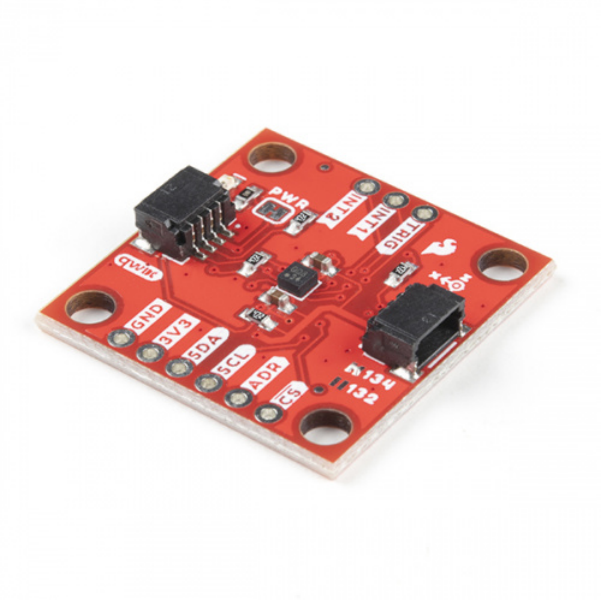
Triple Axis Accelerometer Breakout - KX13x (Qwiic) Hookup Guide

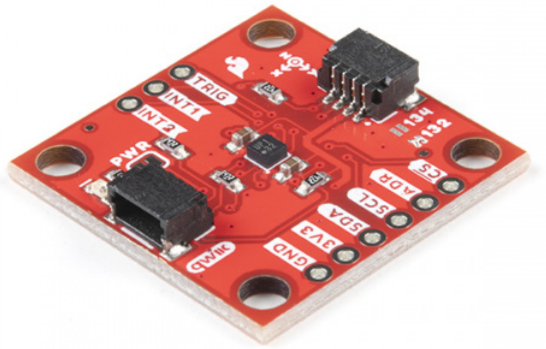
Introduction

The SparkFun Triple Axis Accelerometer Breakout - KX134 (Qwiic) and Triple Axis Accelerometer Breakout - KX132 (Qwiic) offer two high-speed additions to SparkFun's accelerometer selection featuring the KX134-1211 and KX132-1211 3-axis digital accelerometers from Kionix. The KX134 and KX132 both include a host of accelerometer features including Freefall detection, Directional Tap™ and Double-Tap™ detection, tilt orientation detection and more. The breakouts can interface with controllers using both I^2C and SPI at high speeds so you can use it in either an existing Qwiic/I^2C chain or SPI bus.



SparkFun Triple Axis Accelerometer Breakout - KX134 (Qwiic)

SEN-17589



SparkFun Triple Axis Accelerometer Breakout - KX132 (Qwiic)

SEN-17871

Product Showcase: SparkFun Qwiic Triple Axis Accelerometer B...

The KX134 is a low-power, 16-bit resolution 3-axis accelerometer capable of measuring ±8g/16g/32g/64g (user selectable) and has up to a 10kHz (max) output data rate making it ideal for high-g measurements as well as high-speed applications such as vibration sensing. The KX132 offers nearly the same data specifications at smaller acceleration (±2g/4g/8g/16g) ranges. At lower ranges the sensitivity can be set as high as 17367 counts/g (@±2g), so it's a great for applications looking for both high-speed data rates and high-sensitivity measurements at lower acceleration ranges.

Note: Any reference in this guide specific to either version of these breakouts will denote the version (KX132 or KX134) discussed. We'll use the terms "KX13x Breakout(s)" or "KX13x" when discussing subjects or

specifications pertaining to both boards or both accelerometers.

Required Materials

In order to follow along with this tutorial you'll need a few items along with your KX13x Breakout. First, you will need a microcontroller or single-board computer (SBC) like a Raspberry Pi to communicate with the board. Click the button below to toggle to recommended Raspberry Pi and Qwiic Pi products.

RASPBERRY PI MATERIALS (TOGGLE)

Below are a few Arduino development boards that come Qwiic-enabled out of the box:

SparkFun Thing Plus - ESP32 WROOM
WRL-15663

SparkFun RedBoard Qwiic
DEV-15123

SparkFun RedBoard Artemis
DEV-15444

SparkFun Qwiic Micro - SAMD21 Development Board
DEV-15423

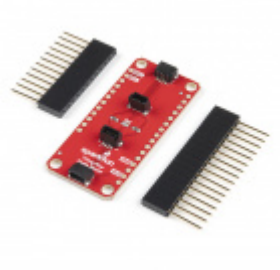
If your preferred microcontroller does not have a Qwiic connector, you can add one using one of the following products:

SparkFun Qwiic Adapter

SparkFun Qwiic Shield for Arduino

DEV-14495

DEV-14352



SparkFun Qwiic Shield for Thing Plus
DEV-16790

SparkFun Qwiic Shield for Arduino Nano
DEV-16789

At least one Qwiic cable is recommended to connect your KX13x Breakout to your microcontroller/SBC:

SparkFun Qwiic Cable Kit
KIT-15081

Qwiic Cable - 100mm
PRT-14427

Qwiic Cable - 500mm
PRT-14429

Qwiic Cable - 200mm
PRT-14428

For users who wish to communicate with the KX13x Breakout using SPI, some through-hole soldering will be necessary. You may already have a few of these items but if not the tools and products below will help with that assembly:

Break Away Headers - Straight
PRT-00116

Hook-Up Wire - Assortment (Stranded, 22 AWG)
PRT-11375

Soldering Iron - 60W (Adjustable Temperature)
TOL-14456

Solder Lead Free - 15-gram Tube
TOL-09163

Suggested Reading

If you aren't familiar with the Qwiic system, we recommend reading here for an overview:

qwiic

We would also recommend taking a look at the following tutorials if you aren't familiar with the concepts covered in them:

Serial Peripheral Interface (SPI)

Logic Levels

SPI is commonly used to connect microcontrollers to peripherals such as sensors, shift registers, and SD cards.

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.

