



# Adafruit Powerboost 1000C

Created by lady ada



<https://learn.adafruit.com/adafruit-powerboost-1000c-load-share-usb-charge-boost>

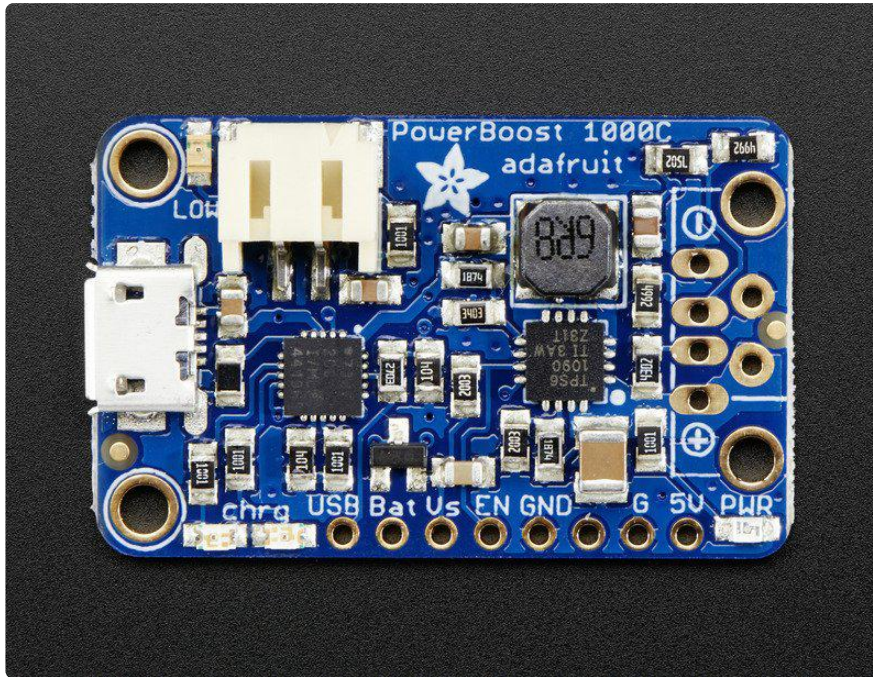
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# Overview



PowerBoost 1000C is the perfect power supply for your portable project! With a built-in load-sharing battery charger circuit, you'll be able to keep your power-hungry project running even while recharging the battery! This little DC/DC boost converter module can be powered by any 3.7V Lilon/LiPoly battery, and convert the battery output to 5.2V DC for running your 5V projects.

[If you dont need the 1A battery charger, smart load-sharing, or 1A iOS resistors, check out the Powerboost 500C \(https://adafru.it/dDF\)](https://adafru.it/dDF)

Like our popular [5V 1A USB wall adapter \(https://adafru.it/duP\)](https://adafru.it/duP), we tweaked the output to be 5.2V instead of a straight-up 5.0V so that there's a little bit of 'headroom' for long cables, high draw, the addition of a diode on the output if you wish, etc. The 5.2V is safe for all 5V-powered electronics like Arduino, Raspberry Pi, or Beagle Bone while preventing icky brown-outs during high current draw because of USB cable resistance.



The PowerBoost 1000C has at the heart a [TPS61090 boost converter from TI \(https://adafru.it/duQ\)](https://adafru.it/duQ). This boost converter chip has some really nice extras such as low battery detection, 2A internal switch, synchronous conversion, excellent efficiency, and 700KHz high-frequency operation. Check out these specs!

