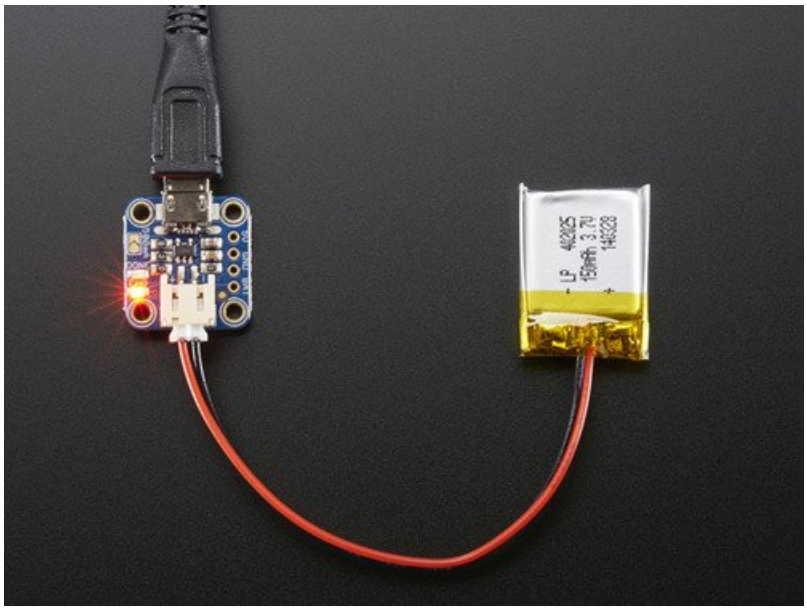
adafruit learning system

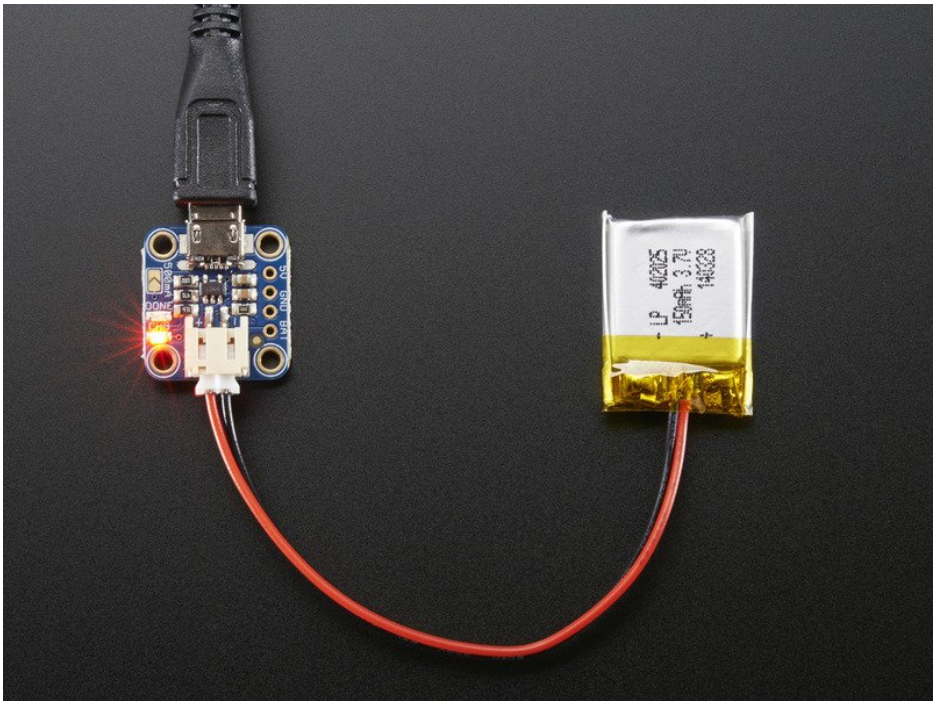
Adafruit MicroLipo and MiniLipo Battery Chargers

