

Project

Power Supply with 220V input and (± 5 , ± 15 , $\pm 1.25:15$)V output

Done By

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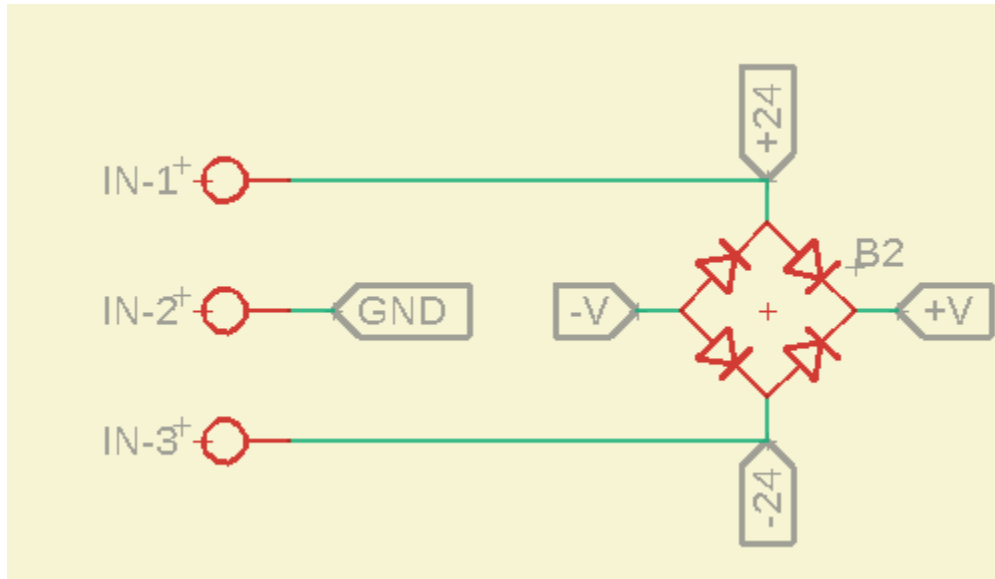
Components

Name in PCB	Name to buy	Description	Link
IN	3pins Terminal Block		http://magicduino.com/ProDetails.aspx?ID=1323
OUT	12pins Terminal Block		https://ram-e-shop.com/product/rc12-12pin-connected/
B2	2W10G	Rectifying bridge	http://magicduino.com/ProDetails.aspx?ID=1639
D1:D6	1N4007	Diode	http://magicduino.com/ProDetails.aspx?ID=1611
C1:C8	Electrolyte Capacitors 1000uF/50V		http://magicduino.com/ProDetails.aspx?ID=2126
C9, C10	Electrolyte Capacitors 10uF/50V		http://magicduino.com/ProDetails.aspx?ID=2049
C11, C13, C15, C17	Ceramic Capacitors 100nF		http://magicduino.com/ProDetails.aspx?ID=6733
C12, C14, C16, C18	Ceramic Capacitors 10nF		http://magicduino.com/ProDetails.aspx?ID=1974
R1, R3	270 Ohm Resistor		http://magicduino.com/ProDetails.aspx?ID=2233
R2, R4	10K Ohm Variable Resistor		http://magicduino.com/ProDetails.aspx?ID=4054

IC1	LM317	3-terminal positive adjustable voltage regulator	http://magicduino.com/ProDetails.aspx?ID=520
IC2	LM337	3-terminal negative adjustable voltage regulator	http://magicduino.com/ProDetails.aspx?ID=528
IC3	LM7815	3-terminal +15 voltage regulator	http://magicduino.com/ProDetails.aspx?ID=1058
IC4	LM7805	3-terminal +5 voltage regulator	http://magicduino.com/ProDetails.aspx?ID=1046
IC5	LM7915	3-terminal -15 voltage regulator	http://magicduino.com/ProDetails.aspx?ID=1059
IC6	LM7905	3-terminal -5 voltage regulator	http://magicduino.com/ProDetails.aspx?ID=1051
	Transformer 18-0-18	220VAC to 18VAC	http://magicduino.com/ProDetails.aspx?ID=5527

