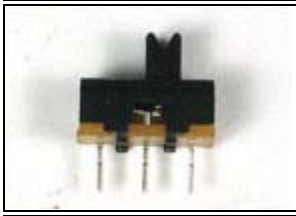
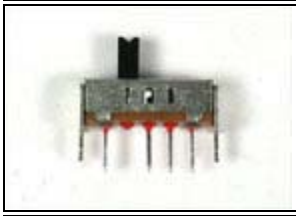
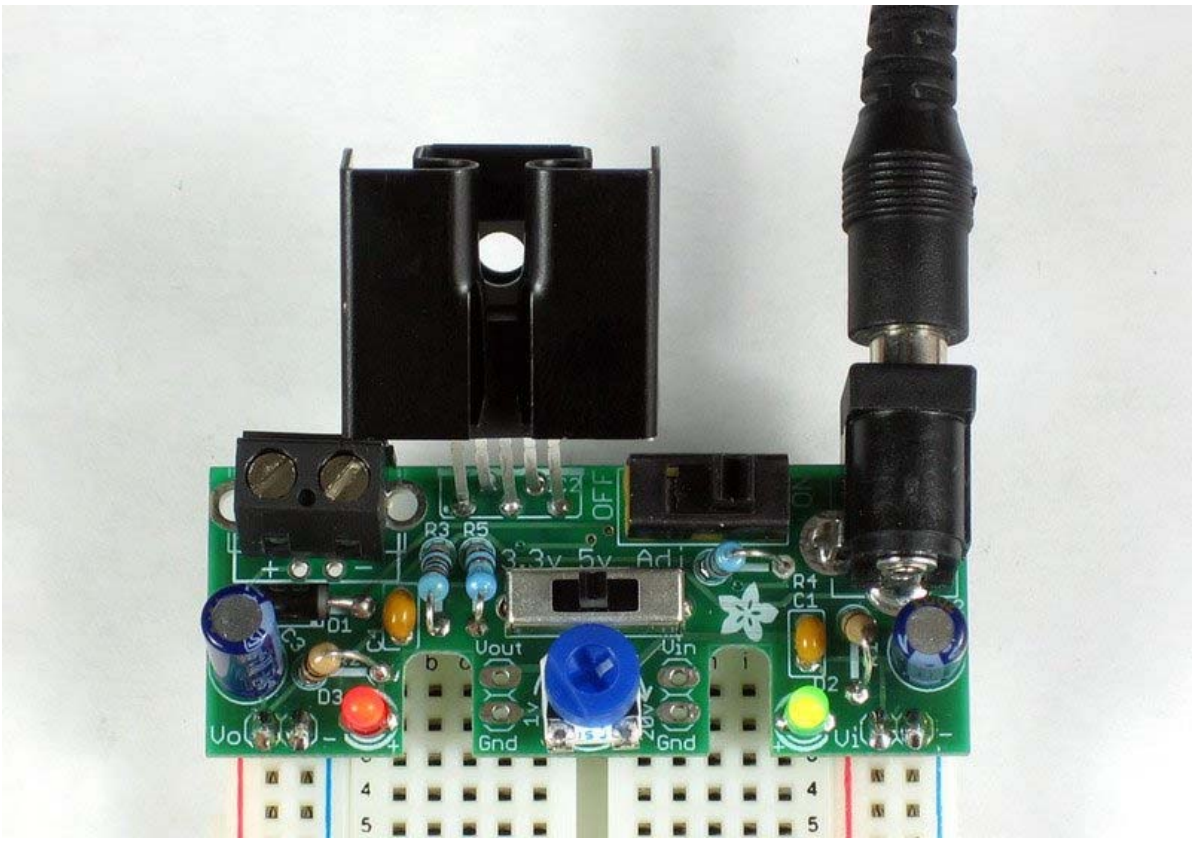
Image	Name	Description	Part # & Datasheet	Qty
	**IC1**	Low dropout adjustable regulator	MIC2941AWT	1
	**D1**	**1N5818** (or 1N5817, etc) diode 1N4001 is acceptable but has higher dropout	1N5818	1
	**LED1**	Red LED Lite-On LTL-1CHE (or any 3mm LED)	Generic	1
	**LED2**	Green LED Lite-On LTL-1CHG (or any 3mm LED)	Generic	1
	**R1, R2**	1/4W 5% 1.0K resistor Brown Black Red Gold	Generic	2
	**R3**	1/4W 1% 11.0K resistor (blue body) Brown Brown Black Red Brown	Generic	1
	**R4**	1/4W 1% 20.5K or 20.0K resistor (blue body) Red Black Green Red Brown **OR** Red Black Black Red Brown	Generic	1
	**R5**	1/4W 1% 6.49K resistor (blue body) Blue Yellow White Brown Brown	Generic	1
		2.1mm Power Jack	CUI PJ-202AH	1

	**TM1**	100K trim potentiometer 6mm top adjust	Bournes 3306	1
	**C1, C4**	0.1uF ceramic capacitor (104)	Generic	2
	**C2, C3**	47uF / 25V capacitor (or higher)	Generic	2
	**X2**	2-position 5.08 terminal block	Generic	1
	**S1**	SPDT ON/OFF switch	10SP001	1
	**S2**	SP3T voltage selection switch	OS103011MS8QP1	1
		Straight male header	Generic	1
		Heat sink	Aavid574102B00000G	1
	**PCB**	Circuit Board		1

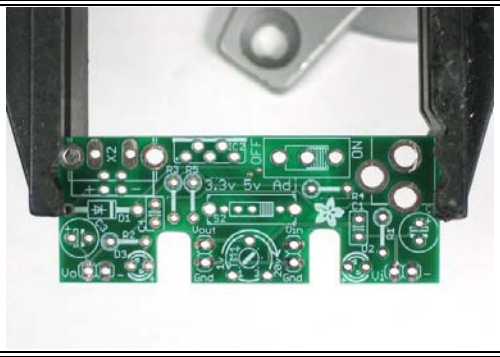
Overview



This project details the design of a very low dropout adjustable power supply. A good power supply is essential to electronic projects. While there are many existing designs for adjustable power supplies, this one makes improvements that make it more useful for hobby designs.

- MIC2941 regulator has guaranteed 1.25A output
- Low dropout, only 40mV - 400mV compared to 1.25V - 2.0V for LM317. This means you can use a wider range of output voltages including generating 3.3V from as low as 3.7V (such as 3 AA's or a lithium ion battery)!
- Short circuit and overheating protection
- Input diode to protect circuitry from negative voltages or AC power supplies.
- 2.1mm DC jack and terminal connector for voltage inputs
- Two indicator LEDs for high and low voltages
- Output selection switch to select from **3.3v, 5v** and **Adjustable**
- Onboard potentiometer for adjusting voltage from 1.25V up to within 0.5V of the input voltage. (20V max)
- On/Off switch for entire board
- Heat sink included

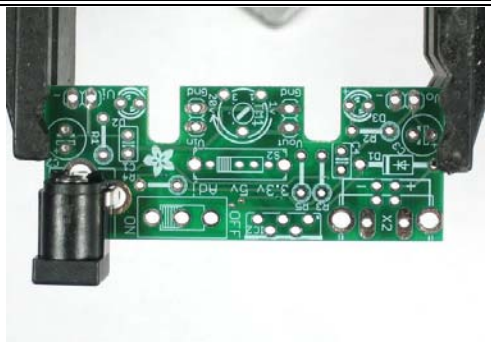
Solder It



Prepare to assemble the kit by checking the parts list and verifying you have everything!

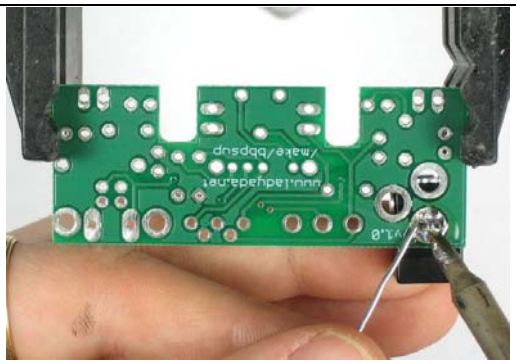
Next, heat up your soldering iron and clear off your desk.

