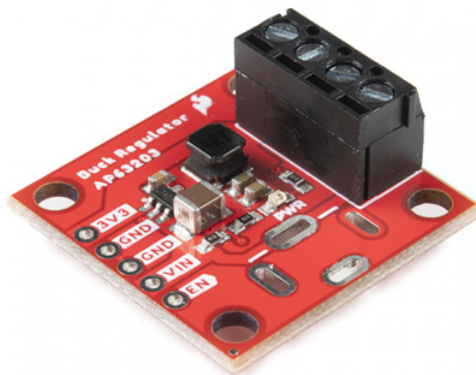


# Buck Regulator Hookup Guide

## Introduction

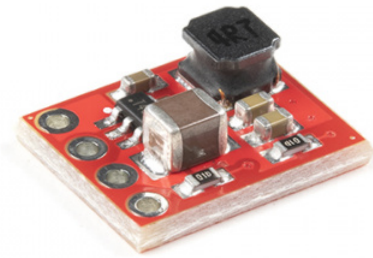
Who doesn't occasionally need power regulation? We certainly do, so we've designed the SparkFun Buck Regulator Breakout and the SparkFun BabyBuck Regulator Breakout to help us with just such a task.

Starring the AP63203 from Diodes Inc, both breakout boards take advantage of the 2A synchronous buck converter that has a wide input voltage range of 3.8V to 32V and fully integrated 125mΩ high-side power MOSFET/68mΩ lowside power MOSFET to provide high-efficiency step-down DC/DC conversion. All of this snuggled up in a a low-profile, TSOT26 package that's integrated into either a 1x1" or 0.4x0.5" board. For a wide variety of power management needs - grab yourself a Buck Regulator or Baby Buck Regulator and let's dive in!



SparkFun Buck Regulator Breakout - 3.3V (AP63203)

© COM-18356



## SparkFun BabyBuck Regulator Breakout - 3.3V (AP63203)

COM-18357

Product Showcase: SparkFun Buck & BabyBuck Regulator Break...



### 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.

#### **Buck Regulator Hookup Guide Wish List** SparkFun Wish List



Thermal Tape 4x4" Square  
PRT-17054



### Small Heatsink

PRT-11510

These tiny little black anodized heatsinks are perfect for cooling off small surface-mount components such as the A...



### SparkFun Buck Regulator Breakout - 3.3V (AP63203)

COM-18356



### SparkFun BabyBuck Regulator Breakout - 3.3V (AP63203)

COM-18357



### (2) DC Barrel Power Jack/Connector

PRT-00119

DC power jack/connector. This is a common barrel-type power jack for DC wall supplies. These are compatible wit...



### Break Away Headers - Straight

PRT-00116

A row of headers - break to fit. 40 pins that can be cut to any size. Used with custom PCBs or general custom head...



### Break Away Male Headers - Right Angle

PRT-00553

A row of right angle male headers - break to fit. 40 pins that can be cut to any size. Used with custom PCBs or gen...



### Hook-Up Wire - Assortment (Solid Core, 22 AWG)

PRT-11367

An assortment of colored wires: you know it's a beautiful thing. Six different colors of solid core wire in a cardboard ...

## Tools

You will need a soldering iron, solder, and general soldering accessories.



### Soldering Iron - 60W (Adjustable Temperature)

● TOL-14456

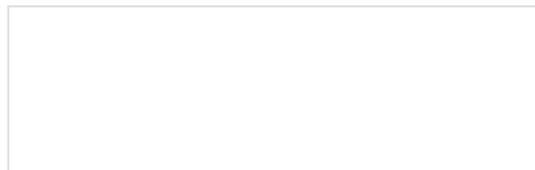
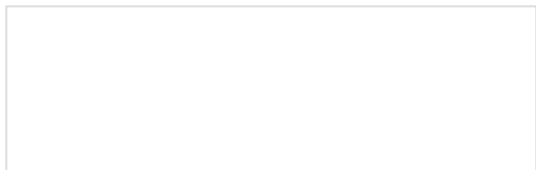


### Solder Lead Free - 15-gram Tube

○ TOL-09163

## Suggested Reading

If you aren't familiar with the following concepts, we recommend checking out these tutorials before continuing.





