$\text{g-value} = \frac{\text{raw value}}{512}$$

Example 3: Auto. Sleep

Open the **Example3 Autosleep** sketch, and load it onto your RedBoard or Uno.



Raw data readings with indicators for when the sensor detects inactivity and enters auto-sleep. (Click to enlarge)

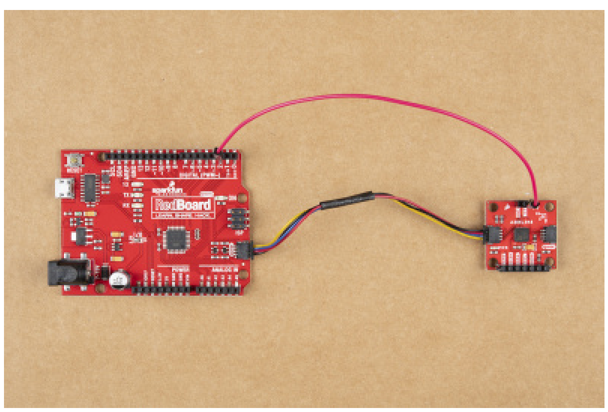
After the sensor detects inactivity for more than 5 seconds, it will automatically enter sleep mode and stop recording data into the FIFO. This conserves power to the accelerometer.

Note: The senor has to be relatively flat on the x-axis in order for it to enter sleep mode. Therefore, users may need to play with a level if their desk isn't level or flat.

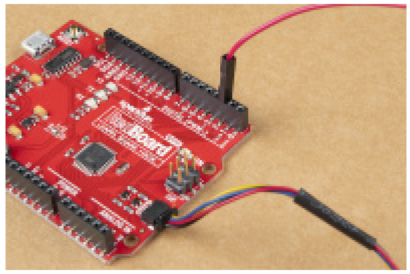
Otherwise, users can change the threshold on line 73: `myAdxl.setActivityThreshold(10); // 0-255 (62.5mg/LSB)` to a higher value, like `40` to increase the inactivity threshold. This means the sensor doesn't have to lie precisely flat, but also means that the sensor requires more acceleration to wake up as well.

Example 6: Interrupt

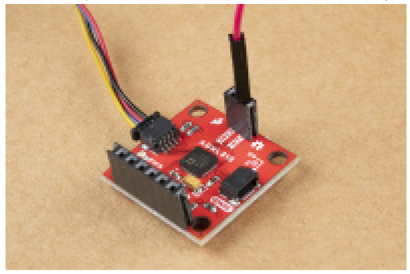
Note: For this example to work, the microcontroller's interrupt pin needs to be connected to the Qwiic ADXL313. Make sure that this pin is also designated in the code. For the RedBoard Qwiic, `Pin 2` can operate as an interrupt and is coded by default in the example.



Wiring between ADXL313 and microcontroller for the interrupt functionality. (Click to enlarge)



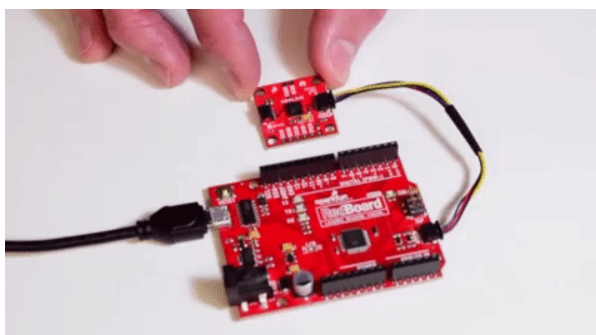
Close up of the wiring at the microcontroller. (Click to enlarge)



Close up of the wiring at the ADXL313 interrupt pin. (Click to enlarge)

Once the interrupt pin has been wired up, open the **Example6 Interrupt** sketch, and load it onto your RedBoard or Uno.

Let the sensor sit still, flat on a table to enter sleep mode. While, shaking the accelerometer will trigger the interrupt on the microcontroller for start reading data. Lying the accelerometer flat and still, will discontinue the sensor readings and put it into sleep mode again.



Waking the microcontroller.

Python Package

Note: The link to the ReadtheDocs documentation for this Python package is currently broken. We are working to resolve the issue.