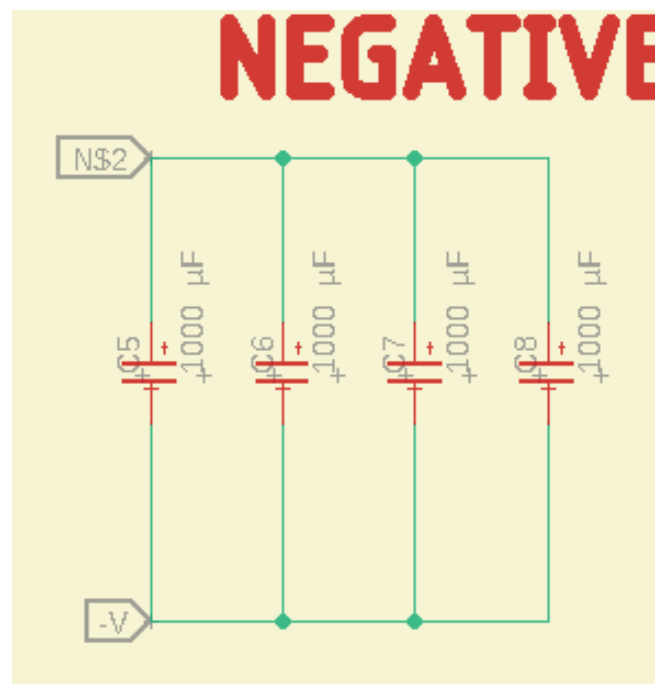
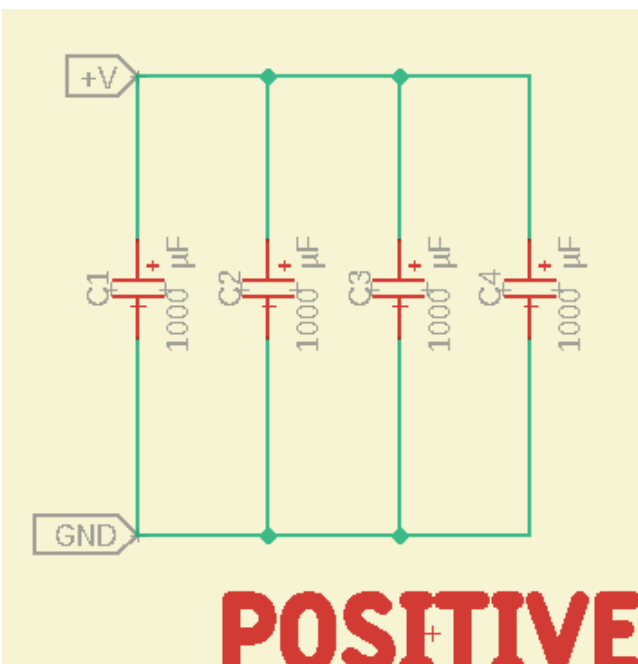
Circuit

1- Input



- there is a transformer that will reduce the 220VAC into 18VAC to deal with it more easily and that's safer.
- The transformer also separate the noise of the AC source from the rest of the circuit so it's a better choice than the transformerless power supply
- The bridge is 2W10G constructed from 4 diodes that work as a rectifier to make the current with one direction so it becomes more like DC

2- Filter



- to transform the AC into DC the first step was to make it of one direction and the second step is to have constant value and that's achieved by using these capacitors as it charges when the current is, in particular, direction and when that direction changes or the current starts to decrease, then the capacitor discharges so now we have almost constant voltage with some ripple.
- How to choose the value of the capacitor:

$$C = I / 2.F.V_{pp}$$

I is the load current

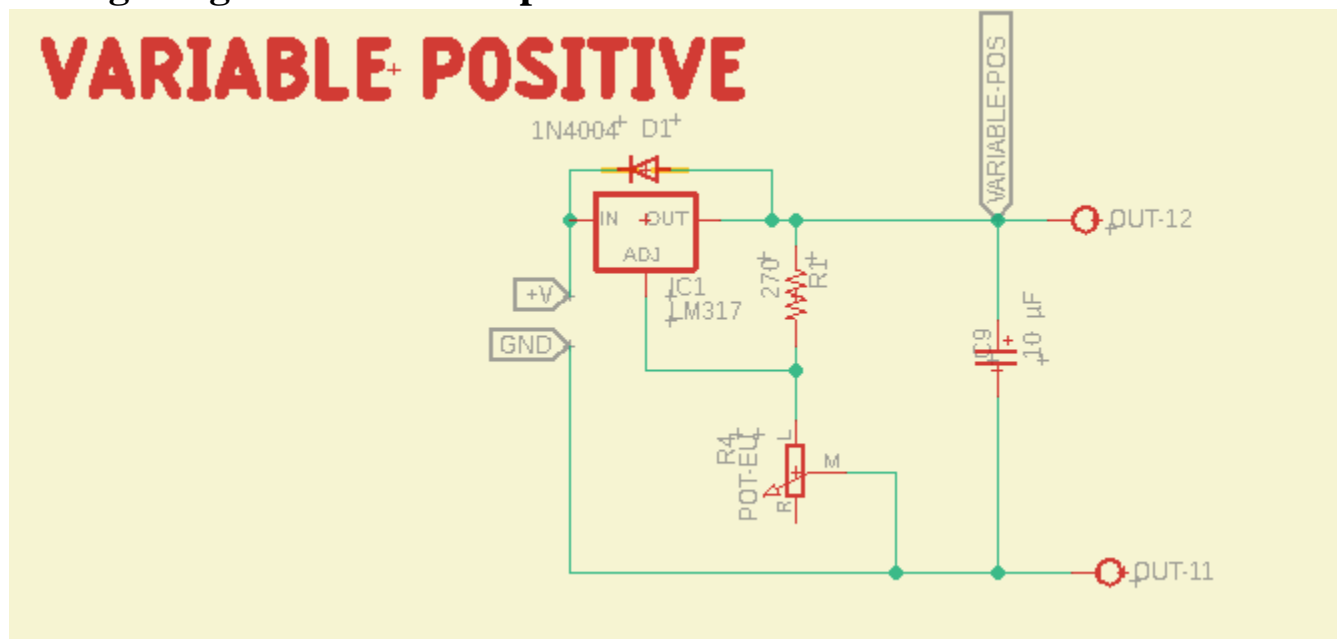
C is the capacitance

F is the source frequency

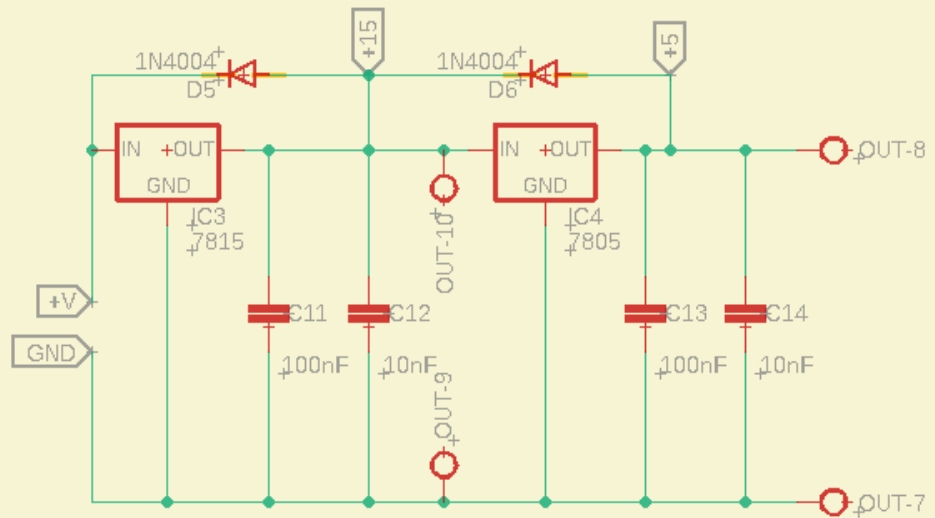
V_{pp} , the minimum ripple (the peak to peak voltage after smoothing) that may be allowable or OK for the user, because practically it's never feasible to make this zero, as that would demand an unworkable, non-viable monstrous capacitor value, probably not feasible for anybody to implement.

For further info: <https://www.homemade-circuits.com/calculating-filter-capacitor-for/>