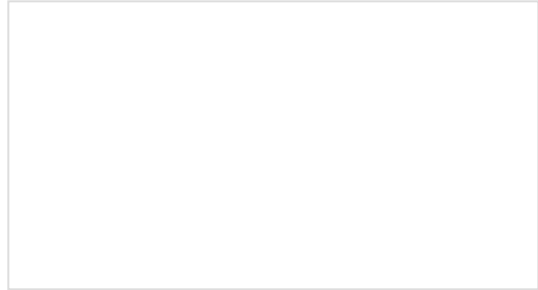
## How to Solder: Through-Hole Soldering

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



## Logic Levels

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



## Electric Power

An overview of electric power, the rate of energy transfer. We'll talk definition of power, watts, equations, and power ratings. 1.21 gigawatts of tutorial fun!

# Hardware Overview

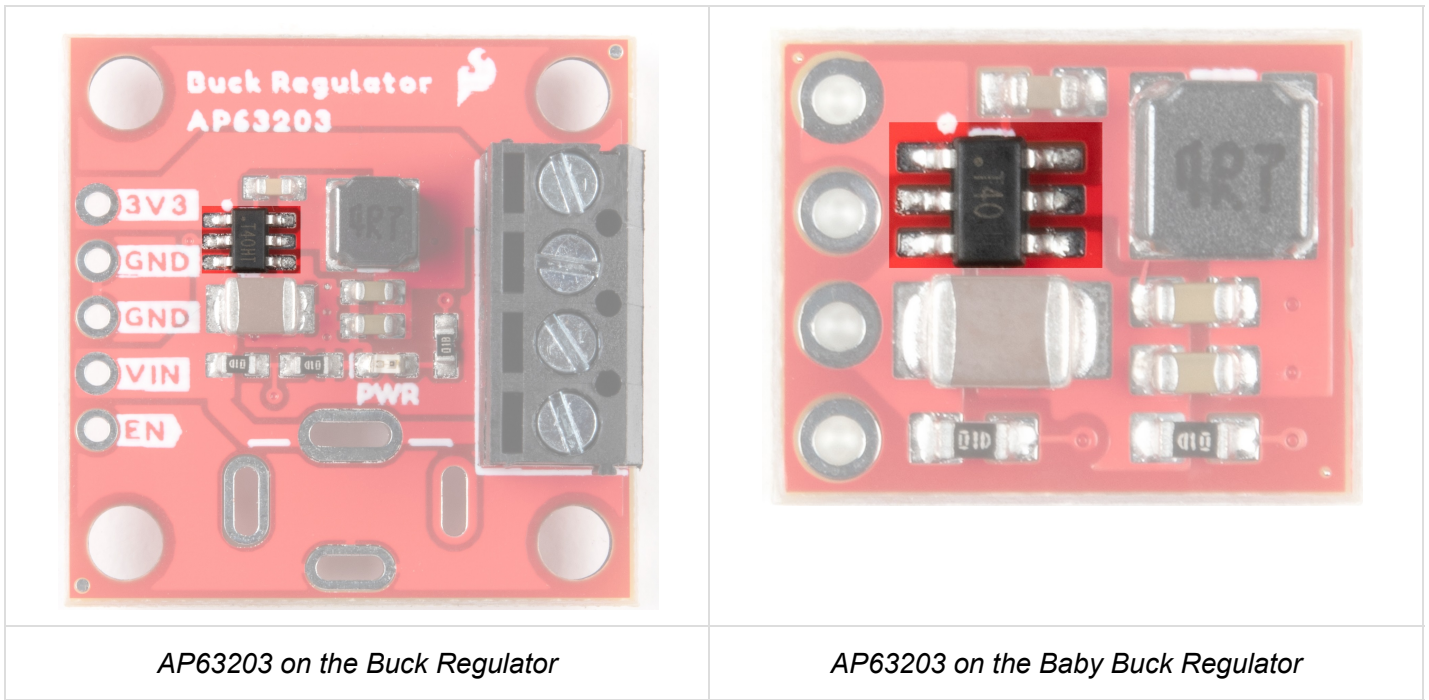
## AP63203

The AP63203 is a 2A, synchronous buck converter from Diodes Inc that has a wide input voltage range (**3.8V** to **32V**) and provides high-efficiency step-down DC/DC conversion to **3.3V**. Frequency Spread Spectrum (FSS) reduces EMI and a proprietary gate driver scheme resists switching node ringing without sacrificing MOSFET turn-on and turn-off times, which further erases high-frequency radiated EMI noise. Full details can be found in the datasheet.

### Features:

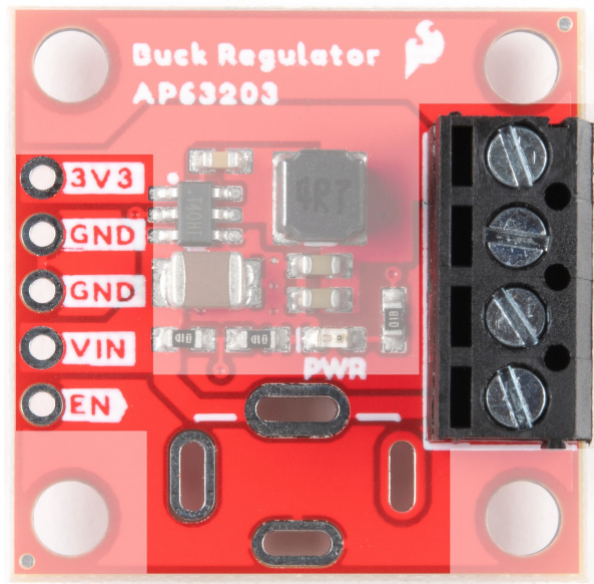
- VIN 3.8V to 32V
- Up to 2A Continuous Output Current