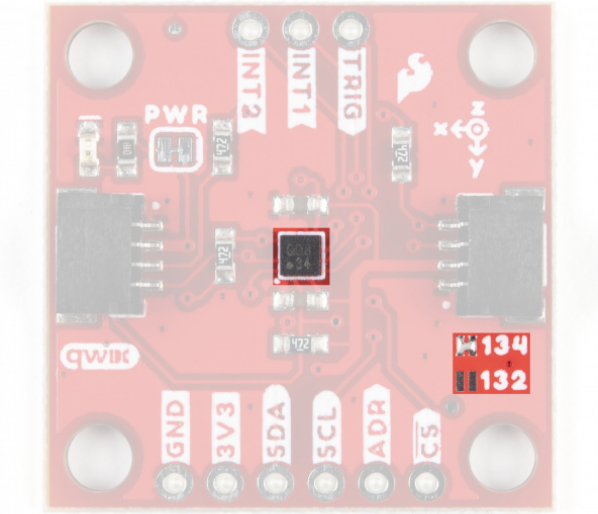
Hardware Overview

In this section we'll cover the unique aspects of the KX134 and KX132 accelerometers along with other components found on the Triple Axis Accelerometer Breakout - KX13x (Qwiic).

KX132 & KX134 3-Axis Accelerometers

First up let's examine the two accelerometers on the boards, highlight their specifications and how they differ. The KX134-1211 and KX132-1211 offer the following features:

- Four User-Selectable Measurement Ranges
  - KX134: ±8 / 16 / 32 / 64g
  - KX132: ±2 / 4 / 8 / 16g
- User-configurable 3-stage Advanced Data Path (ADP) with low-pass filter, low-pass/high-pass filter and RMS calculation engine
- User-selectable Low Power or High-Performance Modes
- Configurable Output Data Rate (ODR) up to 25,600Hz
- High resolution Wake-Up / Back-to-Sleep functions with configurable thresholds (as low as 15.6mg on the KX134 & 39mg on the KX132)
- Free fall detection
- Directional-Tap™/Double-Tap™
- Device Orientation algorithms
- Embedded 512-byte FIFO buffer (continues to record while being read)
- Digital I^2C up to 3.4MHz and Digital SPI up to 10MHz



Note: As these boards both share the same PCB design, a closed solder jumper located below the "right" side Qwiic connector indicates the version (KX132 or KX134). The photo above highlights this solder jumper.

The KX13x also includes an integrated voltage regulator to maintain consistent performance across its entire supply voltage range (**1.7** to **3.6V**). The table below outlines some of the electrical and functional characteristics of the KX134-1211 and KX132-1211 from the sensors' datasheets. All values in the table apply to both accelerometers unless specifically noted in the table or notes below it. Refer to the accelerometers' datasheets for a full overview: KX132-1211 & KX134-1211.

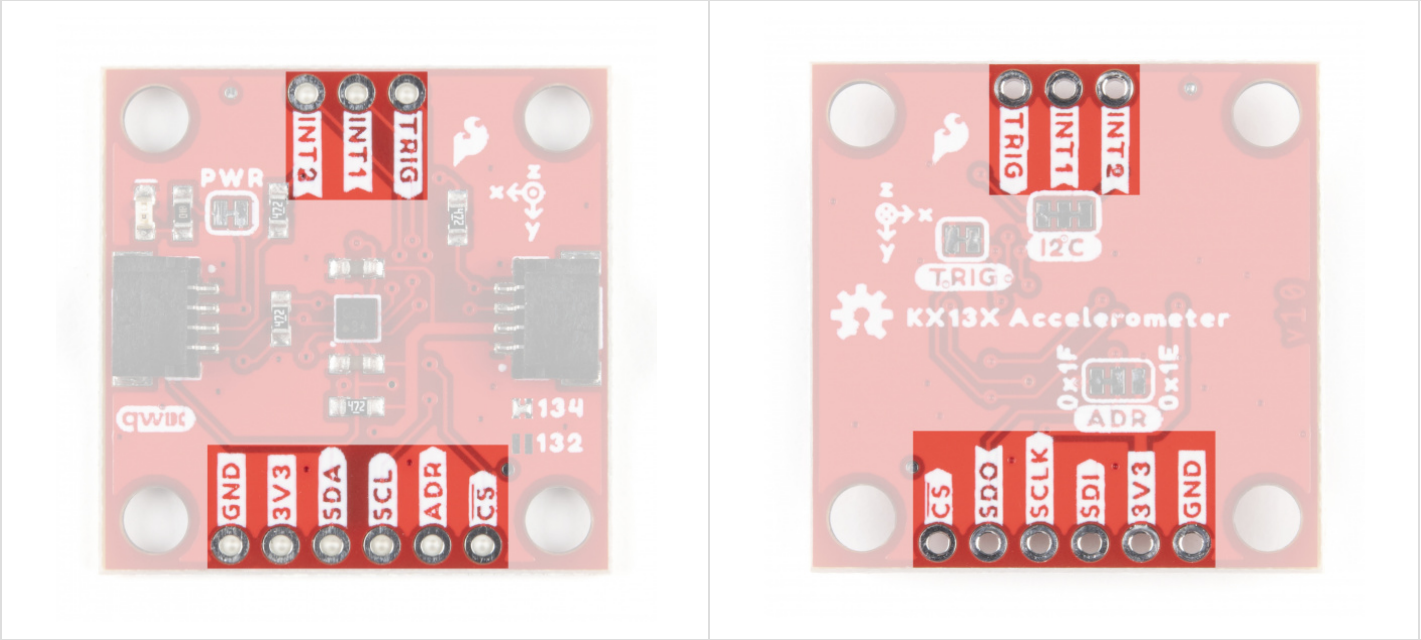
Parameter		**Units**	**Min**	**Typical**	**Max**
Supply Voltage (VDD)		V	1.7	2.5 (3.3 for use with Qwiic)	3.6
Current Consumption (Accelerometer Only)	High Performance w/Wake-up Detection (ODR=800Hz)	µA		148	
	Low Power w/Wake-up Detection (ODR=0.781Hz, 2 samples averaged)			0.53	
	Standby			0.50	
Operating Temperature Range		°C	-40	-	105
Output Data Rate		Hz	0.781	50	25600
Sensitivity (16 bit)	±2g[1]	counts/g	14501	16384	17367
	±4g[1]		7700	8192	8684

	±8g		3768	4096	4424
	±16g		1884	2048	2212
	±32g[2]		942	1024	1106
	±64g[2]		471	512	553
Noise[3]	RMS	mg		KX134: 1.9	
				KX132: 0.7	
	Density	µg/√Hz		KX134: 300	
				KX132: 150	
I^2C Address				0x1E (0x1F alternate)	

1. Reminder: ±2/4g ranges are only available on the KX132.
2. Reminder: ±32/64g ranges are only availabe on the KX134.
3. Acceleration data noise varies depending on ODR, power mode & Average Filter Control settings. Noise measuring settings: High-Performance Mode (RES=1), ODR=50Hz, IIR Filter Enabled and IIR filter corner frequency set to ODR/2. Refer to Table 1 in the sensors' Datasheets as well as the Technical Reference Manuals for more information.