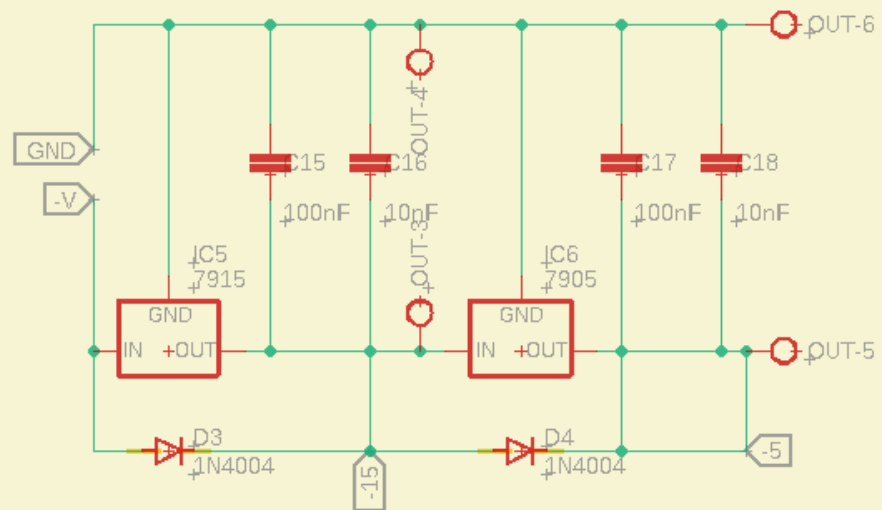
3- Voltage Regulation and Output



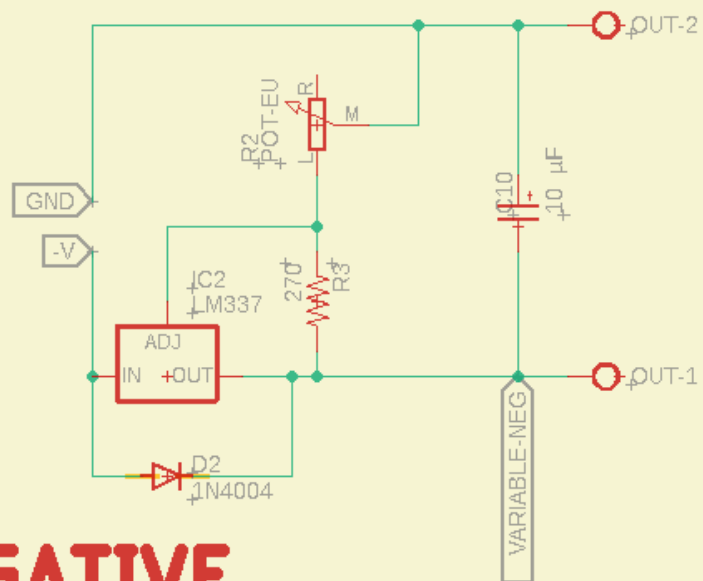
+5, +15



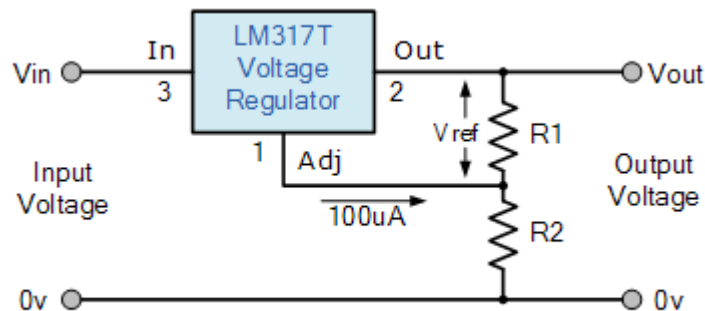
-5, -15



VARIABLE + NEGATIVE



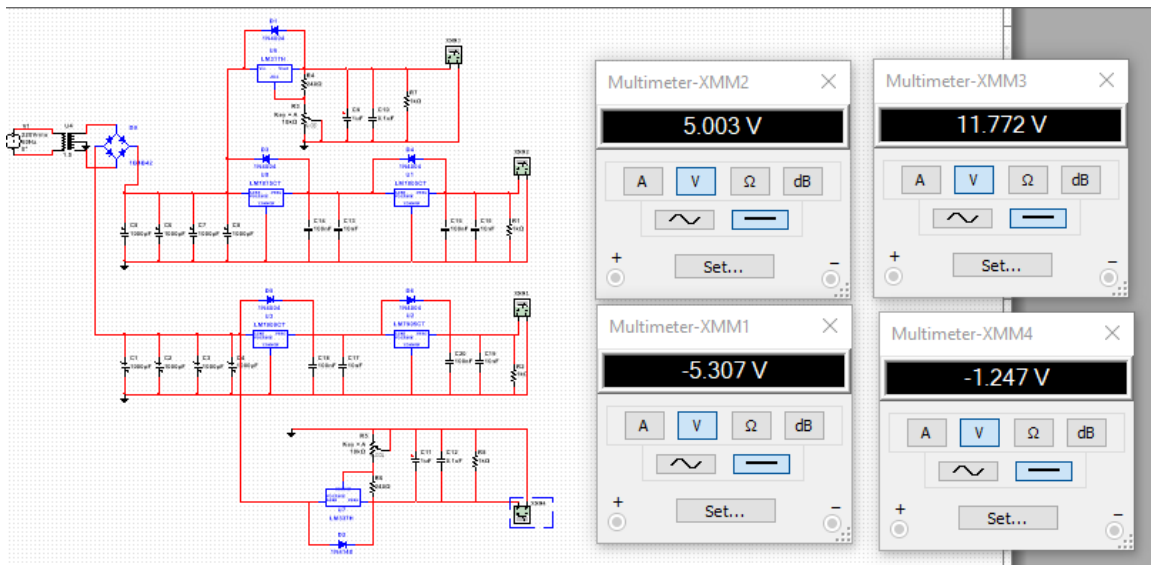
- Voltage regulator is an IC (Integrated Circuit) that decreases the voltage into certain value and the voltage difference between input and output is lost as heat
- Voltage regulators are connected in series (7805, 7815) so that the output of the 7815 (15V) is the input of 7805 which means the input is in the acceptable range that won't break the v-reg
- The adjustable output v-reg: by using the ratio of two resistances, one of a fixed value and the other variable (or both fixed), we can set the output voltage to the desired level with a corresponding input voltage being anywhere between 3 and 40 volts