Created by lady ada

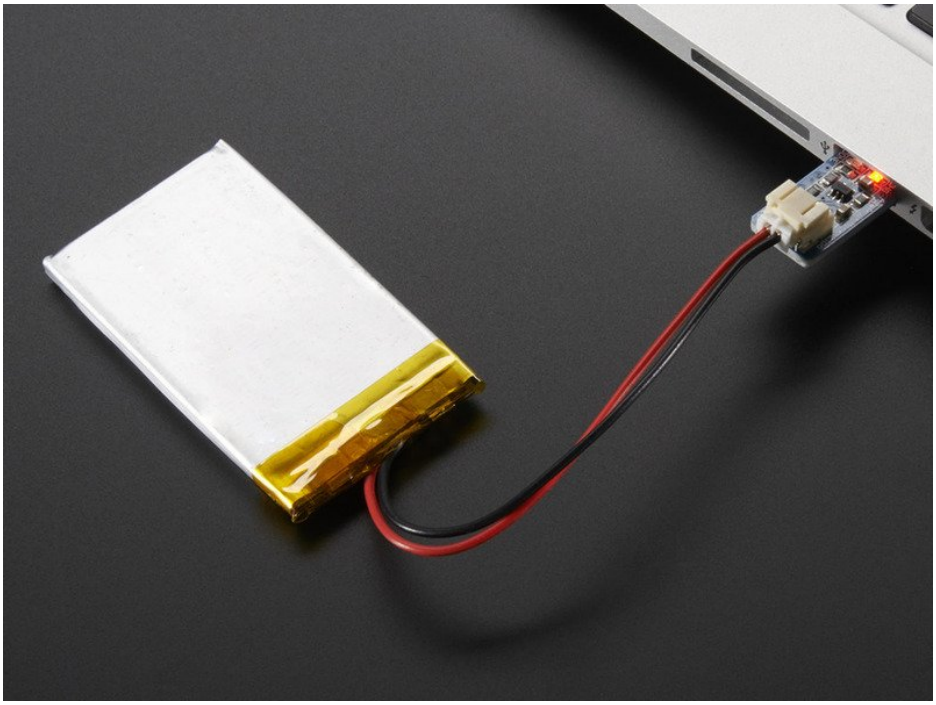


Last updated on 2019-11-05 11:02:28 PM UTC

Overview



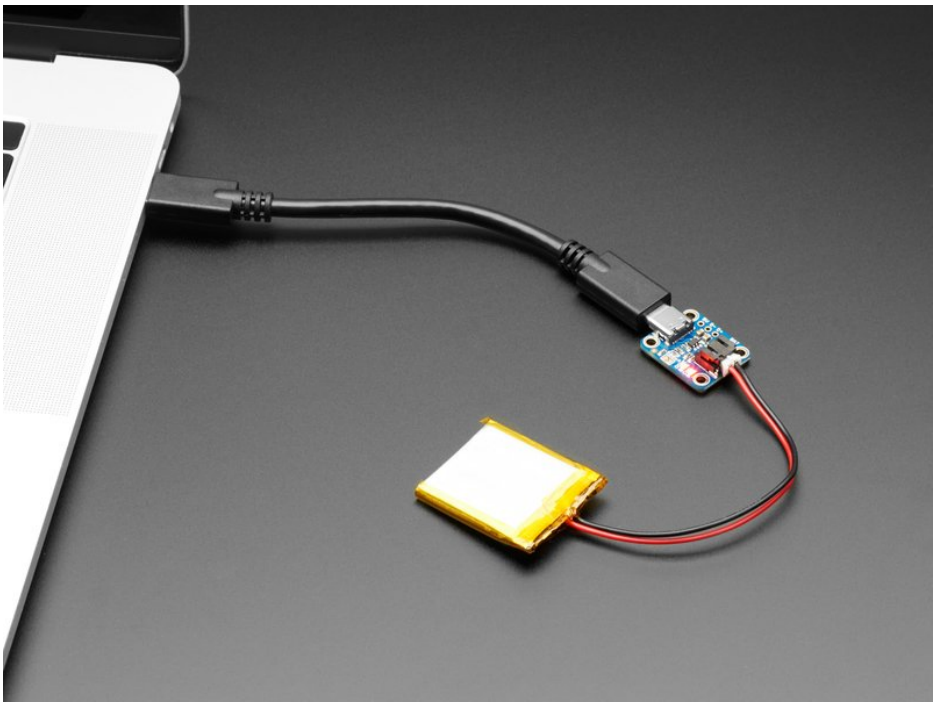
Sooner or later you'll need to cut the cord...the power cord! Untether your electronic project from the tyranny of the wall adapter and take it out into the world. That's where batteries come in, and you may have been seduced by the high power density, large current capabilites and recharge-ability of Lithium Polymer or Lithium Ion batteries. These battery chemistries have quickly become the most popular rechargeable batteries in consumer products, powering everything from keychain mp3 players to huge laptops.