- Synchronous operation means you can disconnect the output completely by connecting the ENable pin to ground. This will completely turn off the output
- 2A internal switch (~2.5A peak limiting) means you can get 1000mA+ from a 3.7V LiPoly/Lilon battery. Just make sure your battery can handle it!
- Low battery indicator LED lights up red when the voltage dips below 3.2V, optimized for LiPo/Lilon battery usage
- Onboard 1000mA charge-rate 'iOS' data resistors. Solder in the USB connector and you can plug in any iPad, iPhone or iPod for 1000mA charge rate.
- Full breakout for battery in, control pins and power out
- 90%+ operating efficiency in most cases (see datasheet for efficiency graphs), and low quiescent current: 5mA when enabled and power LED is on, 20uA when disabled (power and low batt LED are off)

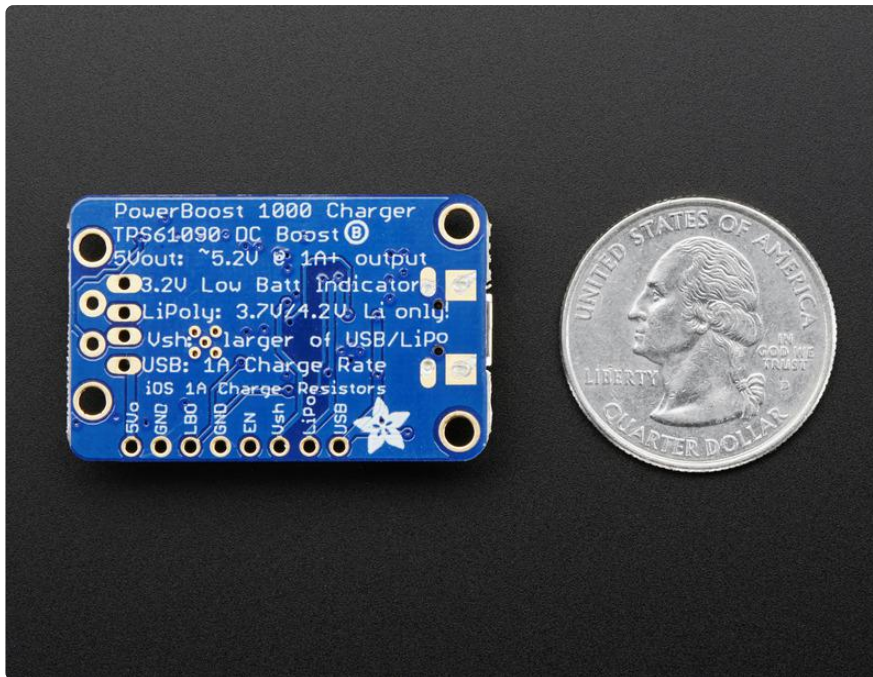




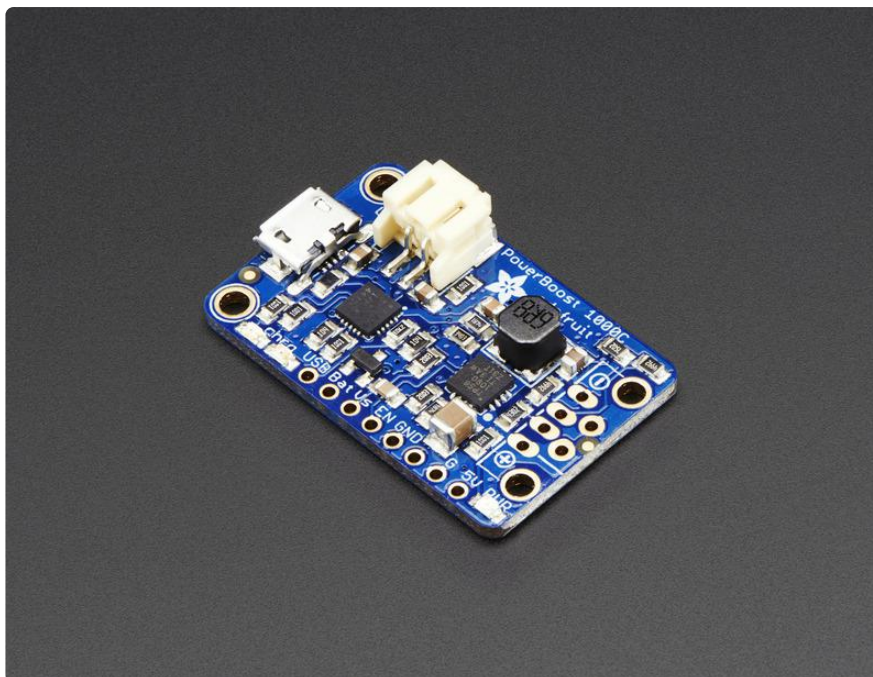
To make this even more useful, we stuck a smart load-sharing Lipoly charger on the other side. The charger circuitry is powered from a microUSB jack, and will recharge any 3.7V/4.2V Lilon or LiPoly battery at 1000mA max rate. There's two LEDs for monitoring the charge rate, a yellow one tells you its working, a green one lights up when its done.