Note: This tutorial assumes you are using the latest version of Python 3. If this is your first time using Python or I^2C hardware on a Raspberry Pi, please checkout our tutorial on Python Programming with the Raspberry Pi and the Raspberry Pi SPI and I2C Tutorial. Jetson Nano users can check out this tutorial on Working with Qwiic on a Jetson Nano through Jupyter Notebooks.

We've written a Python package to easily get setup and take readings from the ADXL313 accelerometer. There are two methods for installing the Python package for the ADXl313.

1. Install the all inclusive SparkFun Qwiic Python package.
2. Independently install the SparkFun ADXL313 Python package.

The all inclusive SparkFun Qwiic Python package, is recommended as is also installs the required I^{2}C driver as well.

> **Note:** Don't forget to double check that the hardware I^{2}C connection is enabled on your single board computer.

SparkFun Qwiic Package

This repository is hosted on PyPi as the `sparkfun-qwiic` package. On systems that support PyPi installation via `pip3` (use `pip` for Python 2) is simple, using the following commands:

For **all users** (note: the user must have **sudo** privileges):

```
sudo pip3 install sparkfun-qwiic
```

For the **current user**:

```
pip3 install sparkfun-qwiic
```

Independent Installation

You can install the `sparkfun-qwiic-adxl313` Python package independently, which is hosted by PyPi. However, if you prefer to manually download and install the package from the GitHub repository, you can grab them here (**Please be aware of any package dependencies. You can also check out the repository documentation page, hosted on ReadtheDocs.*):

DOWNLOAD THE SPARKFUN QWIIC ADXL313 PYTHON PACKAGE (ZIP)

PyPi Installation

This repository is hosted on PyPi as the `sparkfun-qwiic-adxl313` package. On systems that support PyPi installation via `pip3` (use `pip` for Python 2) is simple, using the following commands:

For **all users** (note: the user must have **sudo** privileges):

```
sudo pip3 install sparkfun-qwiic-adxl313
```

For the **current user**:

```
pip3 install sparkfun-qwiic-adxl313
```

Local Installation

To install, make sure the `setuptools` package is installed on the system.

Direct installation at the command line (use `python` for Python 2):

```
python3 setup.py install
```

To build a package for use with `pip3`:

```
python3 setup.py sdist
```

A package file is built and placed in a subdirectory called dist. This package file can be installed using `pip3`.

```
cd dist
pip3 install sparkfun_qwic_adxl313-<version>.tar.gz
```

Python Package Operation

Before we jump into getting readings, let's take a closer look at the available functions in the Python package. Below, is a description of the basic functionality of the Python package. This includes the package organization, built-in methods, and their inputs and/or outputs. For more details on how the Python package works, check out the source code and package documentation.

Dependencies

This Python package has a very few dependencies in the code, listed below:

```
import qwiic_i2c
import time
```

Default Variables

The default variables, in the code, for this Python package are listed below:

```
# qwiic_adxl313 GLOBAL VARIABLES
#-----------------------------------------------------------------------------------------------
-----
# Define the device name and I2C addresses. These are set in the class defintion
# as class variables, making them avilable without having to create a class instance.
# This allows higher level logic to rapidly create a index of qwiic devices at
# runtine
#
# The name of this device
_DEFAULT_NAME = "Qwiic ADXL313"

# Some devices have multiple availabele addresses - this is a list of these addresses.
# NOTE: The first address in this list is considered the default I2C address for the
# device.
_AVAILABLE_I2C_ADDRESS = [0x53, 0x1D]

# define our valid chip IDs
_validChipIDs = [0xCB]
```