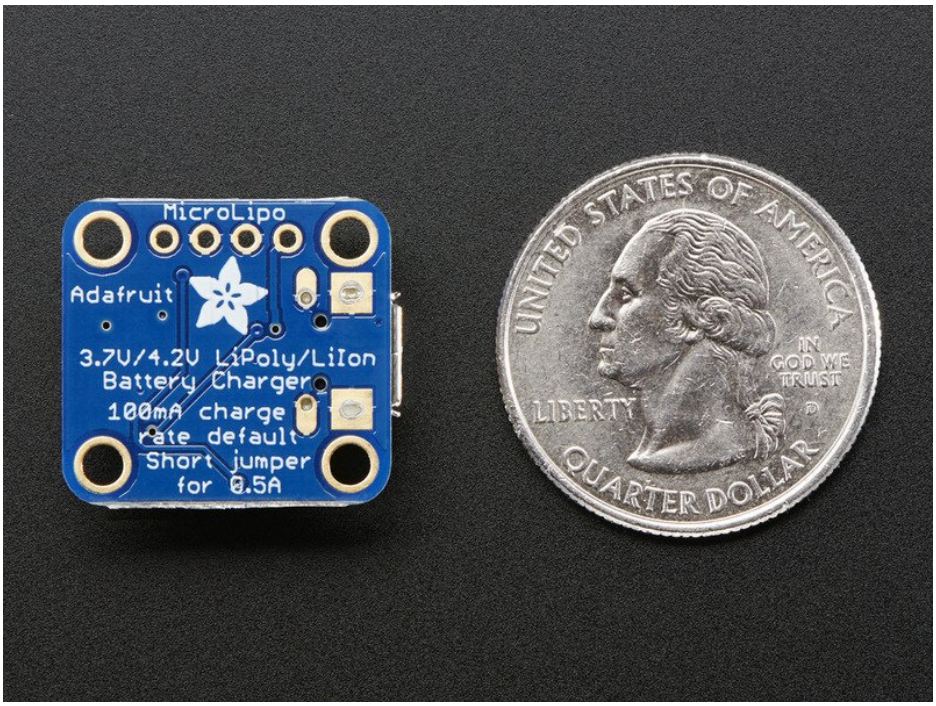
Thanks to the big market demand, the price of lipoly (for short) batteries has plummeted. Now you can get batteries for

$10 each, or even 'recycle' batteries from old cell phones.

However, these batteries need a special type of charger! You can't just use a NiMH or NiCad battery charger, even a LiFePo charger wont cut it. Instead, a proper Lithium charger is required.



Charging is performed in three stages: first a preconditioning charge, then a constant-current fast charge and finally a constant-voltage trickle charge to keep the battery topped-up. The charge current is 100mA by default, so it will work with any size battery and USB port. If you want you can easily change it over to 500mA mode by soldering closed the jumper on the front, for when you'll only be charging batteries with 500mAh size or larger.

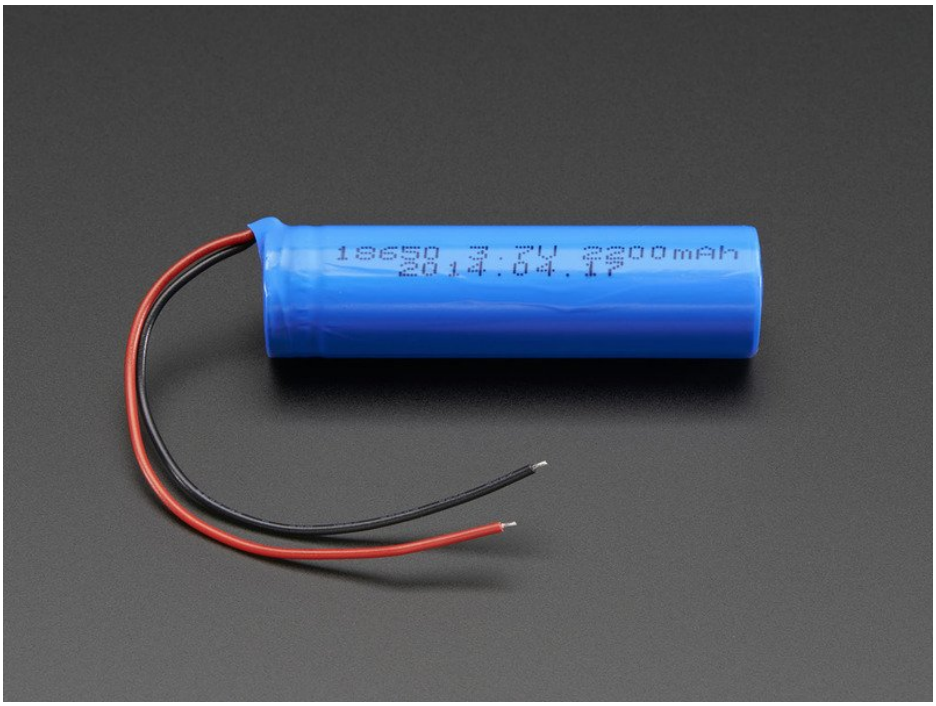


Adafruit has a few small basic chargers that can satisfy your LiPo charging needs. **All of these chargers can only do 1-cell chargers for 3.7V/4.2V cells.** These are by far the most common and all the LiIon/LiPo batteries in the Adafruit shop will work quite nicely.