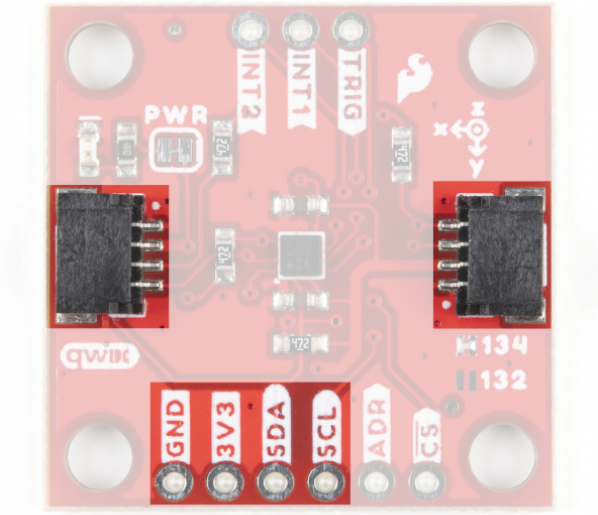
Pinout

The KX13x Breakouts' I^2C and SPI interface share the same pins so users must select the interface mode by altering the state of the ADR/SDO pin. The ADR jumper sets the state of the ADR/SDO pin (more on that in the Solder Jumpers section). Both breakouts operate in I^2C mode by default. We've labeled these shared pins so I^2C labels are visible from the front and SPI labels are visible when viewed from the back.



Qwiic and I^{2}C Interface

As you would expect on a Qwiic breakout, the boards break out the KX134's I^{2}C pins to a pair of Qwiic connectors to easily integrate the board into a Qwiic system. The I^{2}C pins are also routed to a standard 0.1" spaced header for PTH soldering.

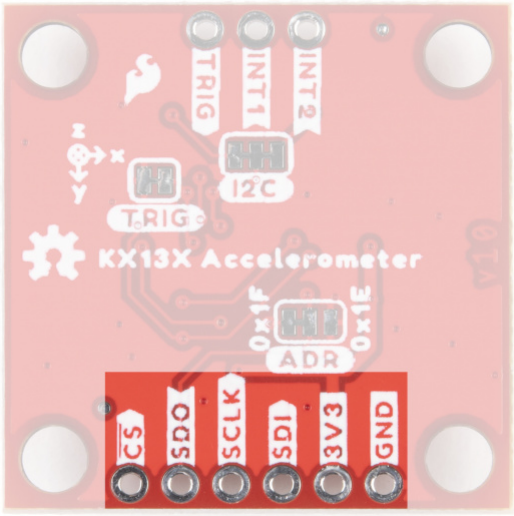


Note: The Qwiic interface is great for general use cases on the lower acceleration ranges and for testing the higher acceleration settings but we recommended to solder the connections for long-term and high-acceleration projects to avoid communication issues.

SPI Interface

Communicating via SPI on the Qwiic KX13x is ideal for taking advantage of the maximum Output Data Rate as the Digital SPI interface on the KX13x-1211 can operate at speeds up to 10MHz.

The Qwiic KX13x breaks out the SPI interface to the same standard 0.1" spaced header as the I^{2}C pins. As mentioned above, the board ships with the I^{2}C interface enabled by default so to switch to the SPI interface users need to **open** the ADR jumper by severing the trace in between the "Center" and "Left" pads.



Interrupt and Trigger Pins

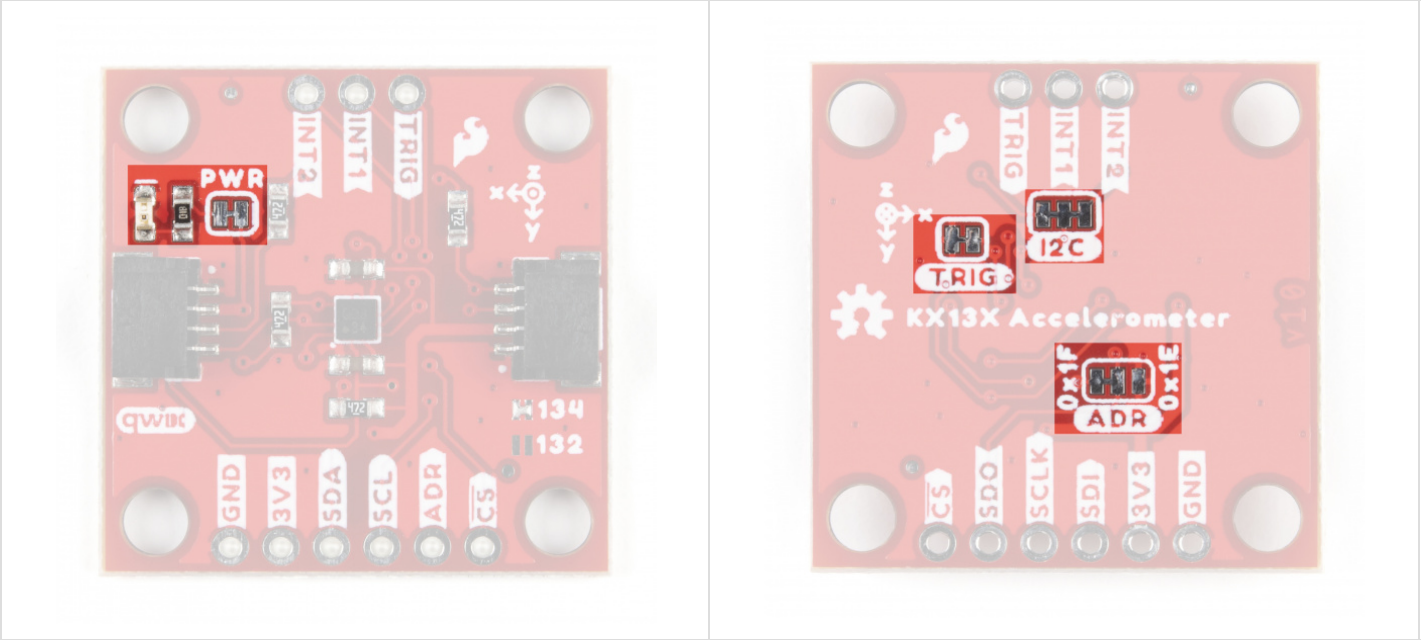
The KX13x has two physical interrupt pins as well as a trigger pin for FIFO buffer control. Both of the physical interrupts operate as push-pull, enter a high-impedence (high-Z) state during the Power-On-Reset (POR) procedure and are driven LOW after POR. Connect these pins to external interrupt-capable pins on your microcontroller to use the interrupt functionalities. Refer to the Interrupt and Buffer examples in the Qwiic KX13x Arduino and Python libraries for a demonstration of using the interrupt pins.