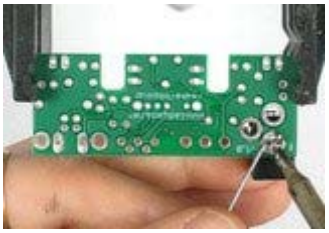
Place the circuit board in a vise so that you can easily work on it.

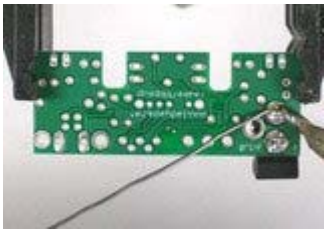


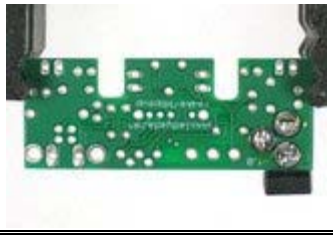
We'll start by placing the DC power jack. This is how we will attach outlet power supplies to the board. The jack is 2.1mm which is the most common size.

The DC jack can only go in one way, so its pretty easy to work with.





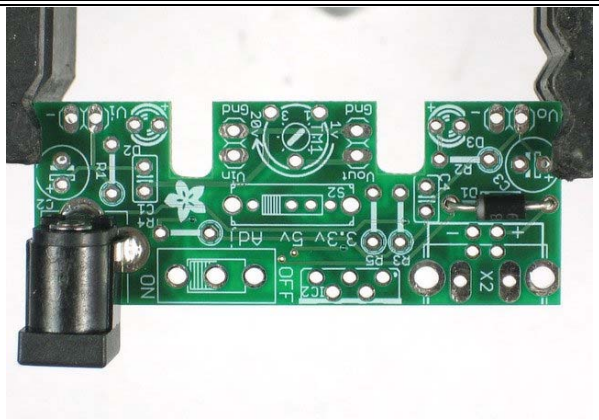
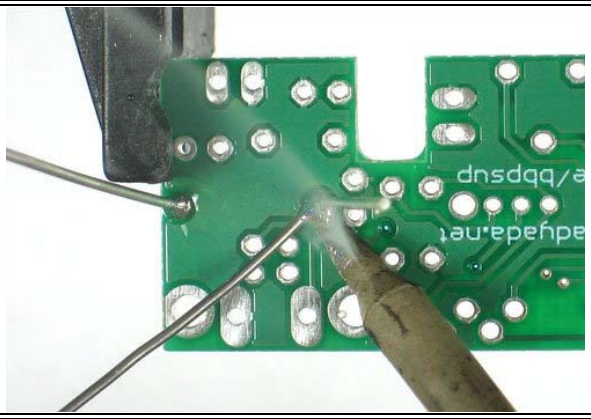
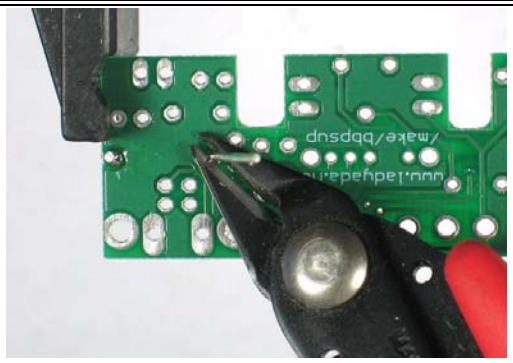


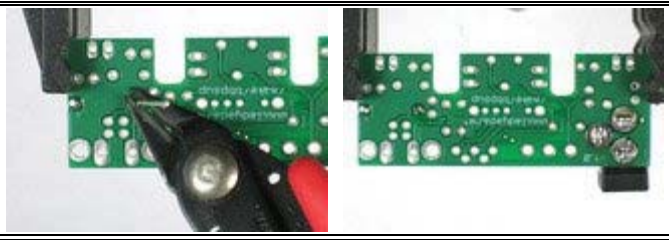
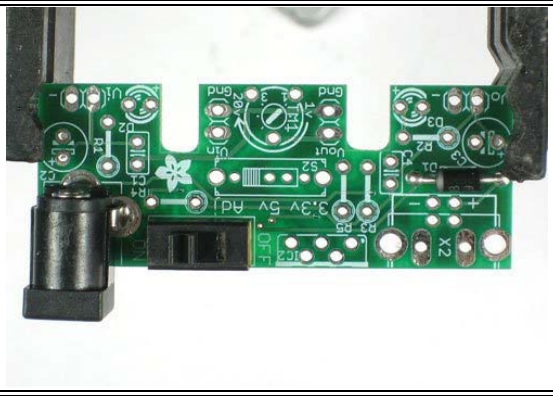
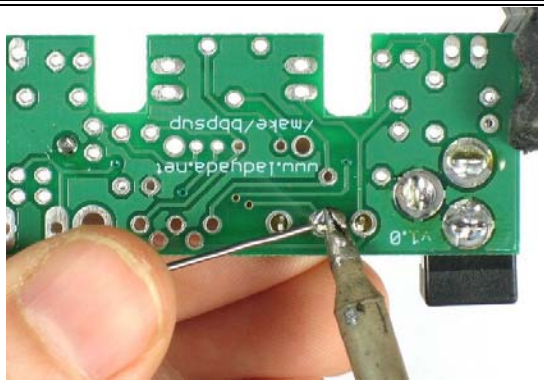


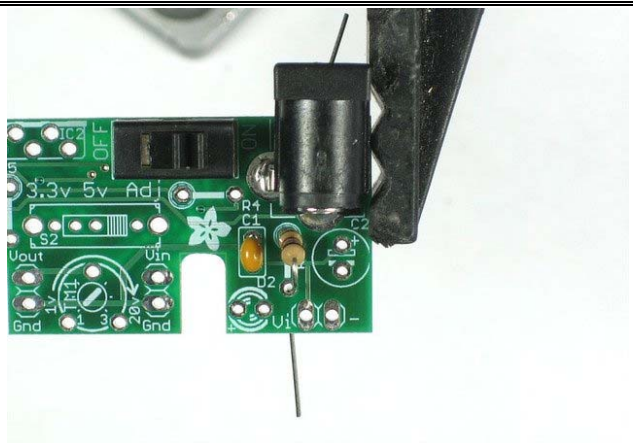
Flip over the PCB - you can either tape the DC jack down or use a finger to keep it place.

Solder the three big pads that bring power to the board.

Make sure to use **lots** of solder! This is both an electrical and mechanical connection so it needs to be solid.

	Next we will solder in the 1N5818 protection diode. Diodes only conduct electricity in one direction. This means we can use them to protect our circuitry from negative voltages - a top killer of electronics! Bend the diode into a staple like so. Note one side has a white/silver stripe on it.
	Place the diode next to the marking **D1**. See that there is a white stripe on the silkscreen? Make sure that the white stripe on the diode matches that below it. Otherwise you'll find that the kit doesn't work at all! Bend the two wire leads out so that the diode sits flat against the PCB.
	Now solder both wires to the PCB. Press the flat of the soldering iron tip against both the wire and the pad (silver ring in the PCB) for a few seconds and then poke in some solder. Then remove the solder. Then finally remove the iron. The solder joint should be a shiny cone. I suggest reading our preparatory tutorials too.
	Now use yoru diagonal cutters to clip the long leads just above the solder joint.