Battery Types

Check your battery before plugging it in!

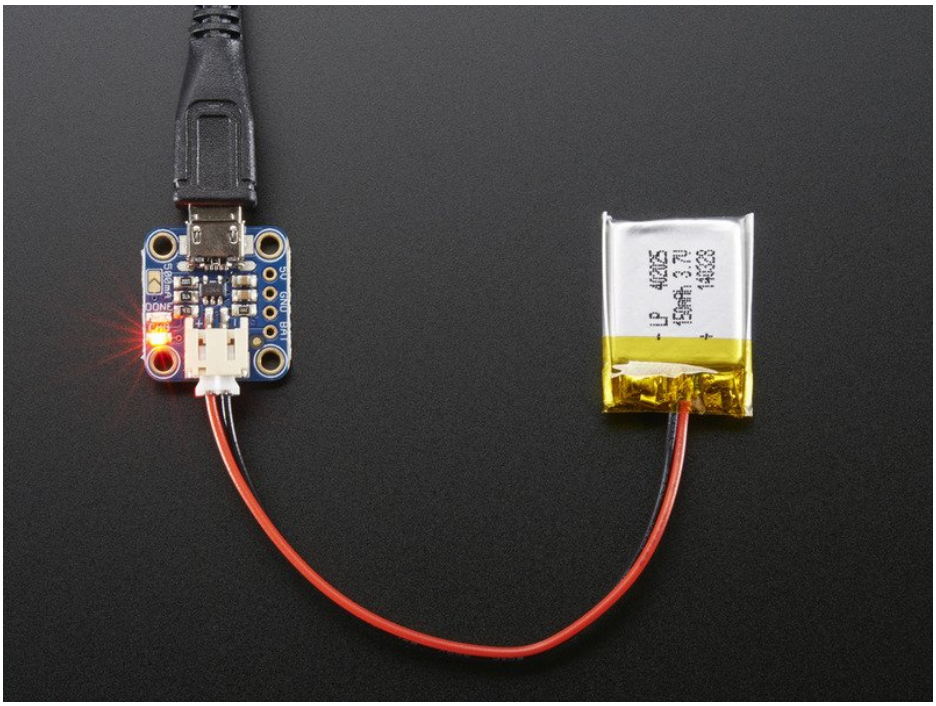
The Mini/Micro Lipo chargers all are for 3.7V/4.2V cells only. These are single LiPoly/LiIon batteries. Some very old types of LiIon cells are '3.6V/4.1V' type - not good! Also, dont use this charger on Lithium coin cells, there are rechargeable coin cells but they are best used with a custom charger.



This is a Lithium Ion battery, often cylindrial with a tough metal casing. It clearly shows the voltage (3.7V) and capacity (2200mAh)

This is an example of a Lithium Polymer battery. They look like silvery pouches. This one is a **3.7V 110mAh** battery.

Plugging In



You can plug in either the battery first or the USB port first. We provide a JST jack since the large number of batteries we carry come with a JST PH connector or cable

If you are soldering on a JST cable or using a non-Adafruit battery check the polarity of the wires going into the battery port. A backwards battery can destroy the charger!

USB Port

USB ports are very handy around the house, you can use any USB port that is on a motherboard. If you are using 500mA charge rate, try to avoid using extension cords! Even for 100mA charge rates, we suggest not plugging into unpowered hubs (most hubs are un-powered), keyboard ports, monitor ports, etc.

You can use USB wall adapters such as those for tablets, phones, GPS, MP3 players, too!

Charge Indictator LEDs

There are two LEDs on each MicroLipo charger.

- **Red** - this means the chip has detected a cell and **is charging** it
- **Green** - this means the chip has completed the charge cycle and the battery is ready to go
- **Both** - this means the battery is damaged or isn't plugged in.

Charging other batteries

We strongly encourage using Adafruit batteries for your projects since they are new, come with protection circuitry and have the right polarity JST cables.

There may be situations where you need to charge a random battery and you can't solder a JST cable to it! In this

case, you can usually hack something together.

For example, here's a GoPro battery that discharged all the way and couldn't be 'revived' by the camera.

You can see its a 3.7V 1000mAh battery. That means we can charge it at 500mA max rate if we wish.

On the back, though, there are these clippy connectors!

By soldering two pins of male header (http://adafru.it/392) onto the JST cable, we can set up a delicate-but-workable charging cable!

CAUTION
• Charge only with specified charger
• Don' t dispose of in fire
• Don' t store in temperature over 60°C
• Don' t disassemble
gopro. com
601-01017-00A
1ICP7/26/32-2
2012-12-18
AHDBT-201
MADE IN CHINA
MH29637
5V
GND
BAT

Charge Rate

When charging Lithium batteries, its important to keep track of the charge rate. A rule of thumb is, you should max charge at 1C of current. For a 500mAh battery, thats 500mA. For a 2200mAh battery it's 2200mA. Pretty easy!