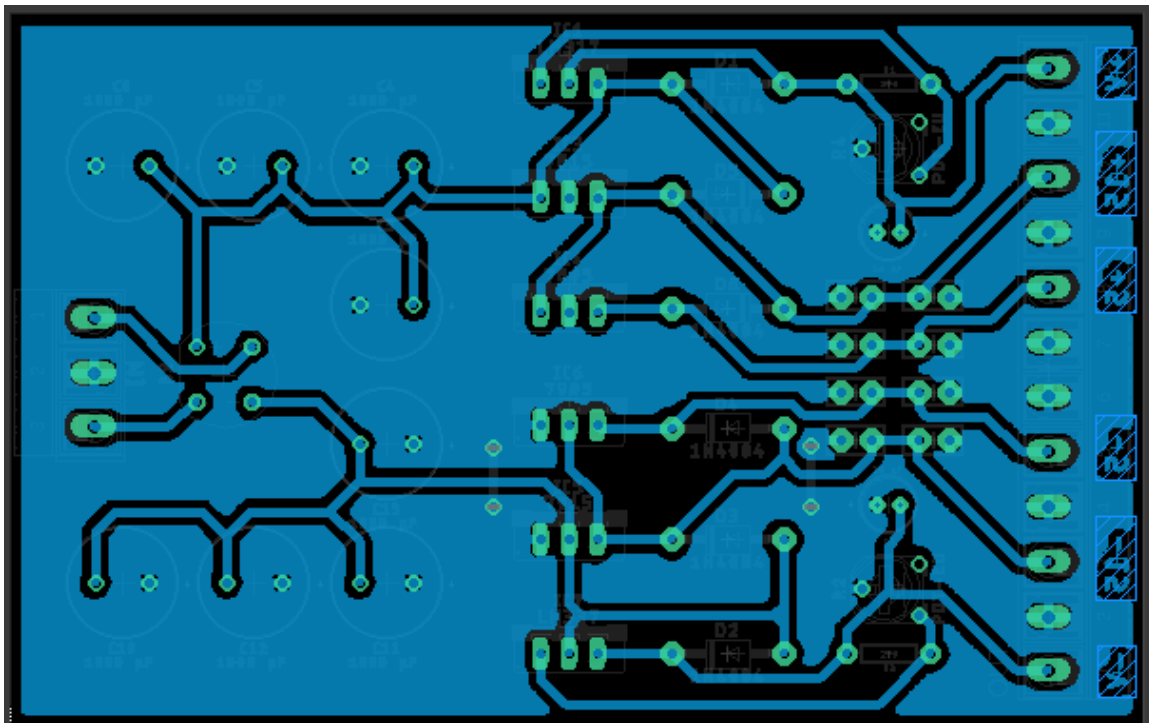
$$V_{out} = 1.25(1 + R1/R2)$$

- The freewheel diode is to protect the voltage regulator from the reverse current which may occur due to sudden disconnection of the load
- The capacitors (C11:C18) are smoothing capacitors to eliminate any remaining noise or ripple from the original wave or occurred in the IC and their values are due to the datasheet of the voltage regulator

Simulation (using multisim)



PCB (using eagle)



3D Modeling (using Fusion360)