- 0.8V  $\pm$  1% Reference Voltage
- 22 $\mu$ A Ultralow Quiescent Current
- Switching Frequency - 1.1MHz
- Supports Pulse Frequency Modulation (PFM)
  - Up to 80% Efficiency at 1mA Light Load
  - Up to 88% Efficiency at 5mA Light Load
- Fixed Output Voltage - 3.3V
- Proprietary Gate Driver Design for Best EMI Reduction
- Frequency Spread Spectrum (FSS) to Reduce EMI
- Precision Enable Threshold to Adjust UVLO
- Protection Circuitry
  - Overvoltage Protection
  - Cycle-by-Cycle Peak Current Limit

- o Thermal Shutdown

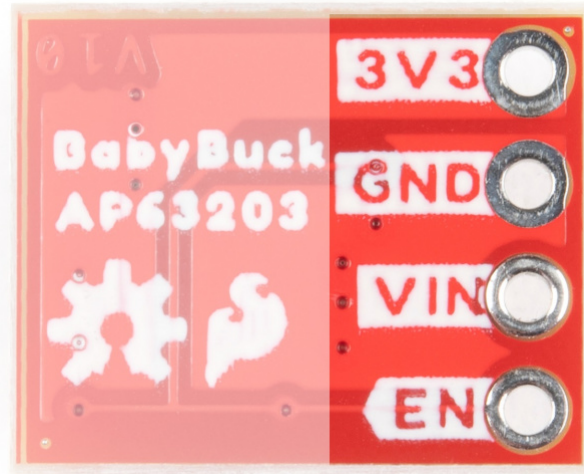


## Power

For the Buck Regulator, input power can be supplied in a number of ways. There are screw terminals on the right side of the board, solder pads for a barrel jack, which can be mounted on the top or bottom side of the board, and the plated through holes on the left side of the board can all be used as input. Output can be obtained via the screw terminals or the plated through holes.



The Baby Buck sacrifices flexibility for space. Use the plated through holes for input and output power.