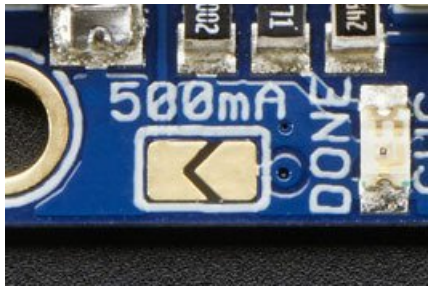
This rating is just the MAX rating, you can always charge at a lower rate - it just takes longer.

You can estimate how long it takes to charge a battery by taking the capacity, dividing by the rate, and multiplying by 125%.

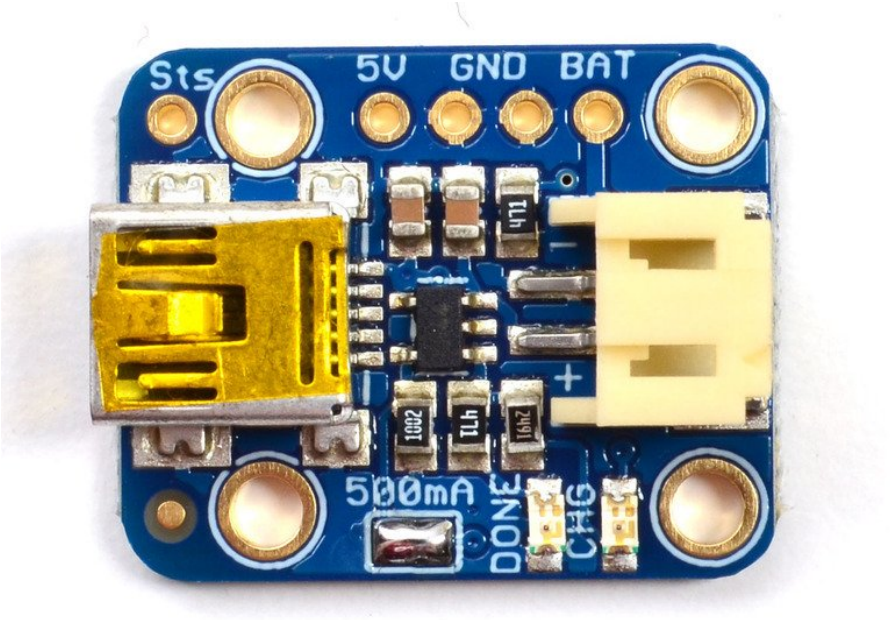
For example: a 2200mAh battery charging at 500mA? It'll take 2200/500 * 125% = 5.5 Hours. Less if its not fully drained!

Changing the Rate

The chip in the MicroLipo can charge at up to 500mA rate. To make it safe for all our batteries, we set the default rate to 100mA. It's very easy to update the charge rate, however. On each board, look for the solder jumper that looks like this:



Melt some solder onto the jumper to close it and set the new charge rate



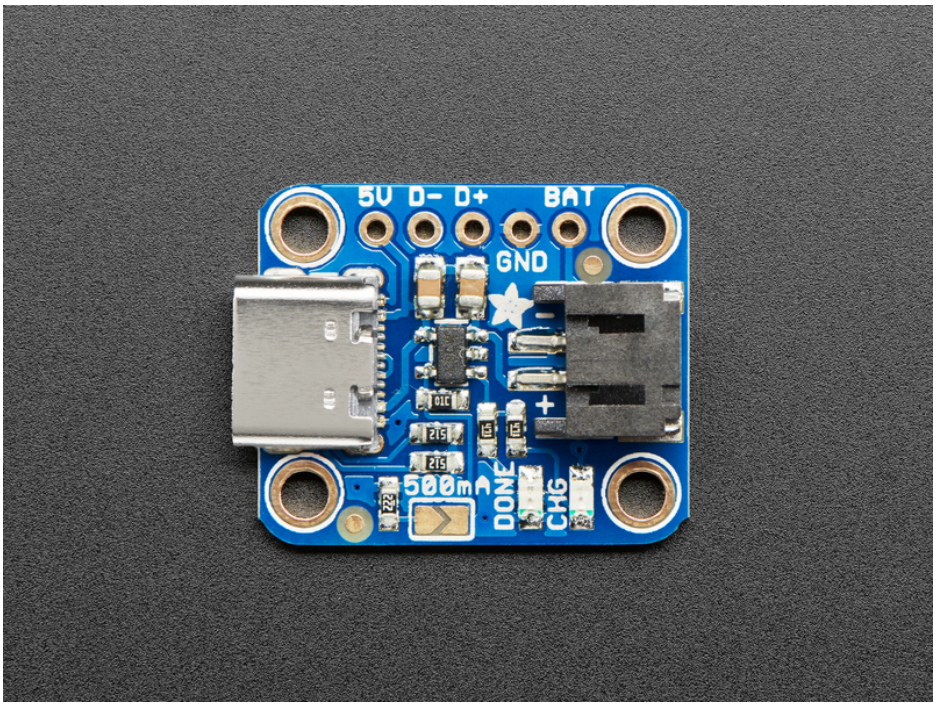
Constant-Current / Constant-Voltage

There's a few stages for charging batteries: pre-conditioning, constant-current and then constant-voltage.

Pre-conditioning is when the battery is very low, and requires low current. Constant-voltage is for 'topping up' the battery when its almost completely full. Constant-current is where the bulk of the charging occurs. If your battery is not ready for constant-current or if it is coming out of the CC stage, it will draw *less* than the max charge rate current!

If you want to check the exact current draw during charge, try out a Charger Doctor between the USB port and charger. (https://adafru.it/dvm)

USB C Pinout



The USB-C Micro-Lipo charger is special. We've exposed the data lines so you can use it both as a USB-C breakout and a Micro-Lipo charger. Since there's a little more to it, we've included the pinouts here. Let's take a look!

Connectors

Using this board as a Micro-Lipo charger is simple with the two connectors available:

- **USB-C connector** - Shown above on the left, 5V input via a USB Type C connector
- **JST connector** - Shown above on the right, this two-pin JST connector is for plugging in single Lithium Ion/Lithium Polymer 3.7/4.2v batteries (not for older 3.6/4.1v cells)

LEDs

There are two LEDs on the board.

- **CHG** - The charge LED is red while the battery is charging
- **DONE** - The done LED is green once the battery is fully charged.

If both LEDs are on at the same time, it means the battery is damaged or isn't plugged in.

Pins

There are optional pins available to use this board as a USB-C breakout:

- **5V** - power pin
- **D+/D-** - data pins
- **GND** - ground pin
- **BAT** - VBAT pin

You can solder header pins (not provided) to the board to use it with a breadboard and your favorite microcontroller.

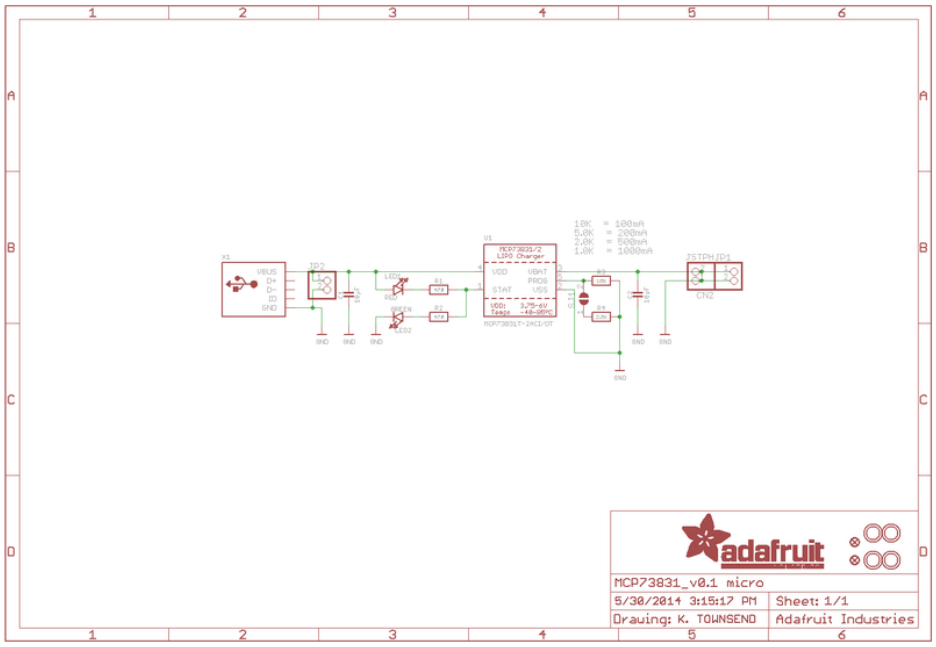
Downloads

Datasheets & Files

- Datasheet for the MCP73831 charger chip used in all three chargers (https://adafru.it/dvn)
- EagleCAD PCB files for the Mini Lipo and MicroLipo chargers (https://adafru.it/pwD)
- Fritzing objects in Adafruit Fritzing library (https://adafru.it/aP3)
- USB-C charger Fritzing object in Adafruit Fritzing Library (https://adafru.it/GDH)