The Trigger pin controls the FIFO buffer. By default, the Qwiic KX13x ties this pin to ground through the TRIG jumper. Users who wish to use the Trigger pin must **open** that jumper before tying it to a pin on their microcontroller. Refer to the Datasheets (KX132 & KX134) and either Technical Reference Manuals (KX132 or KX134) for more information on using this pin to control the FIFO buffer.

Solder Jumpers

> If you have never worked with solder jumpers and PCB traces before or would like a quick refresher, check out our How to Work with Solder Jumpers and PCB Traces tutorial for detailed instructions and tips.

The Qwiic KX13x has four jumpers labeled ADR, I2C, TRIG and PWR. In this section we'll cover each jumper's purpose, their default states and how to configure them to alter the functionality of the KX13x Breakouts.



Address (ADR) Jumper

This 3-way jumper selects the I^{2}C address of the KX13x and also selects the communication interface for the chip by pulling the ADR/SDO pin to either **3.3V**, **0V/Ground** or **No Connect**. By default, the ADR/SDO is pulled to **3.3V** via a **4.7kΩ** resistor to set the KX134 to operate in I^{2}C mode with the I^{2}C address as **0x1E**.

To change the I^{2}C address to **0x1F**, sever the trace between the "Center" and "Left" pads and then connect the "Center" and "Right" pads together to pull the ADR/SDO pin to **0V/Ground**.

Finally, to set the Qwiic KX13x to SPI mode, sever the trace between the "Center" and "Left" pads of the ADR jumper (default setting) to leave the ADR/SDO pin **Floating/No Connect**. After adjusting the jumper, connect the SDO pin to your controller's SDI/COPI pin.

I^{2}C Jumper

The I^{2}C jumper on the Qwiic KX13x pulls the SDA and SCL lines to **3.3V** via a pair of **4.7kΩ** resistors. The default state of this jumper is **CLOSED**. Open the jumper by severing the traces between the three pads to disable the pullups on these lines.

If you have more than one device on a single I^{2}C bus, best practices recommend to only maintain a single pair of pullup resistors to avoid creating too strong of a parallel resistance. A strong parallel resistance can lead to communication issues on the bus. Take note that if you are using a single set of pull-up resistors on your I^{2}C bus, make sure all devices operate at the same logic level or are properly shifted to avoid damage to the device(s).

Trigger (TRIG) Jumper

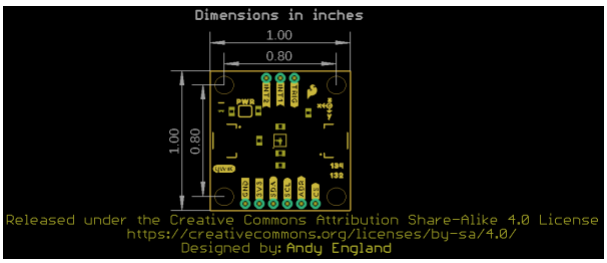
The Trigger jumper ties the TRIG pin on the KX13x-1211 to **0V/Ground**. The default state of this jumper is **CLOSED**. To use the Trigger pin for FIFO control, open the jumper and connect the TRIG PTH pin to a digital I/O pin on your microcontroller. Refer to section 2.5 in the Technical Reference Manuals (KX132 or KX134) for more information on using Trigger Mode.

Power LED (PWR) Jumper

The Power LED jumper (labeled PWR on the board) completes the power LED circuit on the board by tying the anode of the LED to **3.3V** via a **1kΩ** resistor. The jumper is **CLOSED** by default. Disable the power LED by severing the trace between the two pads. Disabling the LED helps reduce the total current draw of the board and is particularly helpful for low-power or battery-powered applications.

Board Dimensions

The Triple Axis Accelerometer Breakout - KX13x (Qwiic) matches the standard 1x1" (25.4mm x 25.4mm) dimensions for Qwiic breakouts and has four mounting holes that fit a 4-40 screw.

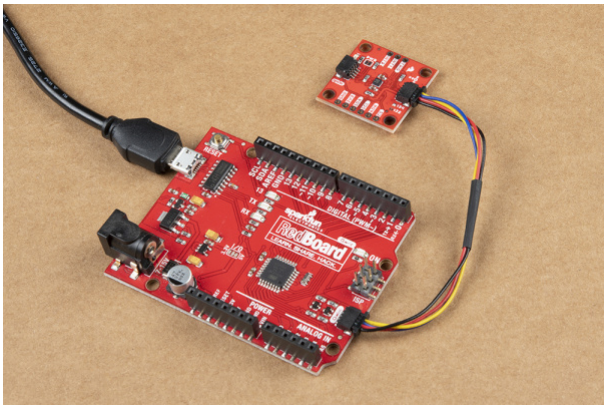


Hardware Assembly

Now that we're familiar with the KX13x and the other hardware present on the KX13x Breakouts we can start assembling our circuit. Depending on your preferred use of the accelerometer, you'll want to connect either using I^2C using the Qwiic connector (or the PTH header) or via SPI using the PTH header on the board.

Qwiic/I^2C Assembly

The fastest and easiest way to get started using the breakout is using either of the Qwiic connectors, a Qwiic cable and a Qwiic-enabled development board like the SparkFun RedBoard Qwiic. If you are using a Raspberry Pi instead for our Python Package, you'll need a Pi, Qwiic cable and an adapter like the Qwiic Shim or another of our Qwiic-enabled pHATs.