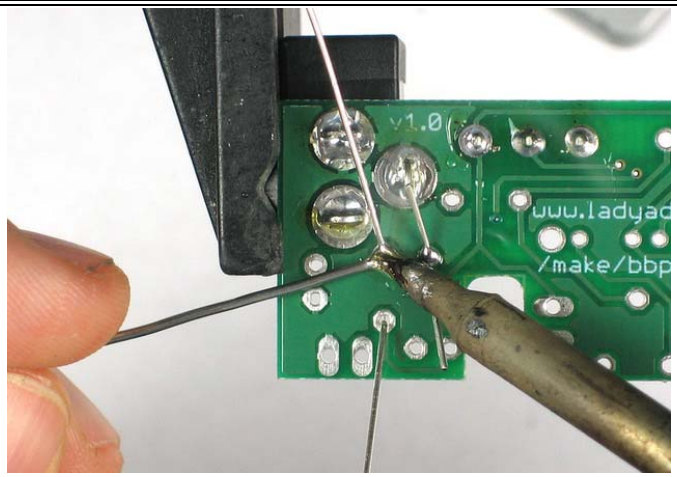
	
	Now flip back over. Next we wil solder in the ON/OFF switch! Its pretty clear what we use it for :) The switch is 'symmetric' so don't worry about putting it in backwards because it is the same either way.
 	Tape or hold the switch in place while you solder all three pins.
	We're going to solder one of the 1.0K resistors in next. The resistors should be bent over 180 like shown. Note that resistors are 'non-polarized' so you can put them in 'either way' - they work the same forwards or backwards.

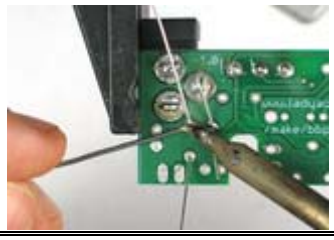


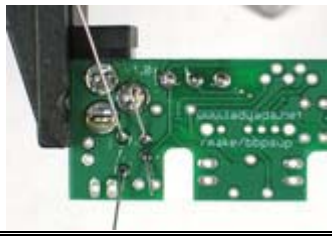
Place one of the 1.0K resistors (Brown Black Red Gold) into the slot marked R1. Then place right next to it one of the 0.1uF ceramic capacitors (they're small and yellow). The resistors and ceramic capacitors are non-polarized so they can go in 'either way'.

The resistor sets the brightness of the 'high voltage' indicator LED. The 0.1uF capacitor provides high frequency filtration to make the power supply cleaner.

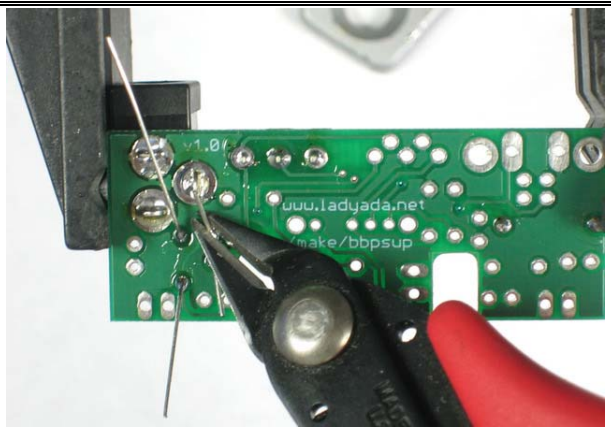
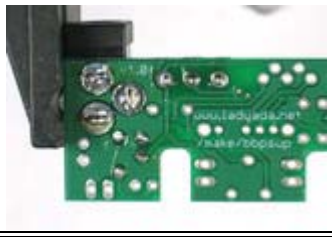
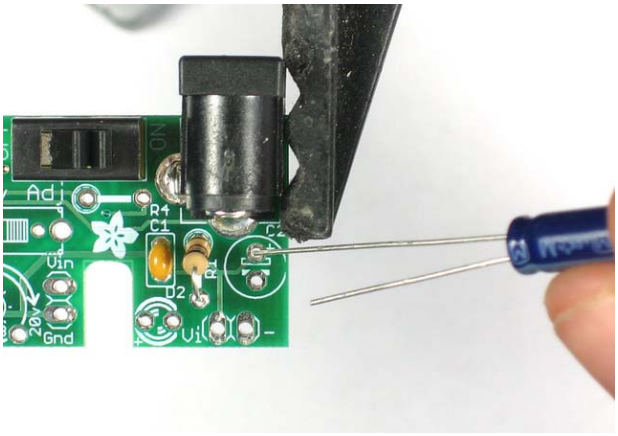
Bend the leads out so that the parts don't fall out when you flip over the board.

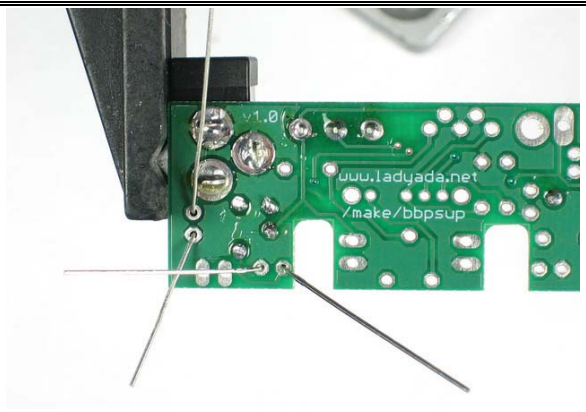


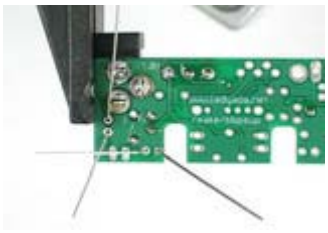


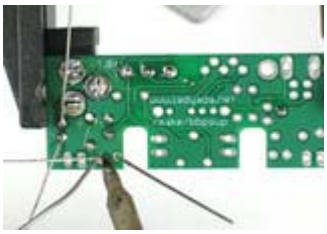


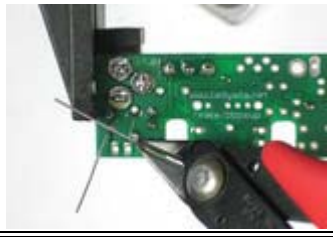
Solder in the two components.

  	Then clip the long leads off.
	Now we will place one of the 47uF electrolytic capacitors **C2**. This component provides low-frequency filtration to clean up the 'high voltage' power line. Electrolytic capacitors are**polarized** that means they must go in the right way or they will make your kit not work! See how one leg of the capacitor is longer? That is the positive (+) lead. Make sure that lead goes into the pad marked with a +. See the image left for details.
	We will finish up the 'high voltage' power supply side by placing the green indicator LED. This LED will let us know that power is working! LEDs are diodes so they are polarized. If not placed correctly they will not work! So make sure you get this right. See how one leg of the LED is longer? That is the positive (+) lead. Make sure that lead goes into the pad marked with a +. See the image left for details.



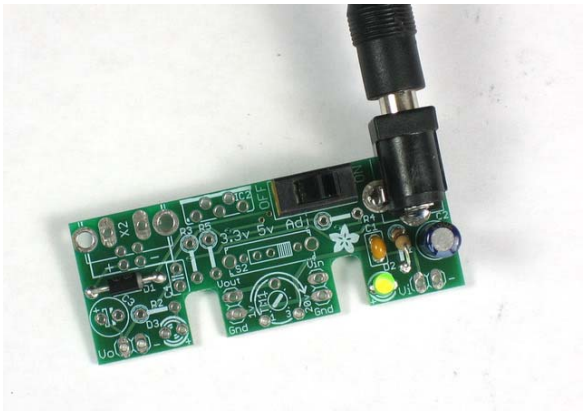






Bend the leads out so the parts sit flat against the PCB.

Solder and clip the leads.