Note: This package is different from previous packages as the register variables are declared in the object class.

```
# QwiicAdxl313 CLASS VARIABLES
#-----------------------------------------------------------------------------------------------
-----

ADXL313_TO_READ = 6      # Number of Bytes Read - Two Bytes Per Axis

#/////////////////////////////////////////
## ADXL313 Registers //
#/////////////////////////////////////////
ADXL313_DEVID_0 = 0x00
ADXL313_DEVID_1 = 0x01
ADXL313_PARTID = 0x02
ADXL313_REVID = 0x03
ADXL313_XID = 0x04
ADXL313_SOFT_RESET = 0x18
ADXL313_OFSX = 0x1E
ADXL313_OFSY = 0x1F
ADXL313_OFSZ = 0x20
ADXL313_THRESH_ACT = 0x24
ADXL313_THRESH_INACT = 0x25
ADXL313_TIME_INACT = 0x26
ADXL313_ACT_INACT_CTL = 0x27
ADXL313_BW_RATE = 0x2C
ADXL313_POWER_CTL = 0x2D
ADXL313_INT_ENABLE = 0x2E
ADXL313_INT_MAP = 0x2F
ADXL313_INT_SOURCE = 0x30
ADXL313_DATA_FORMAT = 0x31
ADXL313_DATA_X0 = 0x32
ADXL313_DATA_X1 = 0x33
ADXL313_DATA_Y0 = 0x34
ADXL313_DATA_Y1 = 0x35
ADXL313_DATA_Z0 = 0x36
ADXL313_DATA_Z1 = 0x37
ADXL313_FIFO_CTL = 0x38
ADXL313_FIFO_STATUS = 0x39

#/////////////////////////////////
## ADXL313 Responses //
#/////////////////////////////////
ADXL313_DEVID_0_RSP_EXPECTED = 0xAD
ADXL313_DEVID_1_RSP_EXPECTED = 0x1D
ADXL313_PARTID_RSP_EXPECTED = 0xCB

ADXL313_I2C_ADDRESS_DEFAULT = 0x1D
ADXL313_I2C_ADDRESS_ALT = 0x53
ADXL313_CS_PIN_DEFAULT = 10

#/************************** INTERRUPT PINS **************************/
ADXL313_INT1_PIN = 0x00     # INT1: 0
ADXL313_INT2_PIN = 0x01     # INT2: 1
```

```
#/********************** INTERRUPT BIT POSITION **********************/
ADXL313_INT_DATA_READY_BIT = 0x07
ADXL313_INT_ACTIVITY_BIT = 0x04
ADXL313_INT_INACTIVITY_BIT = 0x03
ADXL313_INT_WATERMARK_BIT = 0x01
ADXL313_INT_OVERRUN_BIT = 0x00

ADXL313_DATA_READY = 0x07
ADXL313_ACTIVITY = 0x04
ADXL313_INACTIVITY = 0x03
ADXL313_WATERMARK = 0x01
ADXL313_OVERRUN = 0x00

#/********************** RANGE SETTINGS OPTIONS **********************/
ADXL313_RANGE_05_G = 0x00 # 0-0.5G
ADXL313_RANGE_1_G = 0x01 # 0-1G
ADXL313_RANGE_2_G = 0x02 # 0-2G
ADXL313_RANGE_4_G = 0x03 # 0-4G

#/********************** POWER_CTL BIT POSITION **********************/
ADXL313_I2C_DISABLE_BIT = 0x06
ADXL313_LINK_BIT = 0x05
ADXL313_AUTOSLEEP_BIT = 0x04
ADXL313_MEASURE_BIT = 0x03
ADXL313_SLEEP_BIT = 0x02

#/********************** BANDWIDTH RATE CODES (HZ) *******************/
ADXL313_BW_1600 = 0xF           # 1111      IDD = 170uA
ADXL313_BW_800 = 0xE            # 1110      IDD = 115uA
ADXL313_BW_400 = 0xD            # 1101      IDD = 170uA
ADXL313_BW_200 = 0xC            # 1100      IDD = 170uA (115 low power)
ADXL313_BW_100 = 0xB            # 1011      IDD = 170uA (82 low power)
ADXL313_BW_50 = 0xA         # 1010      IDD = 170uA (64 in low power)
ADXL313_BW_25 = 0x9         # 1001      IDD = 115uA (57 in low power)
ADXL313_BW_12_5 = 0x8           # 1000      IDD = 82uA (50 in low power)
ADXL313_BW_6_25 = 0x7           # 0111      IDD = 65uA (43 in low power)
ADXL313_BW_3_125 = 0x6          # 0110      IDD = 57uA

#/********************** FIFO MODE OPTIONS **************************/
ADXL313_FIFO_MODE_BYPASS = 0x00
ADXL313_FIFO_MODE_FIFO = 0x01
ADXL313_FIFO_MODE_STREAM = 0x02
ADXL313_FIFO_MODE_TRIGGER = 0x03

#/****************************** ERRORS *****************************/
ADXL313_OK = 1      # No Error
ADXL313_ERROR = 0       # Error Exists

ADXL313_NO_ERROR = 0        # Initial State
ADXL313_READ_ERROR = 1      # Accelerometer Reading Error
ADXL313_BAD_ARG = 2     # Bad Argument

#/********************** INTERRUPT STATUSES ************************/
ADXL313_INTSOURCE_DATAREADY = 0
```

```
ADXL313_INTSOURCE_ACTIVITY = 0
ADXL313_INTSOURCE_INACTIVITY = 0
ADXL313_INTSOURCE_WATERMARK = 0
ADXL313_INTSOURCE_OVERRUN = 0

#/**************** x,y,z variables (raw values) ********************/
x = 0
y = 0
z = 0
```