If you would prefer a more secure and permanent connection, you can solder headers or wire to the PTH header on the board. This method is recommended for permanent installations as well as high-g and vibration sensing applications.

SPI Assembly

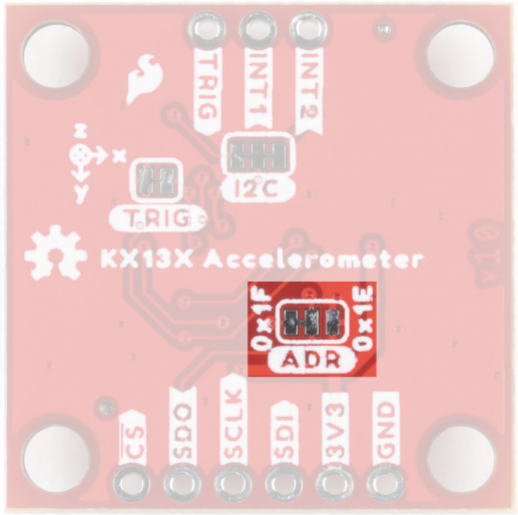
If you'd prefer to take advantage of the max output data rate of the KX13x, you'll want to use the SPI interface instead of the I^2C interface. Assembling the KX13x Breakout in SPI mode requires some through-hole soldering. If you are not familiar with through-hole soldering, take a read through this tutorial:

How to Solder: Through-Hole Soldering

SEPTEMBER 19, 2013

This tutorial covers everything you need to know about through-hole soldering.

Along with tools for soldering, you'll need either some hookup wire or headers and jumper wires. Also, the Address (ADR) Jumper must be opened by severing the trace between the "Center" and "Left" pads to switch to SPI mode. After opening this jumper, connect the SDO pin to your controller's SDI/COPI pin.



With the KX13x Breakout set to SPI mode, solder headers or wire to the PTH header on the board and make the SPI connections with your controller. Remember the KX13x operates at **3.3V** logic so make sure to connect to a board running at the same logic level or use a level shifter to adjust it to a safe voltage.

KX13x 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.

The SparkFun KX13x Arudino library makes it easy to get started measuring acceleration data from the sensor. You can install this library through the Arduino Library Manager. Search for **"SparkFun KX13x Arduino Library"** and install the latest version. If you prefer manually downloading the library from the GitHub repository, you can grab it here:

DOWNLOAD THE SPARKFUN QWIIC KX13X ARDUINO LIBRARY

Library Functions

The list below outlines all of the functions available in the SparkFun Qwiic KX13x Arduino Library along with quick descriptions of what they do. The examples cover many of the functions on this list so refer to them to get started or to demonstrate how to integrate them into your own code.

Class

In the global scope, construct your KX13x object (such as `accel` or `myKX13x`) without arguments.

- `QwiicKX13X accel;`

The KX13x Arduino Library has a class for each version of the KX13x. Construct the object (such as `kxAccel` or `myKX13x`) without arguments:

- `QwiicKX132 kxAccel;`

or

- `QwiicKX134 kxAccel;`

The examples default to using the KX132 so adjust the object to KX134 if needed.

The library also uses an object for the accelerometer data. Construct the object (such as `myData` or `accelData`) in the global class:

- `outputData myData;`

Device Setup & Configuration

- `bool begin(uint8_t deviceAddress = KX13X_DEFAULT_ADDRESS, TwoWire &wirePort = Wire);` - Start communication with the KX13x via I^2C.
- `bool beginSPI(uint*_t, uint32_t spiPortSpeed = 10000000, SPIClass &spiPort = SPI);` - Start communication with the KX13x via SPI.
- `bool initialize(uint8_t settings = DEFAULT_SETTINGS);` - Initialize the KX13x at the specified settings. These settings are specified according to the AN092 Getting Started App Note and can be adjusted to have additional presets. The available settings in the library are:
  - `DEFAULT_SETTINGS` - Initialize the KX13x with no alternate settings active.
  - `INT_SETTINGS` - Initialize the KX13x with the Data Ready Engine enabled (CNTL1 register, bit 5), the KX13x Interrupt 1 pin enabled and configured to trigger on Data Ready.
  - `SOFT_INT_SETTINGS` - Initialize the KX13x with the Data Ready Engine enabled (CNTL1 register, bit 5), no hardware interrupt pin enabled.
  - `BUFFER_SETTINGS` - Initialize the KX13x with the Data Ready Engine enabled (CNTL1 register, bit 5), the KX13x Interrupt 1 pin enabled and configured to trigger when the buffer is full. Buffer enabled and settings configured to FIFO mode and 16 bit samples.
- `bool accelControl(bool);` - Sets the operating mode of the KX13x to stand-by mode or High-Performance/Low Power mode.
- `uint8_t readAccelSate();` - Reads whether the operating state of the KX13x (Stand By or Active Mode).
- `bool setRange(uint8_t range);` - Set the range of the KX13x. Split into dedicated values for either the KX132 or KX134 to avoid errors in data conversion handling. Valid options for this setting are:
  - `KX132_RANGE2G`
  - `KX132_RANGE4G`
  - `KX132_RANGE8G`
  - `KX132_RANGE16G`
  - `KX134_RANGE8G`

    - `KX134_RANGE16G`
    - `KX134_RANGE32G`
    - `KX134_RANGE64G`
- `bool setOutputDataRate(uint8_t rate)` - Set the refresh rate of the KX13x's output data in Hz. The default value is 50Hz (0b0110). Refer to the table on page 26 of the Technical Reference Manual (KX132 & KX134 for valid entries.
- `float readOutputDataRate();` - Reads the value set for the Output Data Rate.
- `bool setInterruptPin(bool enable, uint8_t polarity = 0, uint8_t pulseWidth = 0, bool latchControl = false);` - Configure the Interrupt pin settings. Note: settings just one sets all others to their default.
- `bool routeHardwareInterrupt(uint8_t, uint8_t pin = 1);` - Route any of the interrupt pin settings to either interrupt pin 1 or 2.
- `bool clearInterrupt();` - Clear the interrupt register by reading the interrupt latch release register.
- `bool dataTrigger();` - Triggers collection of data by the KX13X.
- `bool setBufferThreshold(uint8_t);` - Sets the number of samples (not bytes) held in the buffer. Minimum value is two, maximum depends on the buffer resolution (8 or 16bit).
- `bool setBufferOperation(uint8_t, uint8_t);` - Sets the resolution and operation mode of the buffer. Resolution can be 8 or 16 bit. Operation modes are FIFO, Stream & Trigger. More information on the buffer modes found on Table 16 of the Technical Reference Manual.
- `bool enableBuffer(bool, bool);` - Enables the buffer and sets whether the buffer triggers an interrupt event when full.
- `bool runCommandTest();` - Checks the integrity of the IC. Primarily for manufacturing use.