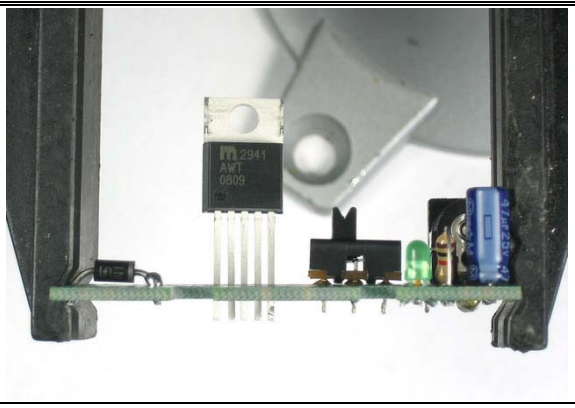
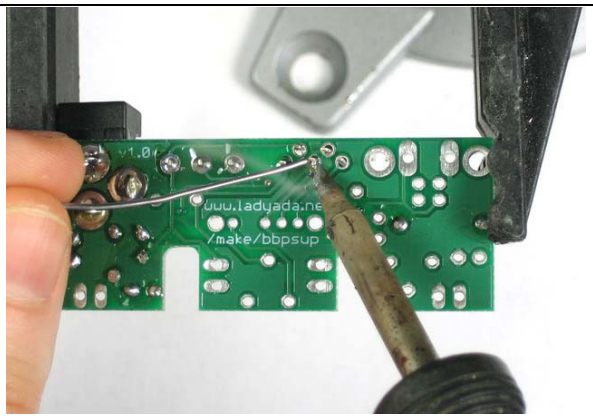
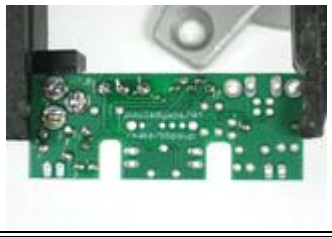
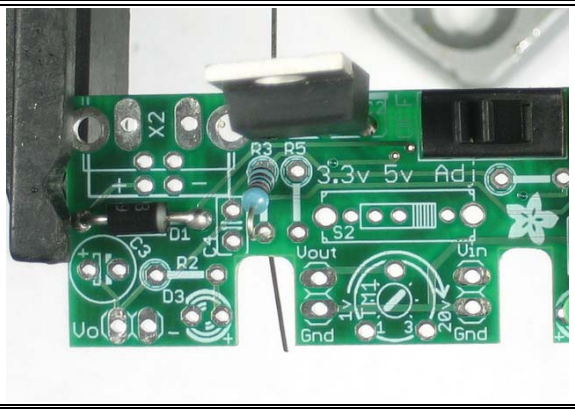
Lets take a break and test the current progress. Take the kit out of the vise and make sure there are no stray wires kicking around that could cause the board to short.

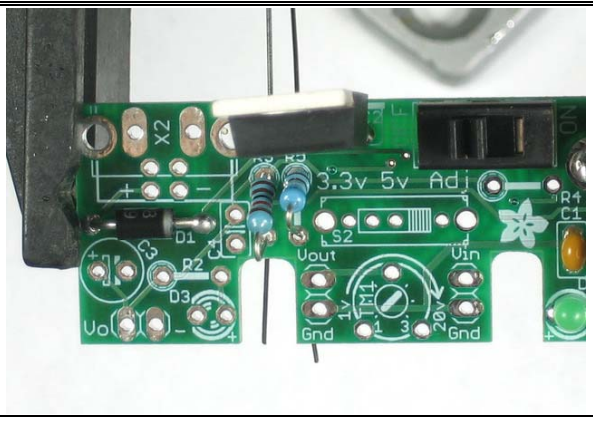
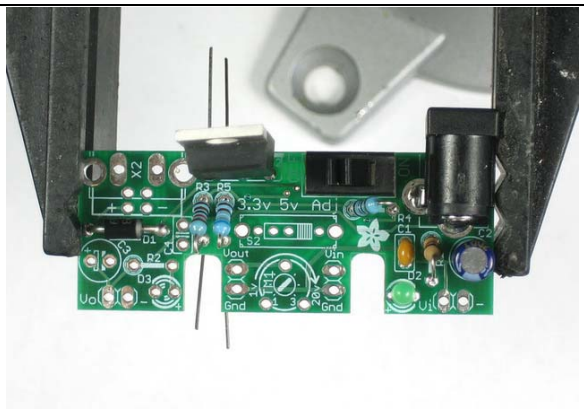
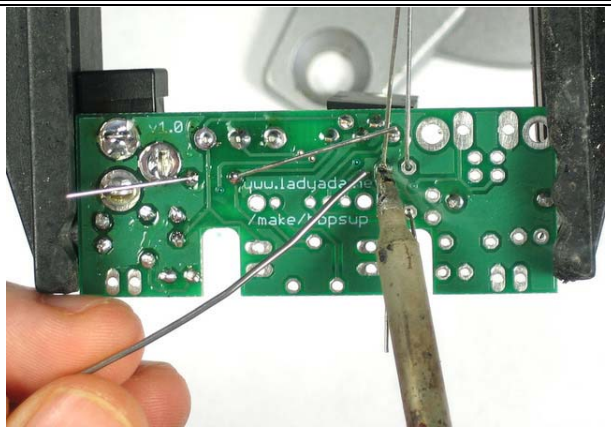
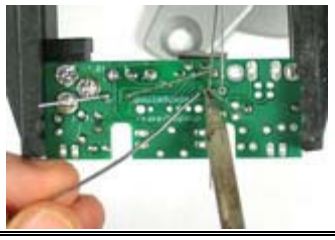
Plug in a DC power supply, center positive. Switch the power switch to the ON position. You should see the green LED light up.

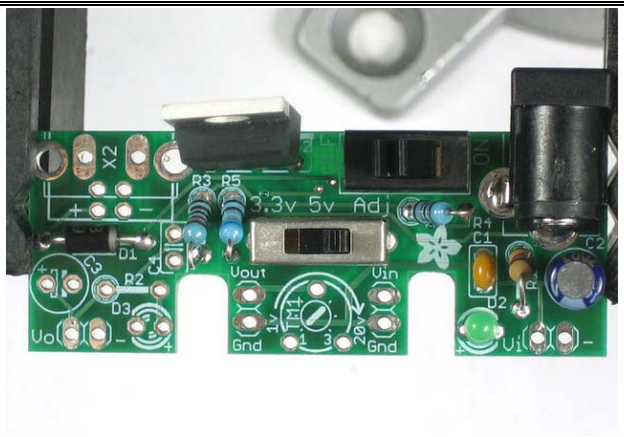
If it doesnt, check that you have a center-positive power supply, that the diode is in right, etc. You may also want to test the voltage at the V- and (-) pads near the LED to see if you are seeing a voltage there.

See my multimeter tutorial for information on how to perform these tests.

Once you've verified its all good, lets continue assembly.

	Now we will solder in the heart of the kit, the MIC2941 adjustable voltage regulator. The regulator must be placed correctly to work. Make sure that the big silver tab is at the edge of the PCB (there is a thick white line on the silkscreen to indicate it). You'll want to solder the part so it sticks up some - that way you can attach a heatsink easily - as shown.
  	Solder the regulator in. If you placed the regulator as suggested, you shouldn't have to clip the leads as they'll be short.
	The regulator uses resistors to set the adjustable output voltages. We'll now solder those in. First is 11.0K **R3** (Brown Brown Black Red Brown) - this resistor sets the 3.3V output level.

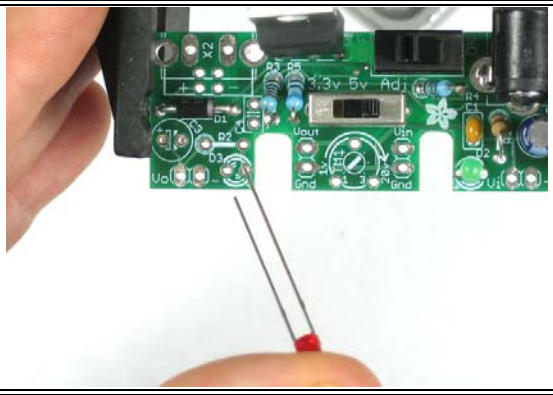
	Second is 6.49K **R5** (Blue Yellow White Brown Brown) - this resistor is the 'reference' divider for all the voltages.
	Third is 20.5K **R4** (Red Black Green Red Brown) - this resistor sets the 5V output voltage.
  	Solder and clip the three resistors.