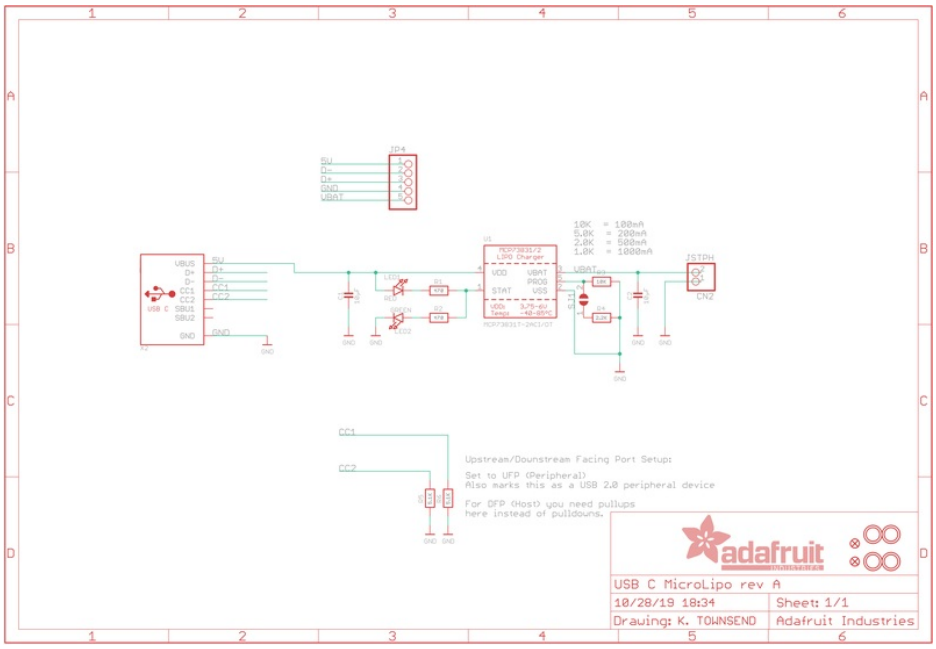
Schematic

All three Micro-Lipo's use essentially the same schematic - but with different USB ports