Acceleration Data

- `bool getRawAccelData(rawOutputData*);` - Pull raw acceleration data values for X, Y and Z axes from either the buffer or output registers depending on if buffer usage is specified by the user.
- `bool convAccelData(outputData*, rawOutputData*);` - Convert the acceleration data into g using the value stored for `setRange();` .
- `outputData getAccelData();` - Pull converted acceleration data for X, Y and Z axes. Call data for the specific axis by using `myData.xData` (or `yData` / `zData`) where `myData` is the definition of `outputData` class. Refer to the examples in the Arduino library for more information.

Arduino Examples

The SparkFun Qwiic KX13x Arduino Library includes four examples to get started with both KX13x boards.

Example 1 - Basic Readings

Example 1 is a basic example to demonstrate how to read data from the accelerometer. Open the example by navigating to **"File > Examples > SparkFun Qwiic KX13x Library > Example1BasicReadings"**. Next, open the **Tools** menu and select your board (in this case, Arduino Uno) and correct Port your board enumerated on. Upload the code, open the serial monitor and set the baud rate to **115200**.

Code to note:

```
QwiicKX132 kxAccel;
outputData myData;
```

The setup starts the accelerometer and initializes it to the Default Settings. The code freezes if either process fails.

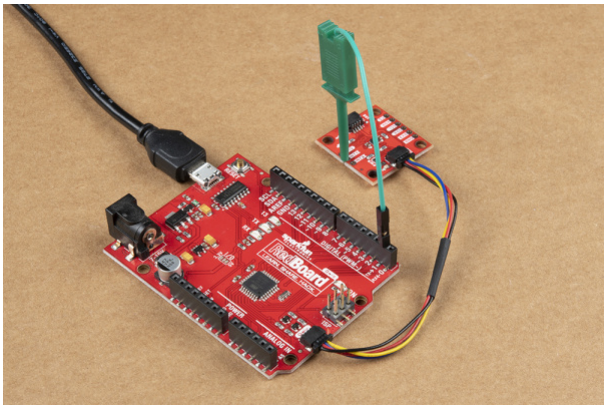
```
if( !kxAccel.begin() ){
    Serial.println("Could not communicate with the the KX13X. Freezing.");
    while(1);
  }
  else
    Serial.println("Ready.");



if( !kxAccel.initialize(DEFAULT_SETTINGS)){
    Serial.println("Could not initialize the chip.");
    while(1);
}
else
    Serial.println("Initialized...");
```

After initializing the IC, the code prints out data for all three axes every 20ms. The delay here is important as it should be 1/ODR (Output Data Rate) and the default setting is 50Hz.

```
void loop() {

  myData = kxAccel.getAccelData();
  Serial.print("X: ");
  Serial.print(myData.xData, 4);
  Serial.print("g ");
  Serial.print(" Y: ");
  Serial.print(myData.zData, 4);
  Serial.print("g ");
  Serial.print(" Z: ");
  Serial.print(myData.zData, 4);
  Serial.println("g ");

  delay(20); // Delay should be 1/ODR (Output Data Rate), default is 50Hz

}
```

Example 2 - Interrupts

Example 2 shows how to use the hardware interrupt pin(s) on the accelerometer. In order to use this example, connect the INT1 pin on the KX13x breakout to an interrupt-capable pin. This example assumes a SparkFun RedBoard Qwiic/Arduino Uno is used so adjust the code as necessary. To follow along with this example (as well as the Buffer Example), assemble your circuit with INT1 connected to `D1` on your RedBoard/Uno similar to the photo below:



Along with creating the KX13x and data objects, the code sets the physical interrupt pin as `D1`.

```
int dataReadyPin = D1;
```

The code sets the dataReadyPin as an input:

```
pinMode(dataReadyPin, INPUT);
```

and initializes the accelerometer in the Interrupt Settings mode. By default, this mode enables INT1 and sets it to go HIGH when data is ready to be read:

```
if( !kxAccel.initialize(INT_SETTINGS)){
    Serial.println("Could not initialize the chip.");
    while(1);
}
else
    Serial.println("Initialized...");
```

After initializing the sensor, the main loop monitors the `dataReadyPin` (`D1`) and if it is HIGH, prints out data for all three axes:

```
void loop() {

  if( digitalRead(dataReadyPin) == HIGH ){ // Wait for new data to be ready.

    myData = kxAccel.getAccelData();
    Serial.print("X: ");
    Serial.print(myData.xData, 4);
    Serial.print("g ");
    Serial.print(" Y: ");
    Serial.print(myData.zData, 4);
    Serial.print("g ");
    Serial.print(" Z: ");
    Serial.print(myData.zData, 4);
    Serial.println("g ");

     //kxAccel.clearInterrupt();// Because the data is being read in "burst"
     //mode, meaning that all the acceleration data is being read at once, we don't
     //need to clear the interrupt.
  }
  delay(20); // Delay should be 1/ODR (Output Data Rate), default is 50Hz
}
```

Example 3 - Software Interrupts

The third example demonstrates how to use the KX13x to trigger software interrupts. The code initializes the KX13x in Software Interrupt mode. The primary difference between Example 3 and Example 2 is, as you may expect, the software interrupt does not use any of the interrupt pins on the KX13x.

The code initializes the KX13x in software interrupt mode:

```
if( !kxAccel.initialize(SOFTWARE_INT_SETTINGS)){
    Serial.println("Could not initialize the chip.");
    while(1);
}
else
    Serial.println("Initialized...");
```

The main loop waits for available data by polling the data ready bit and prints out acceleration data for all three axes whenever data is ready.