Since the built-in battery charger has load-sharing, it will automatically switch over to the USB power when available, instead of continuously charging/draining the battery. This is more efficient, and lets you charge-and-boost at the same time without any interruption on the output so its fine for use as a "UPS" (un-interruptable power supply).

Just be aware that the charge rate is 1000mA max, and there's some inefficiency during the boosting stage, [so make super sure that the USB adapter you're using to charge with is high quality, can supply 2A and has thick power wires. \(https://adafru.it/e5A\)](https://adafru.it/e5A) This one from Adafruit is ideal and has been tested (<https://adafru.it/e5A>), lower quality ones will not act well due to the voltage drop on the wires or droop on the power supply. This is [especially true if you're actually drawing 1000mA out of the PowerBoost 1000C, the MCP73871 maxes out at 1.8A \(https://adafru.it/aMO\)](https://adafru.it/aMO)



This charger-booster is great for powering your robot, Arduino project, single-board-computer such as Raspberry Pi or BeagleBone! Each order comes with one fully assembled and tested PCB and a loose USB A jack. If you are powering your project from USB, solder the USB A jack in (a 3-minute soldering task). [If you would like to use a terminal block, pick up a 3.5mm 2pin block here \(https://adafru.it/duR\)](https://adafru.it/duR) and solder to the output spot where the USB jack would go. Or dont solder anything in for a more compact power pack.

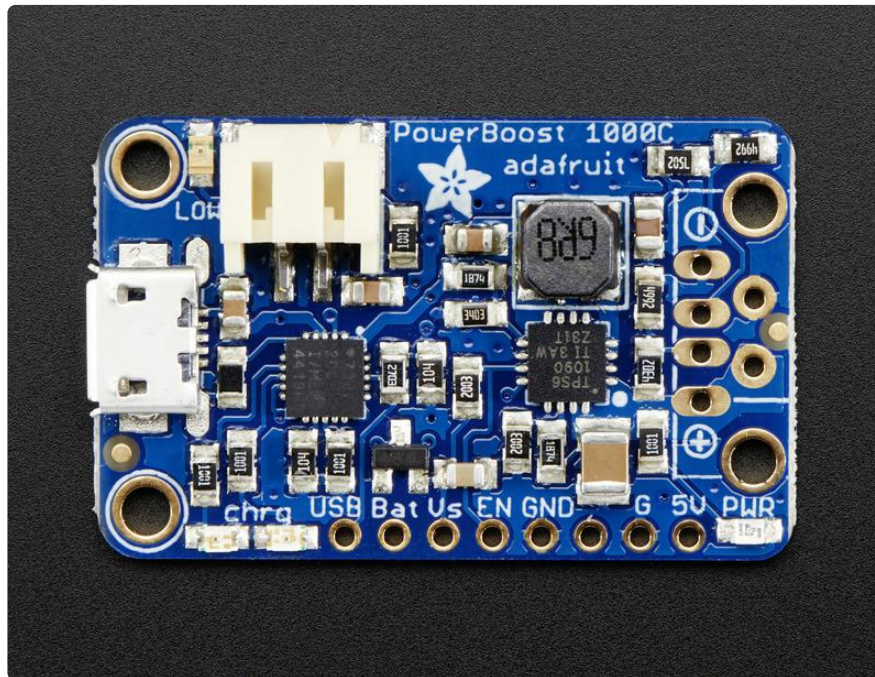


If you're trying to figure out how much current your project is using, check out the [CHARGER DOCTOR! \(http://adafru.it/1852\)](http://adafru.it/1852)