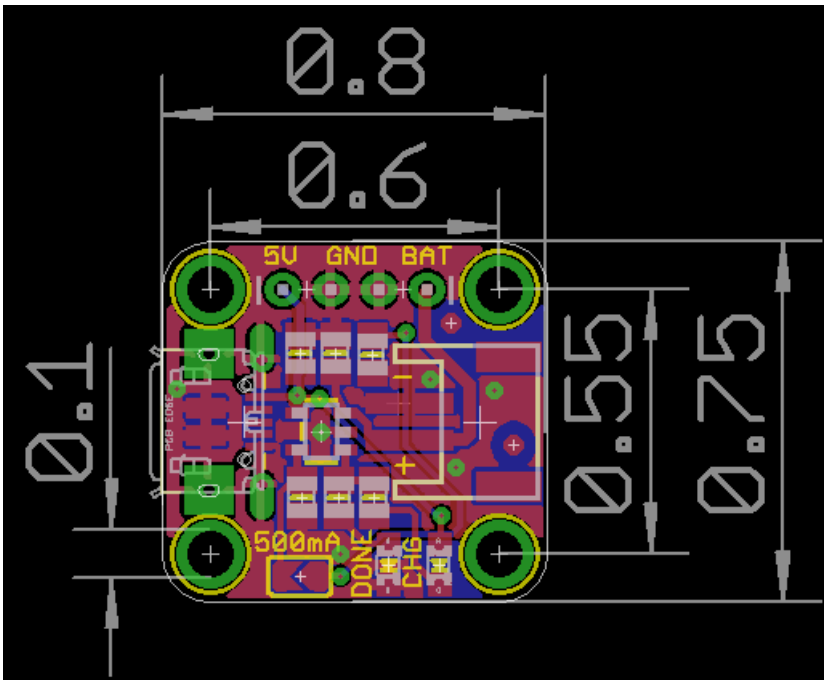


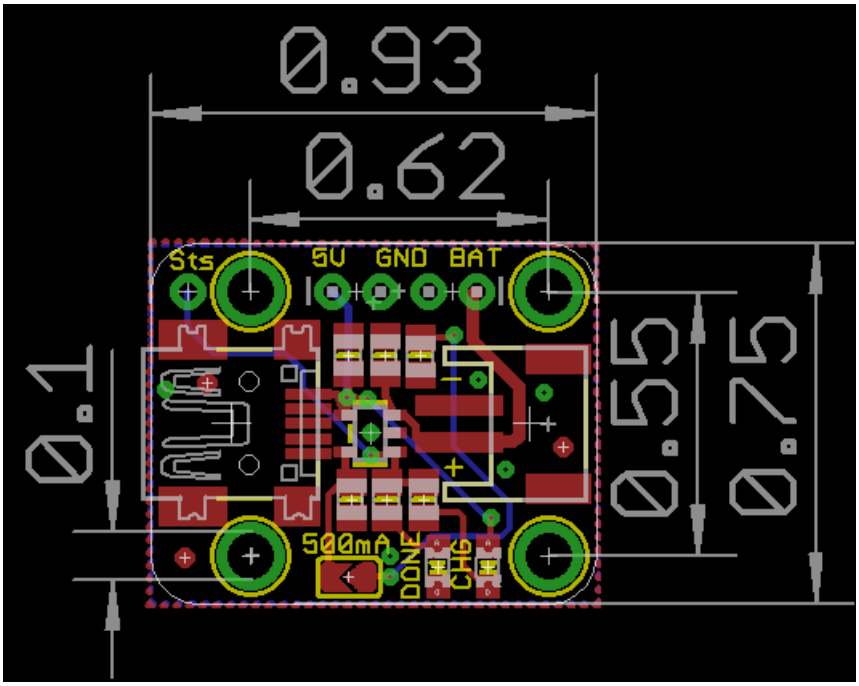
USB-C Schematic

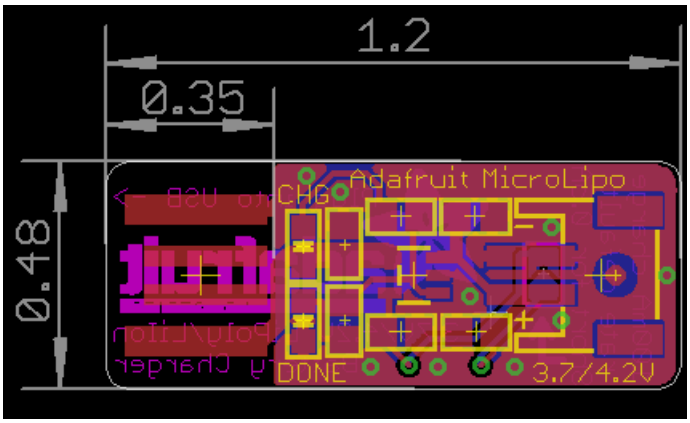
The USB-C charger is a little different, so we've included a separate schematic.

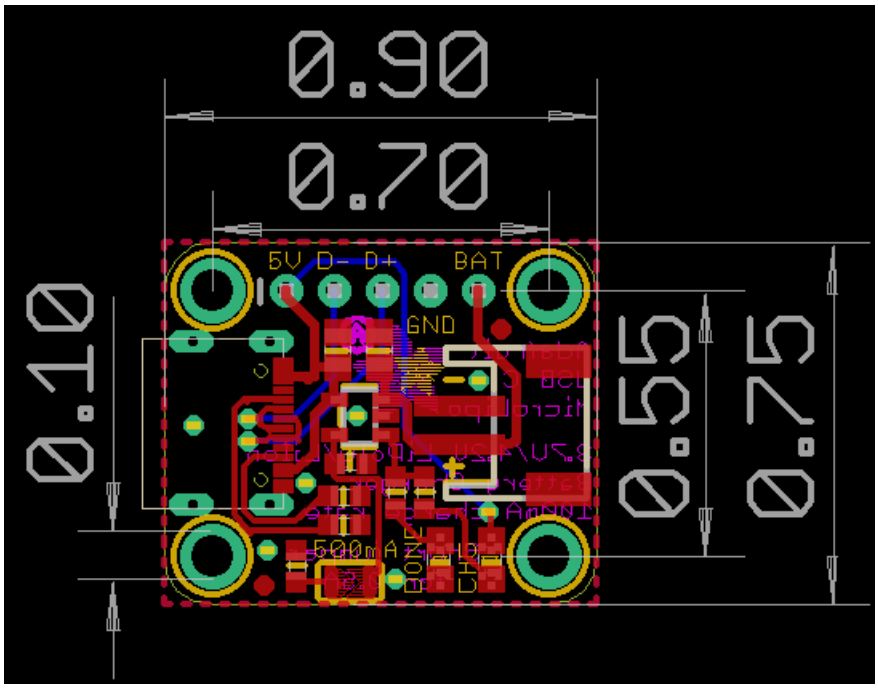


Fabrication Prints




0.93
0.62
Sts
5V GND BAT
0.1
0.55
0.75
500mA
DONE
CHG


1.2
0.35
0.48
Adafruit MicroLipo
CHG
DONE
3.7/4.2V


0.90
0.70
0.10
0.55
0.75
5V
D-
D+
BAT
GND

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