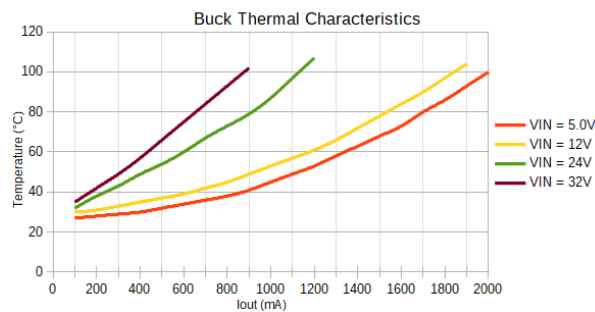
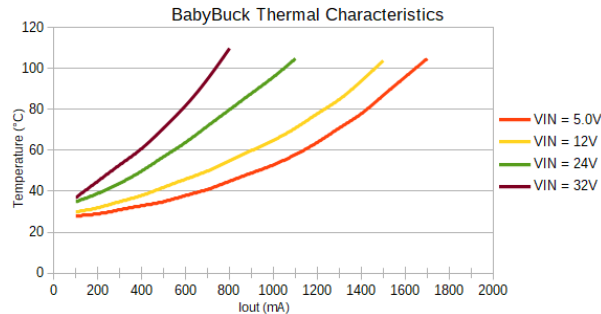


Both the Buck Regulator as well as the Baby Buck Regulator ratchet the output voltage down to **3.3V**. Be mindful that thermal properties change as  $V_{in}$  increases.

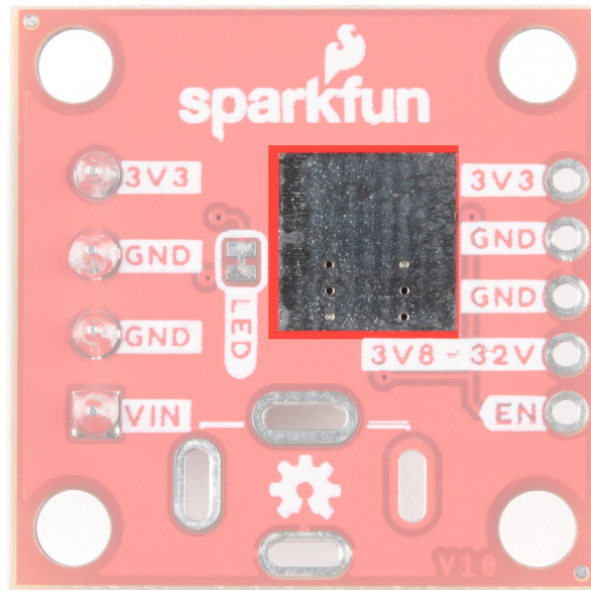
### Thermal Characteristics

One of the benefits of a buck converter over a linear regulator is their superior efficiency at stepping down the voltage. Unfortunately though, heat can still be a problem, particularly as the difference between the input and output voltage increases.

One of the trade-offs of the small size of the BabyBuck is because there is less copper to pull heat away from switching IC, the maximum output current available is reduced due to the thermal protections. Refer to the graphs below to see the how hot you can expect the AP63203 to get at various loads and supply voltages.