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# Pinouts

For many people, the PowerBoost 500C can be used with just the microUSB charge input, battery plug and power outputs. However, we have a couple handy breakouts so lets get started!



## Power Pins

There's three power voltages, the USB input for charging the battery (4.75-5.25V whatever is coming out of the USB port), the battery itself (3-4.2V) and the output (5-5.2V)

- USB - this is the micro USB 5V power pin. It's the pin that is used to charge the battery, NOT the output power! You can use this if you want to grab power from the microUSB port when it is plugged in
- BAT - this is the battery input, connected directly to the JST connector. For most Lithium batteries, this will range from 3.0V when near-dead to 4.2V when fully-charged. Higher voltages will let you draw more current and in general, are more efficient. Try to keep the wires going to this pin nice and short - 3" or less is best!
- VS - this is the load shared output from the battery charger. When there is 5V coming in from the micro-B USB power plug, this pin will have approx 5V on it

(less a little due to the internal resistance of the charger chip's MOSFET). When there's no USB charging, the Vs pin will be the same voltage as the Bat pin.

- GND - this is the power ground. This boost converter is not 'isolated' - the ground input is the same as the ground output
- 5V - this is the boosted output. When the board is running, the voltage will be 5.2V approximately. It may dip down to 5V as the current draw starts to go up (over 500mA). When the board is disabled, this output is 'floating' but you should still try not to apply a voltage to it while the board is disabled. There's a blue LED connected to this pin which will let you know when there's power output

## Control Pins

There's two 'control' pins.

- EN - this is the 'enable' pin. By default it is pulled 'high' to VS. To turn off the booster, connect this pin to ground. The switch can be as small as you like, it is just a signal. Contrast this to an inline power switch which would have to be able to handle up to 2A of current! When the chip is disabled the output is completely disconnected from the input.
- LBO - not a leveraged buy out! this is the Low Battery Output. By default it is pulled high to BAT but when the charger detects a low voltage (under 3.2V) the pin will drop down to 0V. You can use this to signal when its time to shut down or alert the user that the battery is low. There is also a red LED connected to this pin.

Please note - you cannot connect these together to 'auto shut off' when the battery is low.

The LBO output is pulled up to Vin, and is not suitable for direct connection to 3.3V logic GPIO!

## LEDs

There are four onboard LEDs.

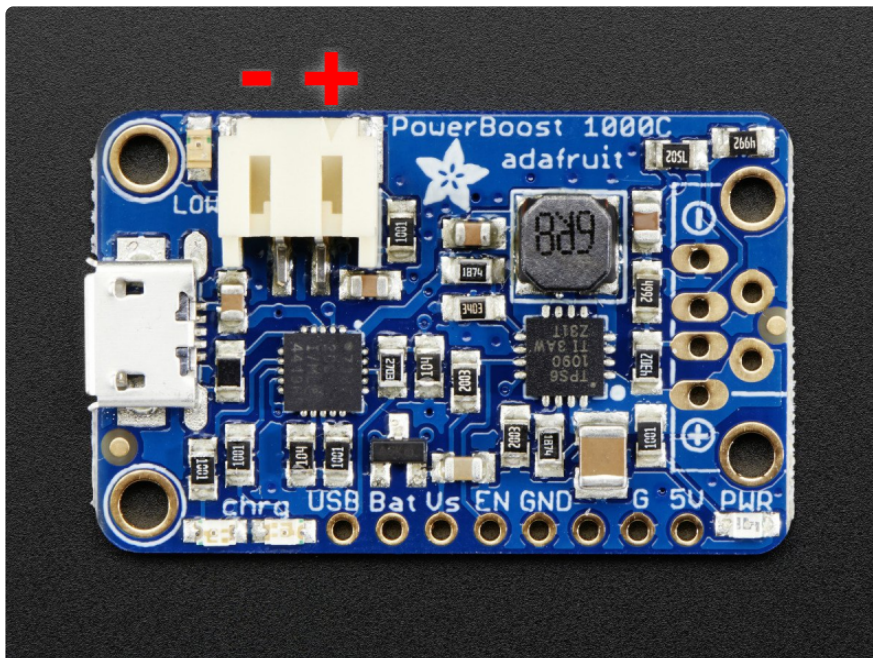
- The Blue LED sits next to the USB connector socket, and indicates the 5V output power state.