Example 4 - Buffer

The fourth example shows how to use the KX13x in the default buffer settings to trigger hardware interrupts when the buffer is full. Just like Example 2 , the code sets the physical interrupt/data ready pin as `D1` which is driven HIGH when the buffer is full. Just like with Example 2, in order to use this example, connect the INT1 pin on the KX13x breakout to an interrupt-capable pin. This example assumes a SparkFun RedBoard Qwiic/Arduino Uno is used so adjust the code as necessary.:

```
int dataReadyPin = D1;
```

In the setup, the dataReadyPin is defined as an input:

```
pinMode(dataReadyPin, INPUT);
```

and the KX13x is initialized with default buffer settings (FIFO mode and 16 bit samples):

```
if( !kxAccel.initialize(BUFFER_SETTINGS)){
    Serial.println("Could not initialize the chip.");
    while(1);
}
else
    Serial.println("Initialized...");
```

After setting everything up, the main loop waits for the buffer to fill and drive the data ready pin HIGH. Once the pin goes HIGH, the code prints out acceleration data for all three axes just like the other examples.

Qwiic KX13x Python Package

Note: This example assumes you are using the latest version of Python 3. If this is your first time using Python or I^{2}C hardware on a Raspberry Pi, these tutorial can help you get started:

- Python Programming with the Raspberry Pi
- Raspberry Pi SPI and I2C Tutorial

We've written a Python package to control the KX13x Breakouts for users who prefer a Raspberry Pi or other Python-specific development environment. You can install the `sparkfun-qwiic-kx13x` Python package hosted by PyPi through a command interface. If you prefer to manually download and build the libraries from the GitHub repository, you can download the package by clicking the button below:

DOWNLOAD THE SPARKFUN QWIIC KX134 PYTHON PACKAGE (ZIP)

(**Please be aware of any package dependencies. You can also check out the repository documentation page, hosted on Read the Docs.*)

Installation

Note: Don't forget to double check that the hardware I^{2}C connection is enabled on your Raspberry Pi or other single board computer. The Raspberry Pi tutorials linked in the note above cover how to enable the Pi's I^{2}C bus.

PyPi Installation

This repository is hosted on PyPi as the `sparkfun-qwiic-kx13x` 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-kx13x
```

For the **current user**:

```
pip3 install sparkfun-qwiic-kx13x
```

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_qwiic_kx13x-<version>.tar.gz
```

Qwiic KX13x Python Package Operation

For a full overview of all the functions included with the Qwiic KX13x Py package and how it works, take a look at the source code and package documentation hosted on ReadtheDocs page.

Upgrading the Python Package

If needed, the Python package can be upgraded using the following commands (use `pip` for Python 2):

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

```
sudo pip3 install --upgrade sparkfun-qwiic-kx13x
```

For the **current user**:

```
pip3 install --upgrade sparkfun-qwiic-kx13x
```

Python Examples

The Qwiic KX13X Python Package includes four examples to get users started with either Qwiic KX13x board using Python. In this section we'll go over the examples and highlight how they work.

To use the examples, open them from the Qwiic KX13X Py location or copy the code into your preferred Python interpreter.

Note, the examples default to using the Qwiic KX132 so if a Qwiic KX1334 is used, adjust the code by un-commenting this line:

```
myKX = qwiic_kx13x.QwiicKX134()
```

And replace any instance of `kx132` with `kx134`. The acceleration range can also be adjusted by uncommenting this line and adjusting the value set for the range:

```
myKx.set_range(myKx.KX132_RANGE8G)
```

Example 1 - Simple Example

The first example is a basic example demonstrating how to initialize a Qwiic KX13x board on the I^2C bus using its default settings. The full example code can be found below if you would prefer to copy it into your preferred Python interpreter:

```
from __future__ import print_function
import qwiic_kx13x
import time
import sys
import RPi.GPIO

def run_example():

    print("\nSparkFun KX13X Accelerometer Example 1\n")
    # myKx = qwiic_kx13x.QwiicKX134() # If using the KX134 un-comment this line and replace othe
r instances of "kx132" with "kx134"
    myKx = qwiic_kx13x.QwiicKX132()

    if myKx.connected == False:
            print("The Qwiic KX13X Accelerometer device isn't connected to the system. Please ch
eck your connection", \
                  file=sys.stderr)
            return

    if myKx.begin():
        print("Ready.")
    else:
        print("Make sure you're using the KX132 and not the KX134")

    # myKx.set_range(myKx.KX132_RANGE8G) # Update the range of the data output.
    myKx.initialize(myKx.BASIC_SETTINGS) # Load basic settings

while True:

    myKx.get_accel_data()
    print("X: {0}g Y: {1}g Z: {2}g".format(myKx.kx132_accel.x,
                                           myKx.kx132_accel.y,
                                           myKx.kx132_accel.z))
    time.sleep(.02) #Set delay to 1/Output Data Rate which is by default 50Hz 1/50 = .02


if __name__ == '__main__':
        try:
            runExample()
        except (KeyboardInterrupt, SystemExit) as exErr:
            print("\nEnding Example 1")
            sys.exit(0)
```

Example 2 -

The second example shows how to enable Hardware Interrupt Pin 1 on the KX13x and fires it whenever data is ready. The complete example code can be found below if you prefer to copy/paste it into your prefered Python interpreter:

```
from __future__ import print_function
import qwiic_kx13x
import time
import sys
import RPi.GPIO

def runExample():

    print("\nSparkFun KX13X Accelerometer Example 1\n")
    # myKx = qwiic_kx13x.QwiicKX134() # If using the KX134 un-comment this line and replace othe
r instances of "kx132" with "kx134"
    myKx = qwiic_kx13x.QwiicKX132()

    if myKx.connected == False:
        print("The Qwiic KX13X Accelerometer device isn't connected to the system. Please check
 your connection", \
                file=sys.stderr)
        return

    if myKx.begin():
        print("Ready.")
    else:
        print("Make sure you're using the KX132 and not the KX134")

    # myKx.set_range(myKx.KX132_RANGE8G) # Update the range of the data output.
    myKx.initialize(myKx.INT_SETTINGS) # Load basic settings

    dataReadyPin = 5
    GPIO.setmode(GPIO.BCM)
    GPIO.setup(dataReadyPin, GPIO.IN)

    while True:

        if GPIO.INPUT(dataReadyPin) == 1:

            myKx.get_accel_data()
            print("X: {0}g Y: {1}g Z: {2}g".format(myKx.kx132_accel.x,
                                                   myKx.kx132_accel.y,
                                                   myKx.kx132_accel.z))

        time.sleep(.02) #Set delay to 1/Output Data Rate which is by default 50Hz 1/50 = .02

if __name__ == '__main__':
    try:
        runExample()
    except (KeyboardInterrupt, SystemExit) as exErr:
        print("\nEnding Example 1")
        sys.exit(0)
```