Now we need a way to select which resistor is connected to the regulator. For that we use a 3-way switch. The switch can only go in one way.

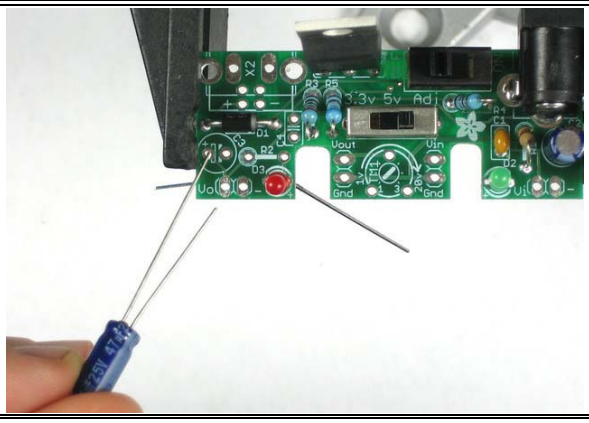
Solder in all the legs of the switch.

Be careful because the solder points are small and somewhat close together. Make sure you don't have a short circuit and that each point is soldered.

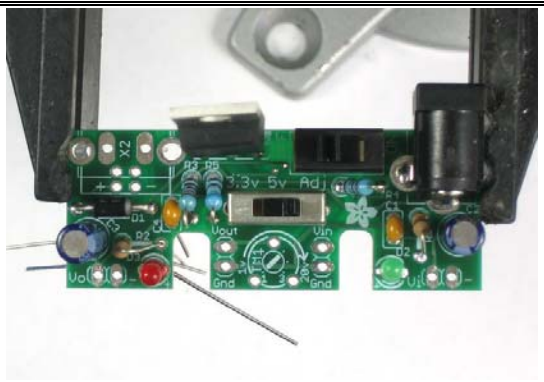


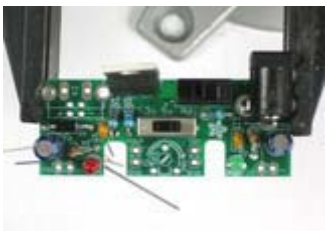
Now we will put in the capacitors and LEDs for the left hand "low voltage" side.

First is the red indicator LED. Remember LEDs are polarized. Make sure the long lead goes into the (+) marked pad.



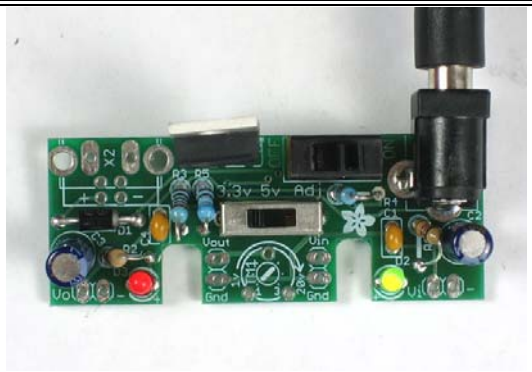
Next is the large electrolytic capacitor. Just like the other one, its polarized. Make sure the long lead goes into the (+) marked pad.





Finish off the 'low voltage' side by inserting the second 1.0K resistor **R2** and the second 0.1uF ceramic capacitor **C4**.

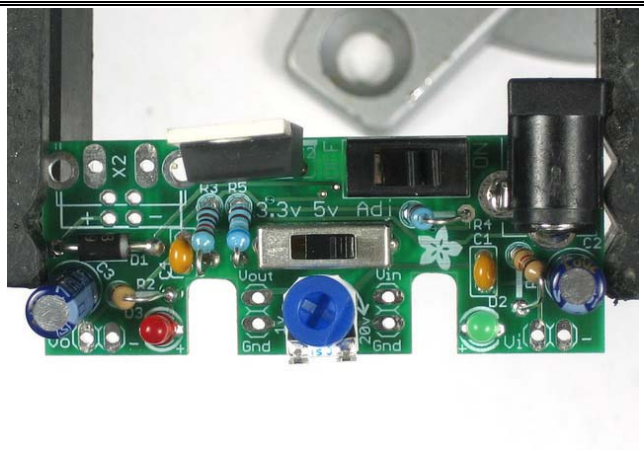
Solder and clip all the leads.

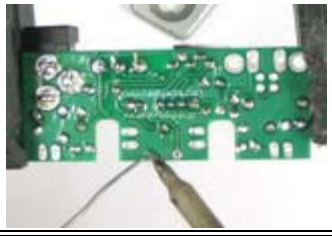


Lets take another break and quickly test what we've done so far.

Remove the PCB from the vise and clear off the tape from wire bits. Then plug in your DC power supply again.

Switch the kit ON and switch the voltage selection switch from 3V to 5V to Adj. The red LED should change in brightness. It should be dim at 3V, brighter at 5V and brightest at Adj. (we haven't put in the adjusting potentiometer yet).

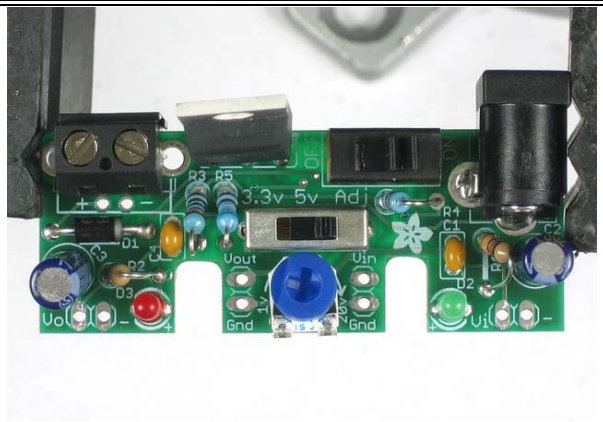




Lets finish up this kit!

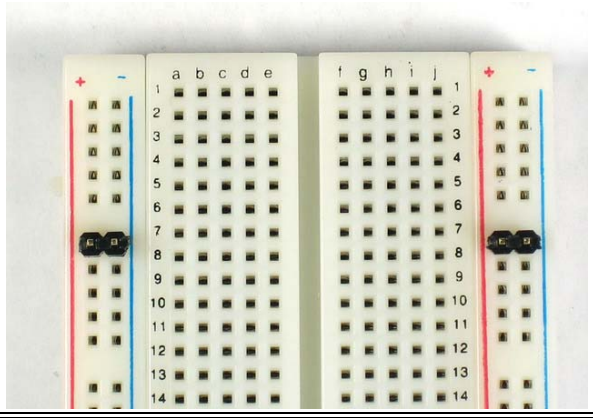
Place the 100K trim potentiometer in the middle. This is what lets us adjust the voltage output from 1.25V to 20V.

The trimmer sits above the PCB a bit, this is OK.



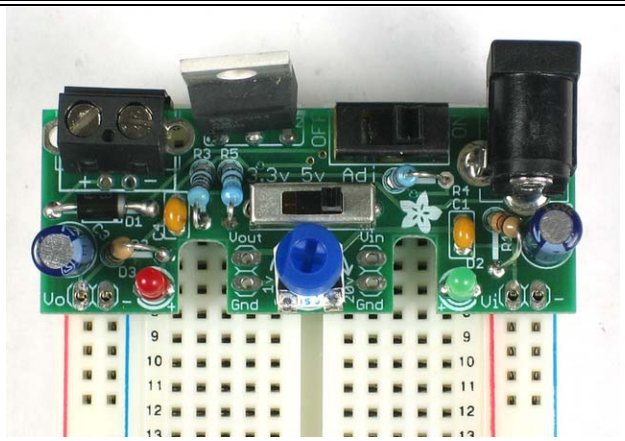
Next we will solder in the 2-pin terminal jack. This lets us connect up wires to power the board from a battery or similar.