- The Red LED is next to the battery JST port and indicates when the battery voltage is below 3.2VDC (Low Battery Output)
- The Yellow LED is next to the microUSB connector and indicates when the battery is being charged
- The Green LED is also next to the microUSB connector and indicates when the battery is done charging (all full)

## Battery and USB connection

You can connect a battery to the breakout strip or to the JST connector. All of Adafruit batteries come with JST cables that will plug in nicely so we strongly suggest that. Watch the polarity of the cable!



The USB connector can be soldered on to create a portable 'USB power pack'. The two data lines on USB have resistor dividers that match Apple charger values for 1A charge rate so that you can plug any iOS device in to charge. 99% of other phones, devices and tables are totally cool with these resistors as well. You can always short the D+ and D- lines if you happen to have a phone that wants shorted data lines.

If you don't want a USB connector attached, there are two holes that are designed for a 3.5mm spaced terminal block (not included)

Some third-party LiPo cells have JST connectors wired opposite from the standard. Connecting these to the PowerBoost will damage your PowerBoost. Double check the polarity before connecting.

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# Assembly

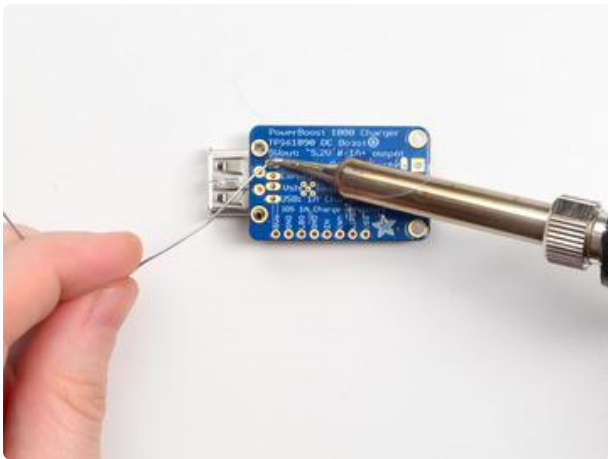
## Attaching USB connector

If you'd like to plug in something that can power from a USB port, the included USB connector will do the job!