Example 3 - Software Interrupts

Example 3 shows how to use software interrupts to signal when accelerometer data is ready. The primary difference between this and the hardware interrupts is none of the KX13x Hardware Interrupt Pins are enabled. The full example is below for users who prefer to copy/paste it into their Python interpreter:

```
from __future__ import print_function
import qwiic_kx13x
import time
import sys

def runExample():

    print("\nSparkFun KX13X Accelerometer Example 1\n")
    # myKx = qwiic_kx13x.QwiicKX134() # If using the KX134 un-comment this line and replace othe
r instances of "kx132" with "kx134"
    myKx = qwiic_kx13x.QwiicKX132()

    if myKx.connected == False:
        print("The Qwiic KX13X Accelerometer device isn't connected to the system. Please check
 your connection", \
                file=sys.stderr)
        return

    if myKx.begin():
        print("Ready.")
    else:
        print("Make sure you're using the KX132 and not the KX134")

    # myKx.set_range(myKx.KX132_RANGE8G) # Update the range of the data output.
    myKx.initialize(myKx.SOFT_INT_SETTINGS) # Load basic settings

    while True:

        if myKx.data_trigger():

            myKx.get_accel_data()
            print("X: {0}g Y: {1}g Z: {2}g".format(myKx.kx132_accel.x,
                                                   myKx.kx132_accel.y,
                                                   myKx.kx132_accel.z))

        time.sleep(.02) #Set delay to 1/Output Data Rate which is by default 50Hz 1/50 = .02

if __name__ == '__main__':
    try:
        runExample()
    except (KeyboardInterrupt, SystemExit) as exErr:
        print("\nEnding Example 1")
        sys.exit(0)
```

Example 4 - Buffer Interrupt

The fourth and final example builds on the hardware interrupt example and uses the Hardware Interrupt Pins to indicate when a buffer is full and ready to be read. Copy/paste the code below into your preferred Python interpreter:

```
from __future__ import print_function
import qwiic_kx13x
import time
import sys
import RPi.GPIO

def runExample():

    print("\nSparkFun KX13X Accelerometer Example 1\n")
    # myKx = qwiic_kx13x.QwiicKX134() # If using the KX134 un-comment this line and replace othe
r instances of "kx132" with "kx134"
    myKx = qwiic_kx13x.QwiicKX132()

    if myKx.connected == False:
        print("The Qwiic KX13X Accelerometer device isn't connected to the system. Please check
 your connection", \
                file=sys.stderr)
        return

    if myKx.begin():
        print("Ready.")
    else:
        print("Make sure you're using the KX132 and not the KX134")

    # myKx.set_range(myKx.KX132_RANGE8G) # Update the range of the data output.
    myKx.initialize(myKx.BUFFER_SETTINGS) # Load basic settings

    dataReadyPin = 5
    GPIO.setmode(GPIO.BCM)
    GPIO.setup(dataReadyPin, GPIO.IN)

    while True:

        if GPIO.INPUT(dataReadyPin) == 1: # When the buffer is full, the pin will go high

            myKx.get_accel_data()
            print("X: {0}g Y: {1}g Z: {2}g".format(myKx.kx132_accel.x,
                                                   myKx.kx132_accel.y,
                                                   myKx.kx132_accel.z))

        time.sleep(.02) #Set delay to 1/Output Data Rate which is by default 50Hz 1/50 = .02

if __name__ == '__main__':
    try:
        runExample()
    except (KeyboardInterrupt, SystemExit) as exErr:
        print("\nEnding Example 1")
        sys.exit(0)
```

Troubleshooting

Switching to SPI

As we've covered before in this tutorial, using either KX13x Breakout in SPI mode requires a slight modification to the board. The ADR Jumper must be **completely opened** so the ADR/SDO pin is floating prior to being connected to the SPI controller's SDI/COPI pin. Also, make sure the controller the KX13x Breakout connects to runs at **3.3V** logic to avoid damaging the IC. Using either accelerometer breakout with a **5V** controller requires level shifting the signal.

General Troubleshooting and Technical Support

Not working as expected and need help?

If you need technical assistance and more information on a product that is not working as you expected, we recommend heading on over to the SparkFun Technical Assistance page for some initial troubleshooting.

SPARKFUN TECHNICAL ASSISTANCE PAGE

If you don't find what you need there, the SparkFun Forums are a great place to find and ask for help. If this is your first visit, you'll need to create a Forum Account to search product forums and post questions.

CREATE NEW FORUM ACCOUNT | LOG INTO SPARKFUN FORUMS

Resources and Going Further

For more information on the SparkFun Triple Axis Accelerometer Breakout - KX13x (Qwiic), take a look at the following recources:

- Schematic (PDF)
- Eagle Files (ZIP)
- KX134 Datasheet (PDF)
- KX132 Datasheet (PDF)
- KX134 Technical Reference Manual (PDF)
- KX132 Technical Reference Manual (PDF)
- AN092 Getting Started App Note (PDF)
- Hardware GitHub Repository
- Qwiic KX13x Arduino Library
- Qwiic KX13x Python Package
- Qwiic Landing Page

For some inspiration on motion-based projects using your KX13x Breakout, take a look at these tutorials:

Hacker in Residence: The Harmonic Skew Zoetrope

Check out Hacker in Residence, Jesse's awesome Harmonic Skew Zoetrope in this project tutorial.

micro:bot Kit Experiment Guide

Get started with the moto:bit, a carrier board for the micro:bit that allows you to control motors, and create your own robot using this experiment guide for the micro:bot kit.

SparkFun ProDriver Hookup Guide

The SparkFun ProDriver utilizes Toshiba's TC78H670FTG stepper motor driver and with the latch pin connections, this new board is easier to get started with than the "Easy" Drivers. To get started, follow this hookup guide and you will be spinning stepper motors, in no time.

SparkFun PIR Breakout Hookup Guide

Get started with these Panasonic EKM-Series PIR breakouts following this Hookup Guide.