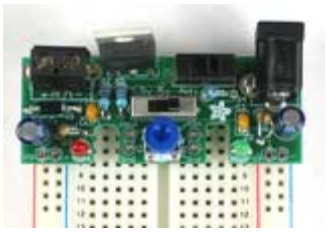
Make sure that the 'holes' of the terminal block are facing **out** so that you can plug wires in!

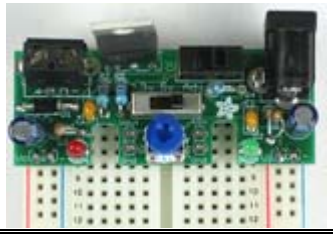


You've finished the power supply, now onto the 'breadboard' part!

Break off 2 2-pin pieces of header and stick them into the two power rails on the side of the breadboard

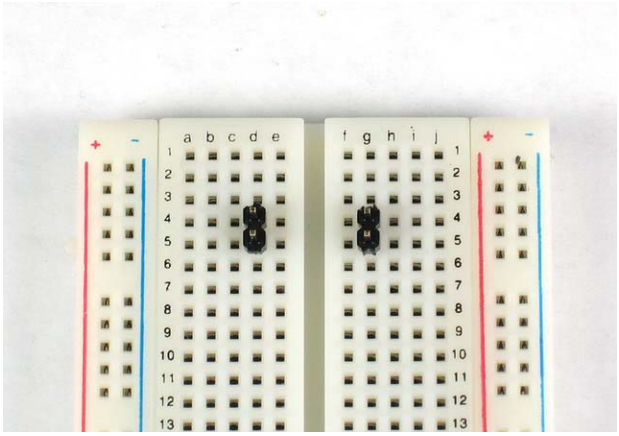


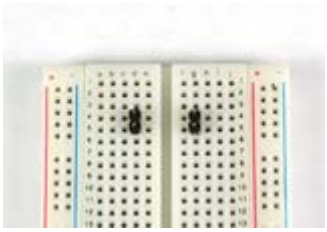


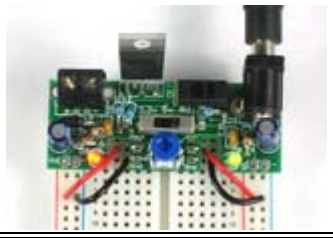


Now place the power supply on top. If it fits nicely, solder the four pins.

Some breadboards are spaced differently, in which case you will have to skip ahead.

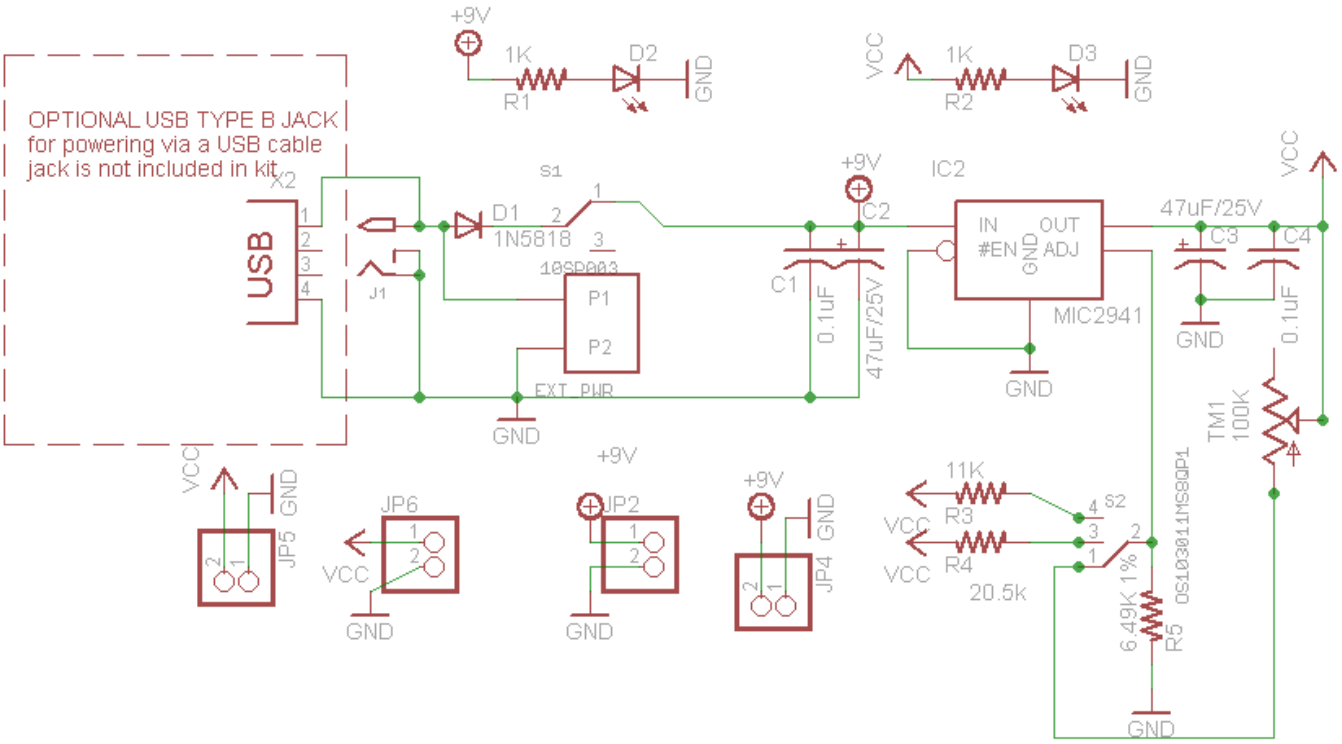






If your breadboard has nonstandard spacing, you can still plug it in using the header-breakouts in the middle.

You'll need to jumper the wires over to the power supply rails as shown.



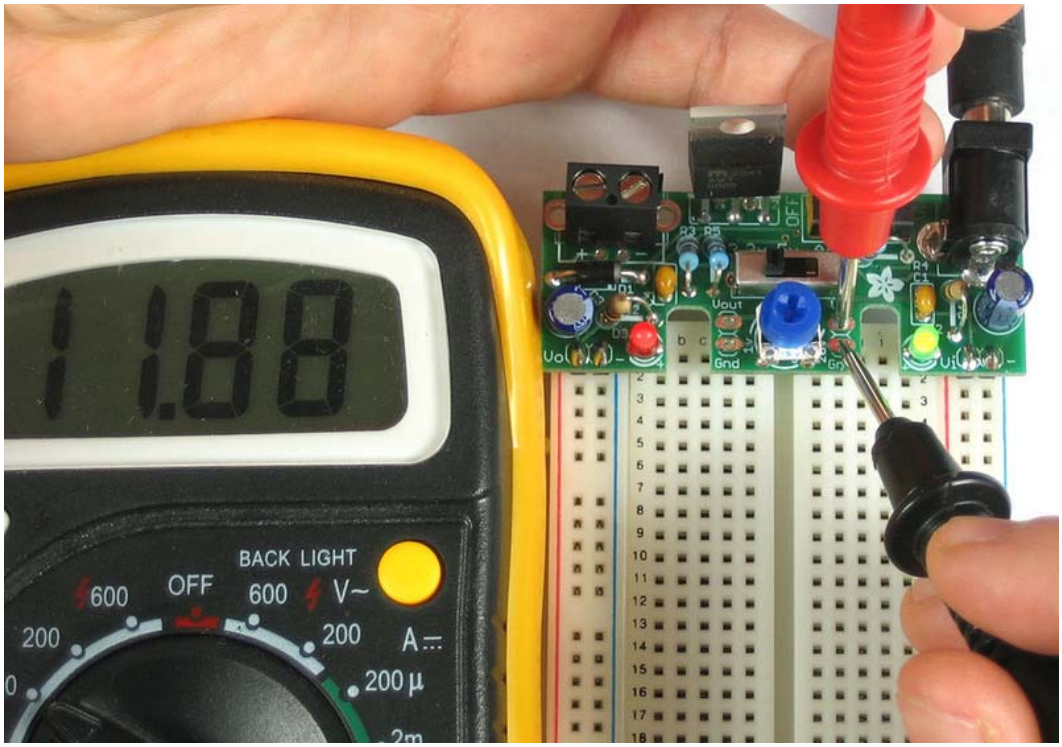
How to Use

This kit is very easy to use. First you should make sure your kit is all assembled, check the assembly instructions and solder it up!