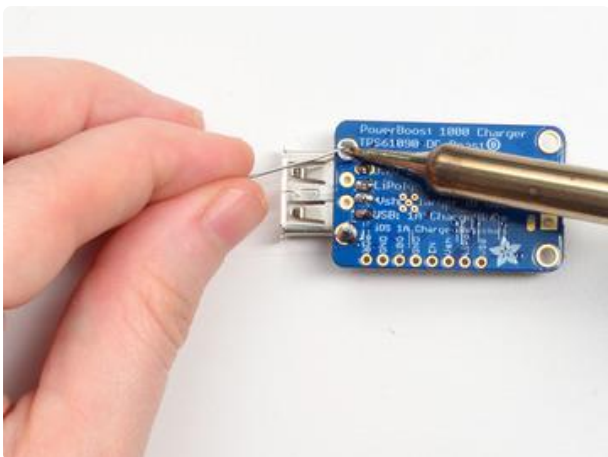
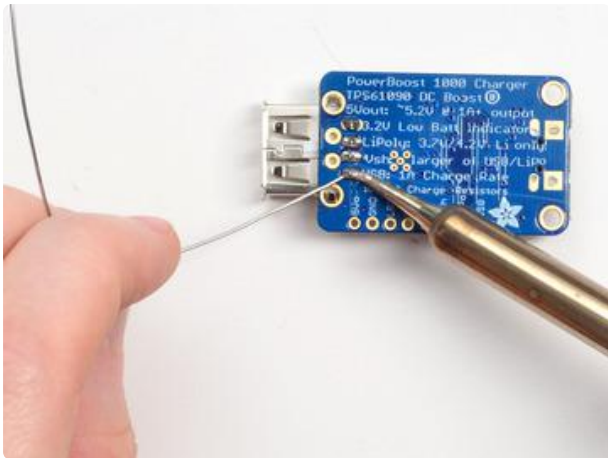
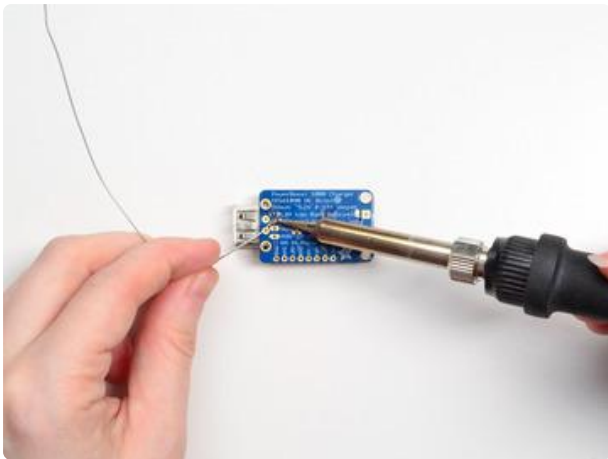
You will need to solder it in place, however. Press-fitting wont work!



Snap the USB connector in so that all of the pins go through the PCB. Make sure you're solder them on the back of the PCB



Solder the four power/data lines



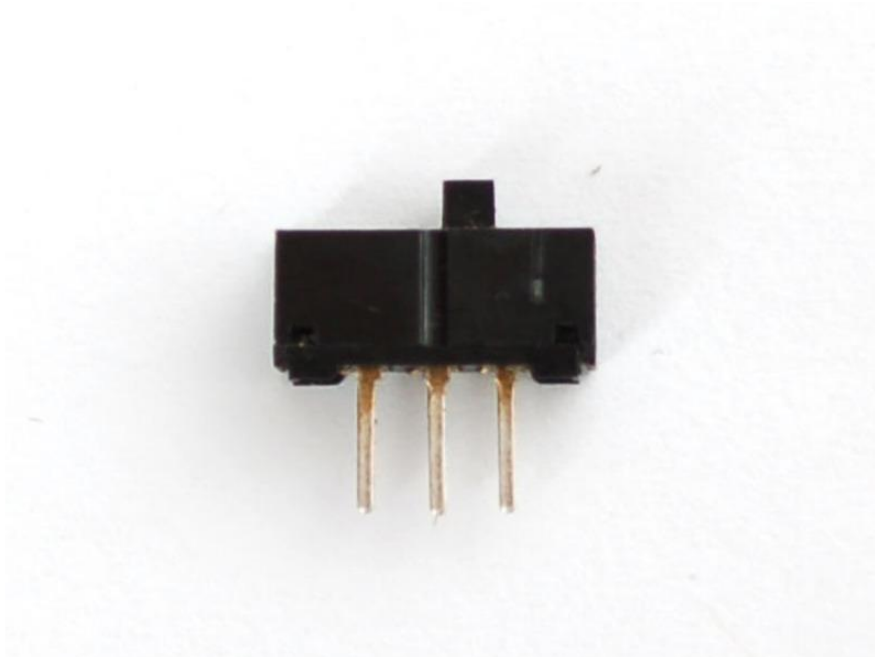
Finally, solder the two mechanical tabs on the side to keep the USB connector solidly in place.