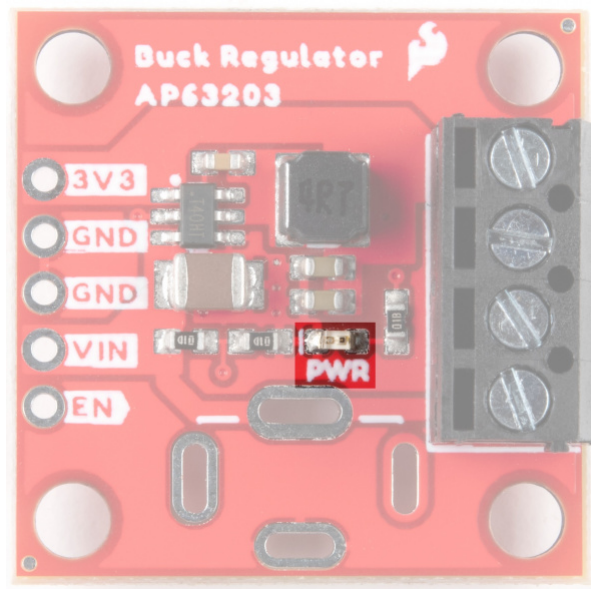


To dissipate some of the excess heat, we've added a copper pad for a heat sink on the back of the 1" x 1" Buck Regulator Board. Use one of our small heatsinks and attach it with some thermal tape.

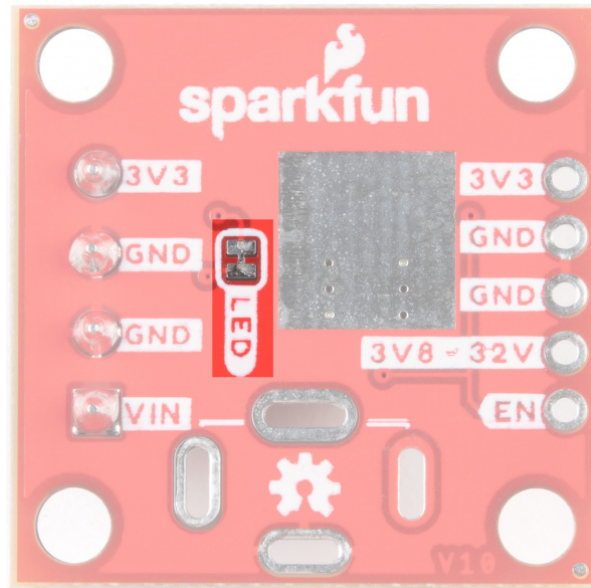


## Power LED and Jumper

On the 1" x 1" Buck Regulator, there is a power LED available for use.

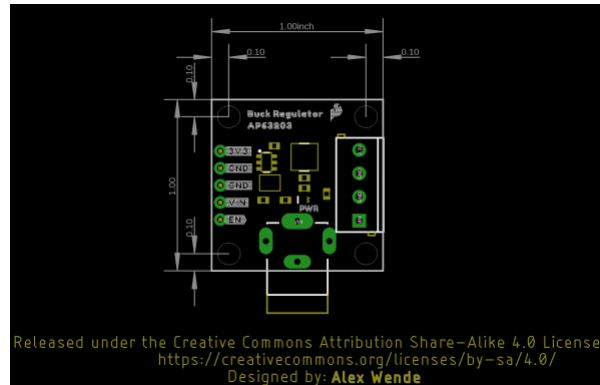


To disable this LED, cut the Jumper on the back of the board:



Board Outline

Buck Board Outline:



Baby Buck Board Outline:



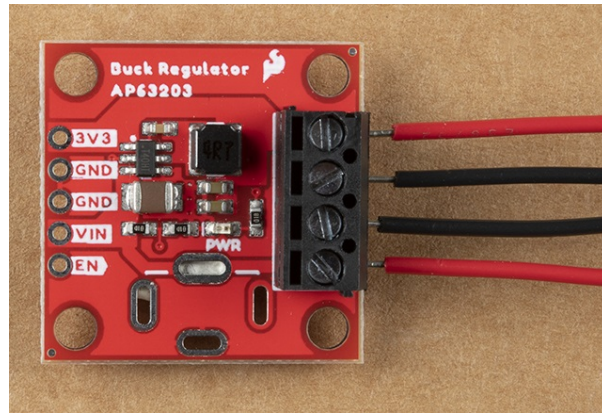
## Hardware Hookup

There are three options when using the 1" x 1" Buck Regulator.