Please note, there is a silkscreen typo on this version of the board: For the terminal block input, + and - are reversed. The input is polarity protected so if you connect ground to - and positive input to + nothing will turn on. Please swap the wires to use it!

Right hand 'input'

There are two "outputs" on the board. The right hand side is the 'high' voltage side. This is the power coming straight from the DC jack or terminal block. There is a diode to prevent negative voltages but pretty much its going to be within 200mV of the input.

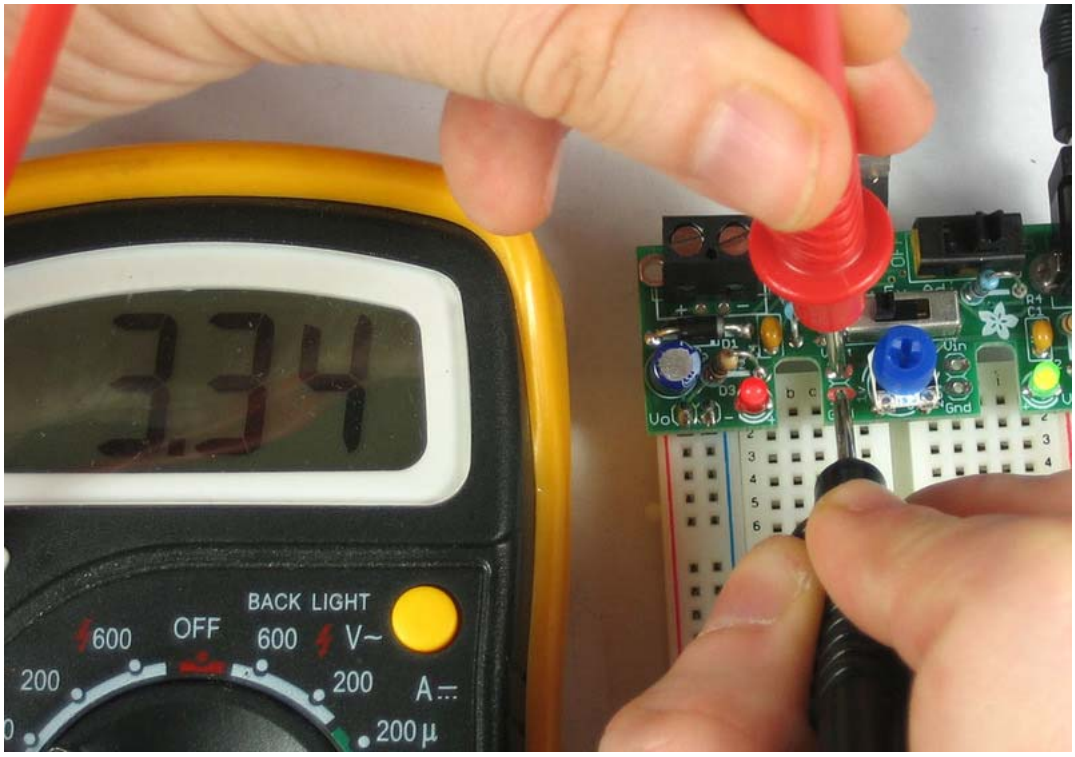


For example, this photo is me testing the output of the right hand side with a 12VDC regulated power adapter attached. The voltage is within 200mV of 12V. The green LED indicates that there is power on the right hand side.

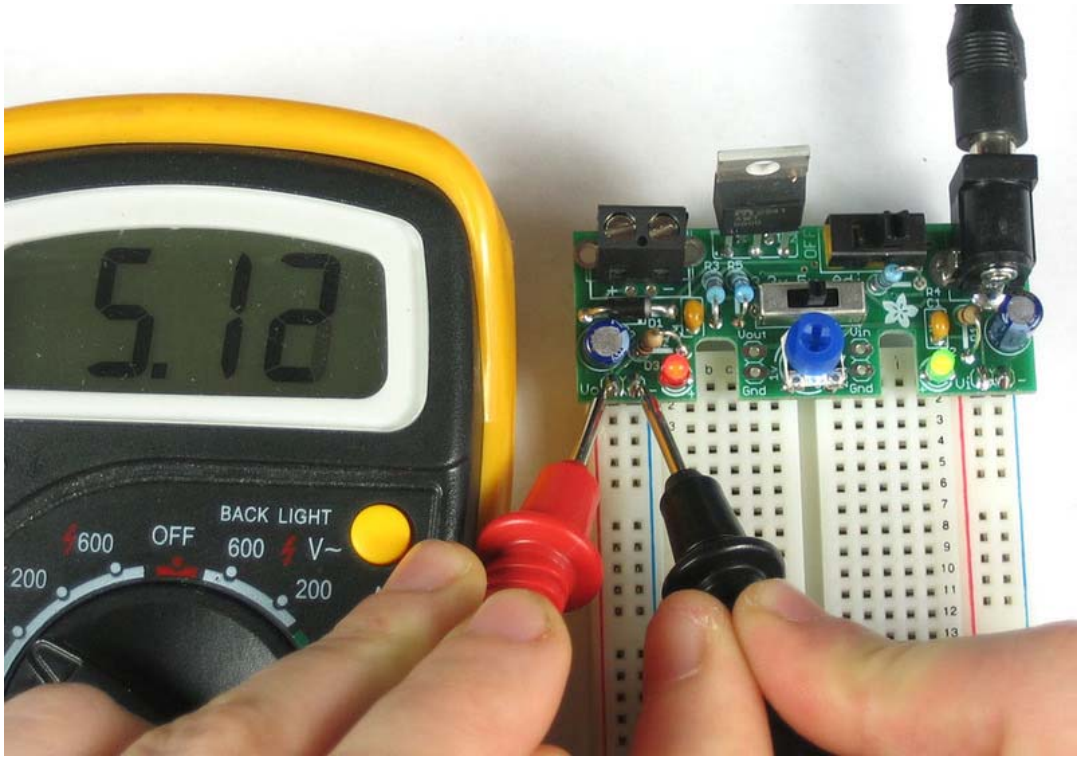
Left hand 'output'

The left hand side is the 'regulated' voltage side. This is the power that is running through the voltage regulator. This voltage is adjustable