# On/Off Switch

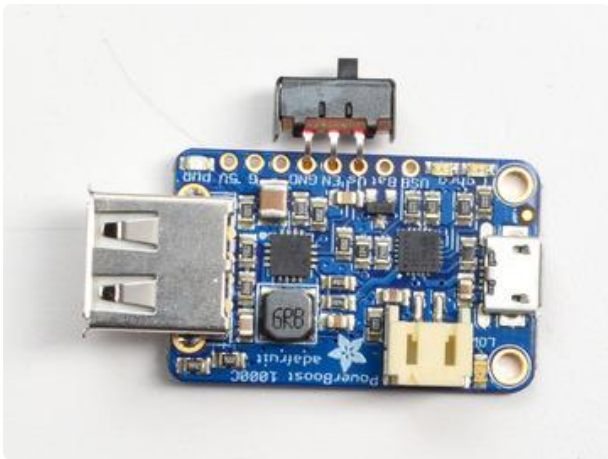
The PowerBoost 1000C does not come with an on/off switch for the output, but its very easy to add one! [Just grab a Breadboard friendly SPDT slide switch from the adafruit shop.](https://adafruit.com/products/1000) (<https://adafru.it/drN>)

We will be turning the boost on/off via the ENABLE pin, so the switch does not have to carry any power, it is only signalling to the boost converter what to do. This means the switch can be small. Use any switch you like, if it is 0.1" spacing thats ideal. If your switch only has two pins instead of three, tie one pin to GND and the other pin to EN - when the switch is closed, the power will turn off

Some types of 3-pin slide switches are 'make before break' and can cause a short circuit between VS and GND while switching. To avoid that possibility, you can cut off the 3rd pin and solder the switch just to EN and GND.







The switch will go into the breakout header, and attach to VS EN and GND  
The switch is symmetric so as long as those three pins are attached to the switch you are good to go

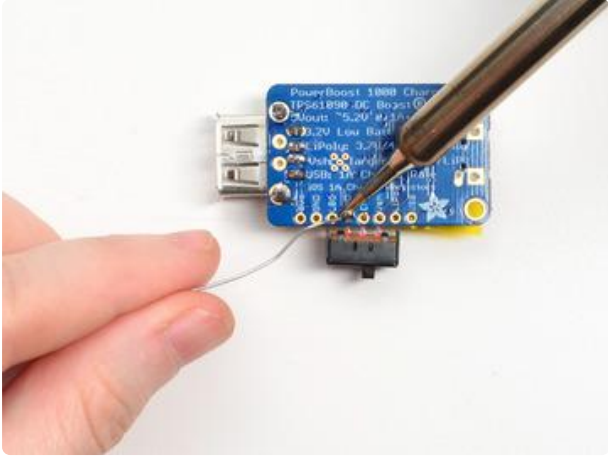


Before soldering, check that you have the right three pins!