### Screw terminals

To use the screw terminals, simply insert the correct wires into the screw terminal opening and gently tighten the screw for that port. Your board should look similar to the following:





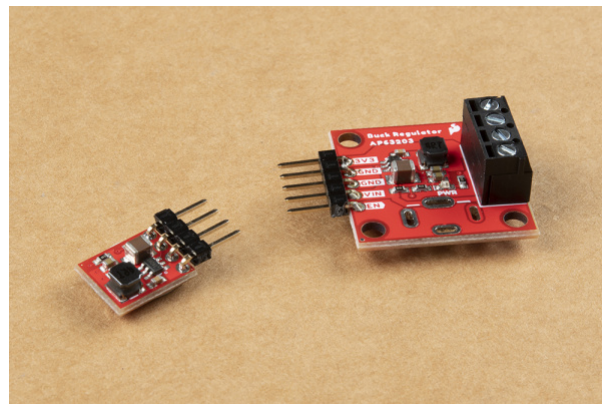
## Barrel Jack

To use a barrel jack for input, grab one of our PTH Mount Barrel Jack Connectors and solder that sucker on. It should look something like what you see here:



## PTH Pins

To use the plated through holes on either the Buck Regulator or the Baby Buck Regulator, you'll need to solder either straight headers or angle headers to the board.



## Troubleshooting

## 🔗 Need help?

If your product is not working as you expected or you need technical assistance or information, head on over to the SparkFun Technical Assistance page for some initial troubleshooting.

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.

## Resources and Going Further

For more information, check out the resources below:

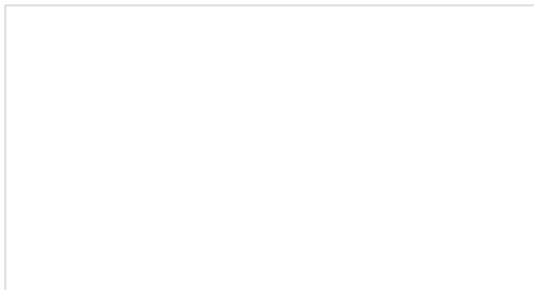
Buck Regulator:

- Schematic
- Eagle Files
- GitHub Repo
- AP63203 Datasheet

Baby Buck Regulator:

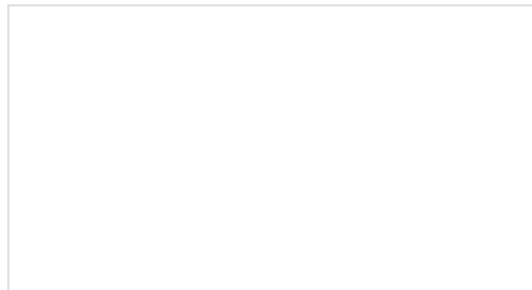
- Schematic
- Eagle Files
- GitHub Repo
- AP63203 Datasheet

Need some inspiration for your next project? Check out some of these related tutorials:



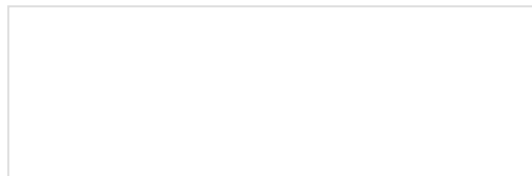
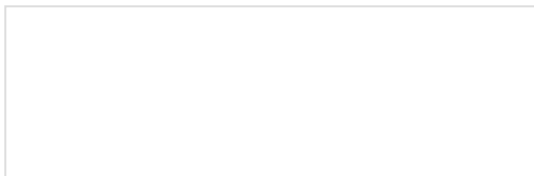
### INA169 Breakout Board Hookup Guide

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



### Wake-on-Shake Hookup Guide

A basic hookup guide for getting started with the SparkFun Wake-on-Shake. The board gives you the ability to put your project into hibernation until bumped or shaken awake using the ADXL362 accelerometer. This means you can design projects meant to stay inert for long periods of time, possibly even several years, depending on the battery type used to power the project.





## 12V/5V Power Supply Hookup Guide

In this tutorial, we will replace the 12V/5V (2A) power supply's molex connector with two male barrel jacks adapters.



## Understanding Thermal Resistance

Discussing what thermal resistance is, how it's used for thermal management, and how to maximize the life of your project.