Class

`QwiicAdxl313()` or **`QwiicAdxl313(address)`**
This Python package operates as a class object, allowing new instances of that type to be made. An `__init__()` constructor is used that creates a connection to an I^{2}C device over the I^{2}C bus using the default or specified I^{2}C address.

The Constructor

A constructor is a special kind of method used to initialize (assign values to) the data members needed by the object when it is created.

`__init__(address=None, i2c_driver=None):`

Input: value
: The value of the device address. If not defined, the Python package will use the default I^{2}C address (**0x71**) stored under `_AVAILABLE_I2C_ADDRESS` variable.

Input: *i2c_driver*
: Loads the specified I^{2}C driver; by default the Qwiic I^{2}C driver is used: `qwiic_i2c.getI2CDriver()`. Users should use the default I^{2}C driver and leave this field blank.

Functions

A function is an attribute of the class, which defines a method for instances of that class. In simple terms, they are objects for the operations (or methods) of the class. A list of all the available functions are detailed on the API Reference page of ReadtheDocs for the Qwiic_ADXL313_Py Python package.

Upgrading the Python Package

In the future, changes to the Python package might be made. Updating the installed packages has to be done individually for each package (i.e. sub-modules and dependencies won't update automatically and must be updated manually). For the `sparkfun-qwiic-adxl313` Python package, use the following command (use `pip` for Python 2):

For **all users** (note: the user must have **sudo** privileges):

```
sudo pip3 install --upgrade sparkfun-qwiic-adxl313
```

For the **current user**:

```
pip3 install --upgrade sparkfun-qwiic-adxl313
```

Python Examples

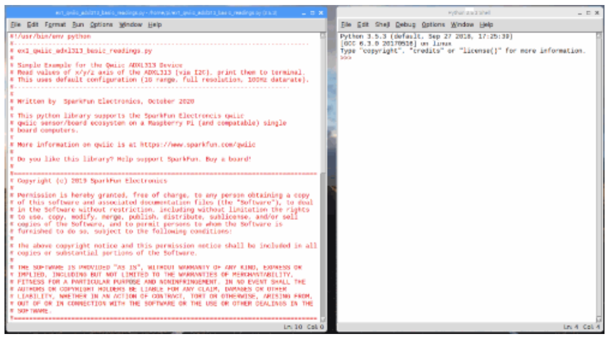
Note: The link to the ReadtheDocs documentation for the Python package is currently broken. We are working to resolve the issue.

There are several examples written for the Qwiic_ADXL313_Py Python package. They can be found in the **Examples** folder of the GitHub repository or view on the repository documentation page, hosted on ReadtheDocs. Users can also grab them here, using the link below. (**Please be aware of any package dependencies.*):

DOWNLOAD THE SPARKFUN ADXL313 PYTHON PACKAGE (ZIP)

Example 1 - Basic Readings

This example is hosted on ReadtheDocs: Example 1.



Raw data readings for ADXL313. (Click to enlarge)

This example outputs the raw acceleration values read by the sensor. To convert the values, use the following equation.

