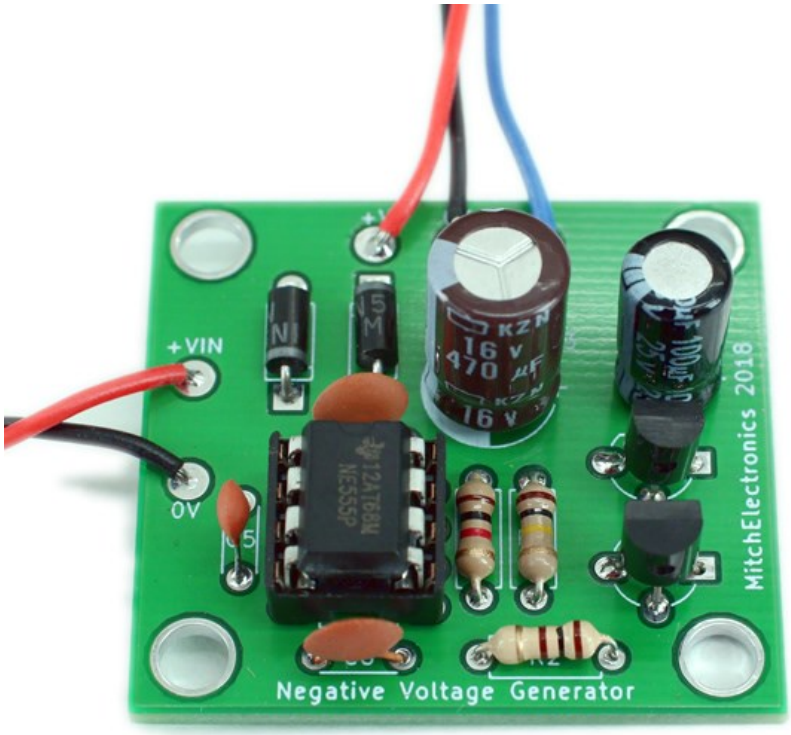
Negative Voltage Generator Kit

MitchElectronics 2019



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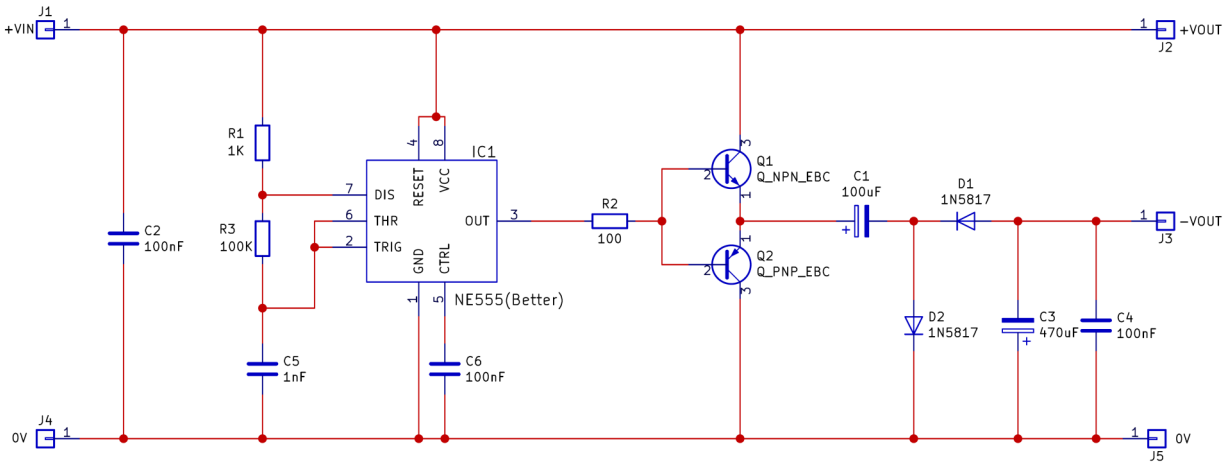
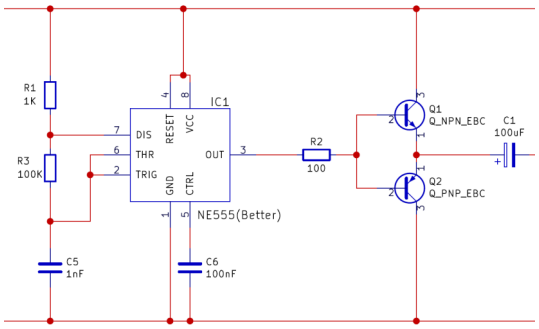

J1
+VIN
1
J2
+VOUT
R1
1K
R3
100K
C2
100nF
IC1
DIS
THR
TRIG
RESET
VCC
OUT
GND
CTRL
NE555(Better)
R2
100
Q1
Q_NPN_EBC
Q2
Q_PNP_EBC
C1
100uF
D1
1N5817
D2
1N5817
C3
470uF
C4
100nF
C5
1nF
C6
100nF
J3
-VOUT
J4
0V
J5
0V