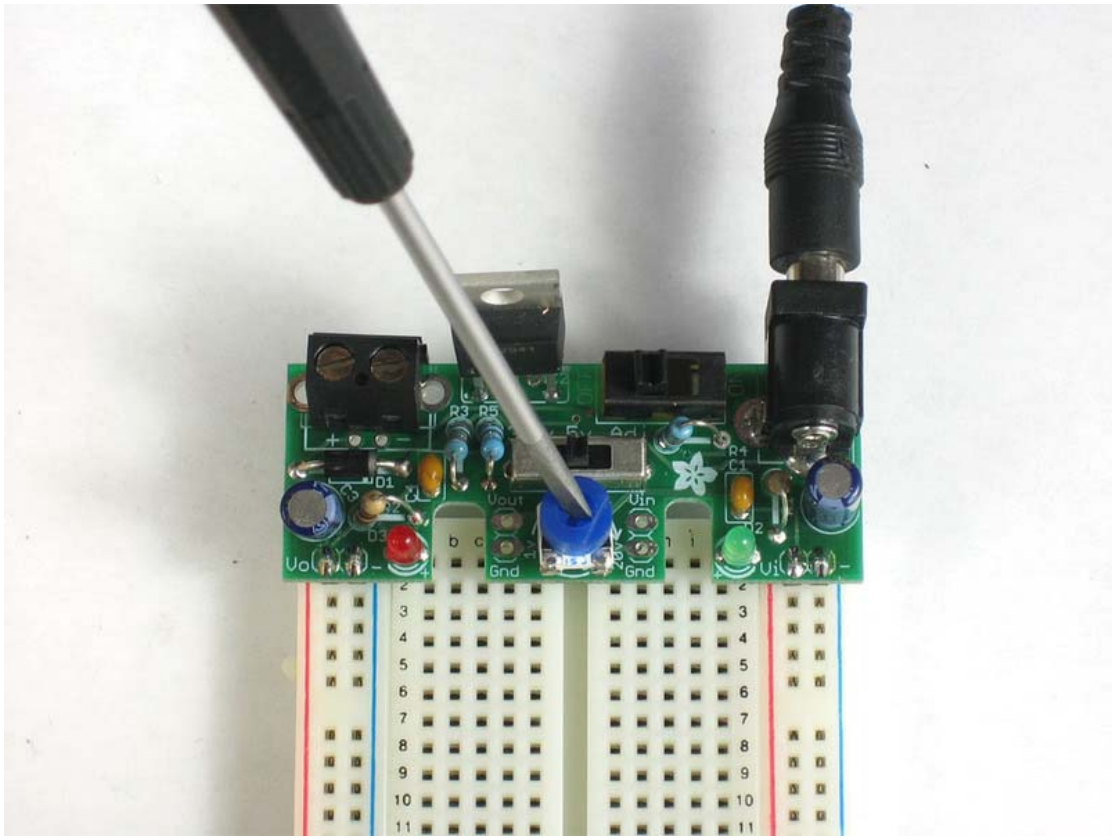
If you select **3.3v** on the voltage selection switch you will be able to measure that output voltage. The red indicator LED will be somewhat dim



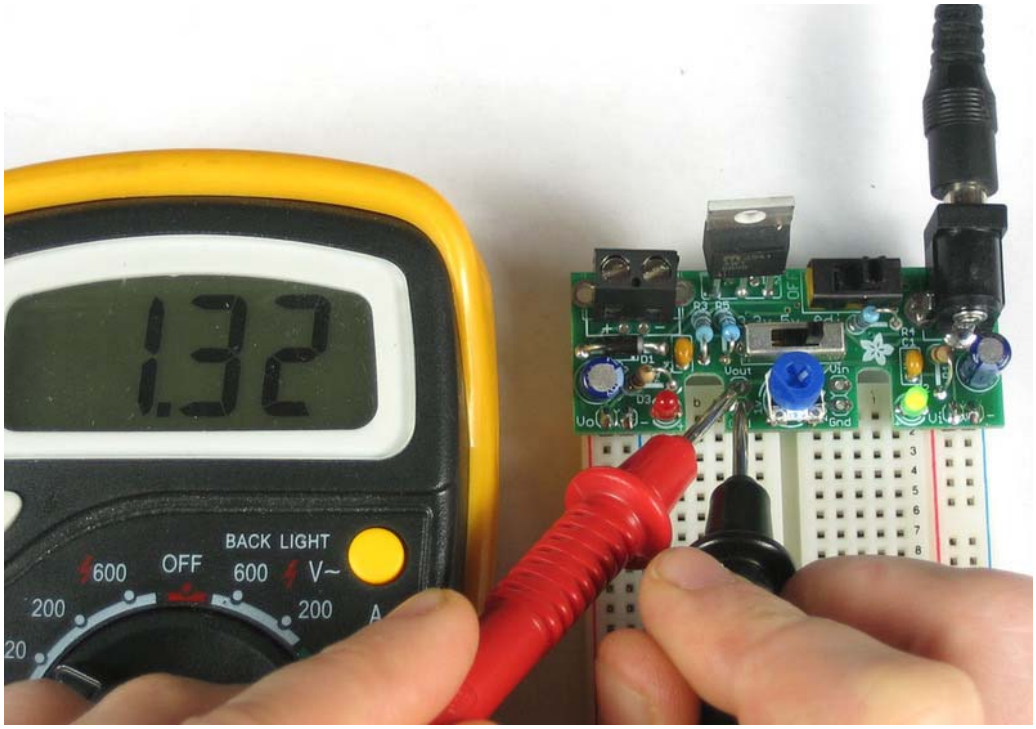
Then you can also select **5V** to generate a regulated 5V supply.

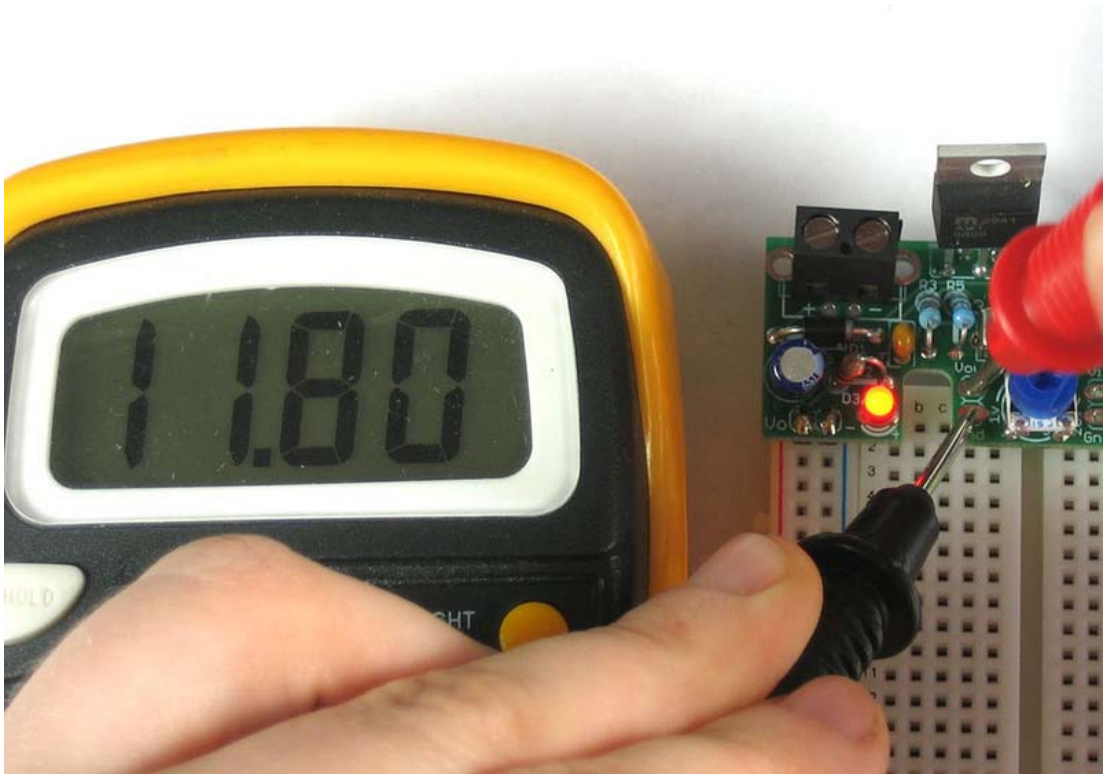


Finally, by selecting **Adj.** you can adjust the supply to anything you want from as low as ~1.3V to within half a volt of the input (which can be as high as 20V).



Once you set the pot, the output voltage is not dependent on the input voltage. That is, if you dial in 6V and you switch from a 9V to 12V supply, the output will stay at 6V.





Heatsinking!

If your supply keeps cutting out and is very hot, it needs a heatsink! You can just slip it on.