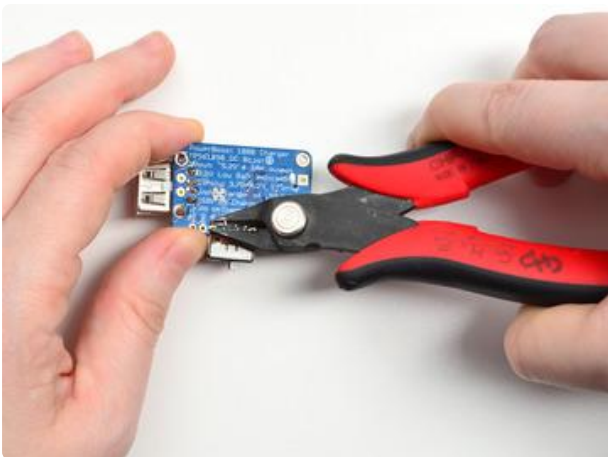
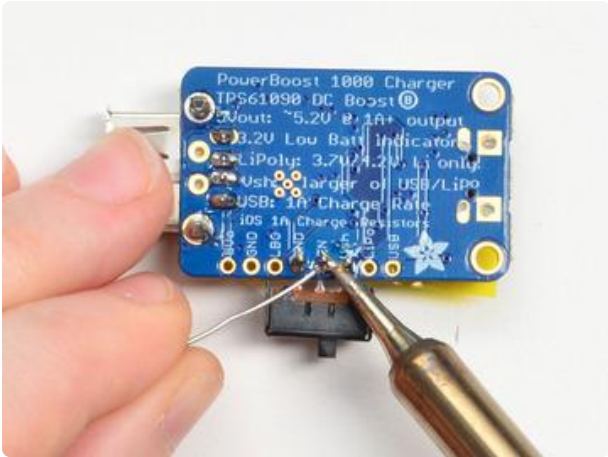
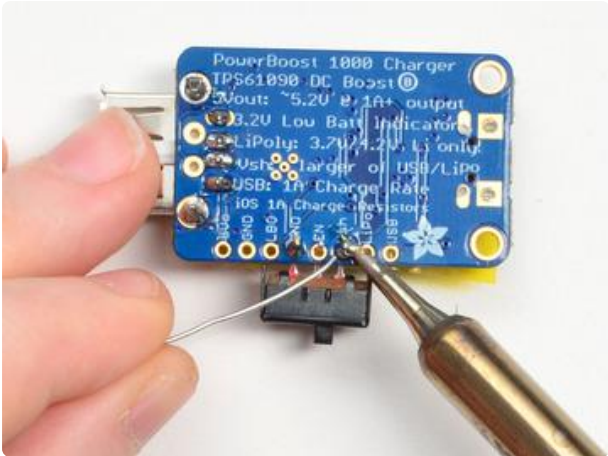
I used some tape to keep the switch in place while soldering



Flip over to solder the three pads in place



Solder in all three pins with any kind of solder making sure you have a good connection



Clip off the long pins with diagonal cutters



When the switch is to the left, the 5V power will be on, you can tell because the blue LED is lit



Slide to the right to turn it off.

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## F.A.Q.

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### Can I use the PowerBoost without a battery attached?

No. Please note that this board is designed to be used only with a LiPoly attached, it won't work without a battery.

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### When I plug into the microUSB jack the PowerBoost gets really hot!

Yep, that is normal - the charging circuit will draw up to 1000mA to charge the battery fast, the charger chip will get very hot! It has internal thermal protection but it is not unusual for it to get too hot to touch

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### When I am charging the battery while also boosting, the PowerBoost gets really hot!

Yep, that is normal - the charging circuit will draw up to 1800mA to charge the battery and also supply current to the boost circuitry, the charger chip will get very

hot! It has internal thermal protection but it is not unusual for it to get too hot to touch

Can I use the LBO output to automatically turn off the Powerboost when the battery level is low?

No - you cannot!

## Downloads

## Datasheets

- [TPS61090 datasheet](https://adafru.it/duS) (https://adafru.it/duS)(the DC/DC boost control chip used)
- [MCP73871T-2CCI datasheet](https://adafru.it/aMO) (https://adafru.it/aMO) (the USB LiPoly charger chip used)

## Downloads

- [PCB files on GitHub](https://adafru.it/rDU) (https://adafru.it/rDU)
- [Fritzing object in the Adafruit Fritzing Library](https://adafru.it/aP3) (https://adafru.it/aP3)

## Schematic

Click to embiggen