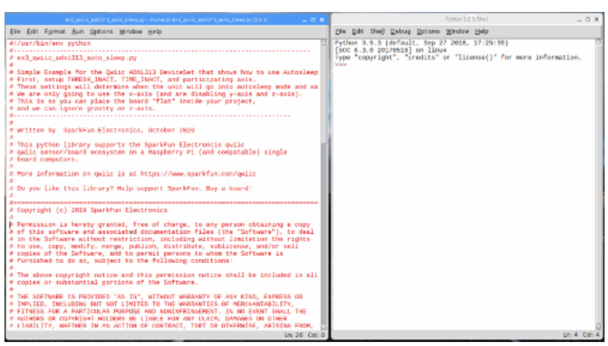
$$\text{g-value} = \frac{\text{g-range} \cdot \text{raw value}}{\text{resolution}}$$

In this example, `g-range` = 2 and the `resolution` = 10-bits = 1024; therefore the measured acceleration (g's):

$$\text{g-value} = \frac{\text{raw value}}{512}$$

Example 3 - Auto. Sleep

This example is hosted on ReadtheDocs: Example 3.



Raw data readings with indicators for when the sensor detects inactivity and enters auto-sleep. (Click to enlarge)

After the sensor detects inactivity for more than 5 seconds, it will automatically enter sleep mode and stop recording data into the FIFO. This conserves power to the accelerometer.

Note: The senor has to be relatively flat on the x-axis in order for it to enter sleep mode. Therefore, users may need to play with a level if their desk isn't level or flat.

Otherwise, users can change the threshold on line 74: `myAdxl.setActivityThreshold(10) # 0-255 (62.5mg/LSB)` to a higher value, like `40` to increase the inactivity threshold. This means the sensor doesn't have to lie precisely flat, but also means that the sensor requires more acceleration to wake up as well.

Troubleshooting

Below, we have also included some troubleshooting tips for issues that you may come across.

1. One of our employees compiled a great list of troubleshooting tips based on the most common customer issues. This is the perfect place to start.
2. For any Arduino IDE specific issues, we recommend starting with their troubleshooting guide.

If neither of the troubleshooting guides above were able to help, here are some resources you might have missed. (Most of this material is summarized from the tutorial.):

Raspberry Pi

For comprehensive information or troubleshooting issues, on the Raspberry Pi, users should check out the Raspberry Pi Foundation website and their forum.

As a general guideline, users should use the following resources when looking for technical information or assistance that is specifically related to the Raspberry Pi itself:

1. Raspberry Pi FAQ
    - FAQ Troubleshooting Section
2. Raspberry Pi Beginner's Subforum
3. Raspberry Pi Documentation and Help Guides
    - Troubleshooting Guide
4. Raspberry Pi Forum
    - STICKY - Booting Issues
    - See other **STICKY** topics in the Troubleshooting section of the forum

Nvidia Jetson Nano

For comprehensive information or troubleshooting issues, on the Nvidia Jetson, users should check out the Nvidia website and their forum.

As a general guideline, users should use the following resources when looking for technical information or assistance that is specifically related to the Jetson Nano itself:

1. Jetson Support Resources
2. Jetson Nano Getting Started Guide
3. Developer Kit User Manual
4. Jetson Nano Wiki
5. Nvidia FAQ
6. Jetson Forum
7. Jetpack Documentation

For users looking for technical assistance, click on the link. There you will find, basic troubleshooting tips and instructions to get started with posting a topic in our forum. Our technical support team will do their best to assist you.

Resources and Going Further

For more information on the SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic), check out the links below:

- GitHub Hardware Repository -- Home base for the sensor's latest design files
- SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic) Schematic (PDF)
- SparkFun 3-Axis Digital Accelerometer Breakout - ADXL313 (Qwiic) Eagle Files (ZIP)
- ADXL313 Datasheet (PDF)
- SparkFun ADXL313 Arduino Library -- Source and example files for the Arduino library used in this tutorial.
- Qwiic ADXL313 Python Package
    - ReadtheDocs
- Product Showcase Video

For more sensor action, check out these other great SparkFun tutorials.

INA169 Breakout Board Hookup Guide

How to interface with the INA169 Breakout Board to measure current.

Weather Station Wirelessly Connected to Wunderground

Build your own open-source, official Wunderground weather station that connects over WiFi via an Electric Imp.

OpenLog Hookup Guide

An introduction to working with the OpenLog data logger.

LilyPad Safety Scarf

This scarf is embedded with a ribbon of LEDs that illuminate when it gets dark out, making yourself more visible to vehicle and other pedestrians.