SCHEMATIC EXPLANATION

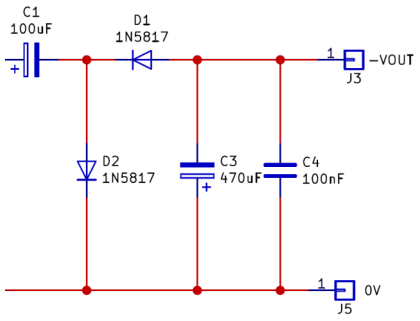
The negative voltage generator is made up of two main circuits; a 555 astable oscillator and a special capacitor / diode arrangement. The 555 oscillator is made up of R1, R3, C5, and IC1 where the output frequency of the square wave (found on pin 3) is determined by the combination of R1, R3, and C5. Other MitchElectronics kits that have a 555 astable typically have a potentiometer so the output frequency can be changed but in this kit the frequency is predetermined at approximately 70kHz.



The output of the 555 is connected to a special push / pull arrangement made up of Q1 and Q2 which is used to significantly increase the current capability of the square wave. When the output of the 555 is high the transistor Q1 conducts (an NPN transistor) which allows current to flow from the +V rail into the capacitor C1 and when the output of the 555 is low Q2 conducts (a PNP transistor) which allows current to flow from the positive plate of C1 into ground. The last stage in the circuit is the special diode / capacitor arrangement made up of C1, C3, D2, and D4. Before we look at how this circuit creates a negative voltage we first need to understand what capacitor coupling is and how it works.

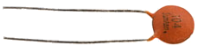
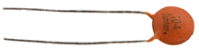
Essentially, a capacitor will always *try* to keep the voltage across it as constant as possible. For example, if you charge one plate of a capacitor to 10V quickly then the plate on the other side will also quickly rise to 10V. If the first plate is charges to 20V and the second plate is charged to 10V and the first is then suddenly reduced to 10V then the second plate will also reduce by 10V bringing it to 0V. However, this effect can also be used to generate a negative voltage such that if the first plate is charged at 10V and the second is charged at 0V and then the first plate is quickly discharged to 0V the second plate will also reduce by 10V which will result in –10V. This, is capacitive coupling!

In our negative voltage generator the 555 charges C1 to +V while D2 keeps the negative plate of C1 at 0V. Then when the 555's output suddenly falls to 0V the positive plate of C1 also falls to 0V and this results in the negative plate of C1 falling to ***0V—V = -V*** . When the negative plate of C1 falls to –V D1 becomes forward conducting and this results in the capacitors C3 and C4 being charged with the same negative voltage and C3 is used to store the generated negative voltage while C4 is used to smooth out the high frequency switching noise of the 555 output.

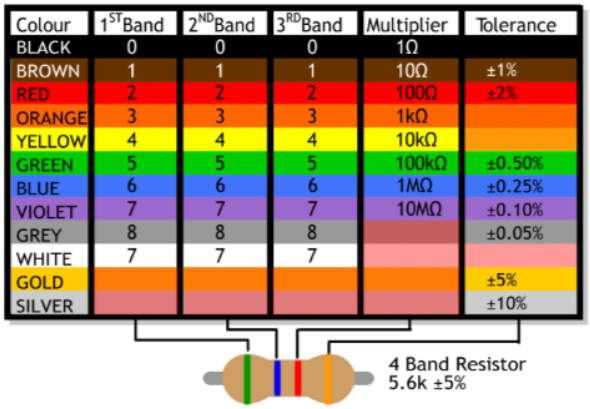


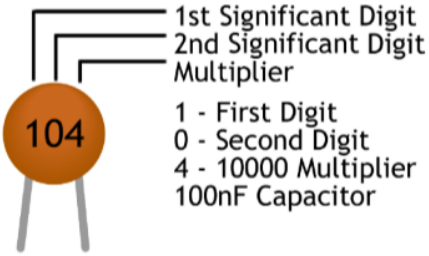
MATERIALS

Check that you have the following components

Component	Component Name	Quantity	Looks like
2N3904 BJT	Q1	1	
2N3906 BJT	Q2	1	
1nF Capacitor	C5	1	
100nF Capacitor	C2, C4, C6	3	
100uF Capacitor	C1	1	
470uF Capacitor	C3	1	
555 IC	IC1	1	
8-DIP Socket	IC1	1	
100Ω Resistor	R2	1	
1KΩ Resistor	R1	1	
100kΩ Resistor	R3	1	
Diode 1N5817	D1, D2	2	
Red, Black and Blue wire	-	5	
PCB	-	1	

RESISTOR AND CAPACITOR IDENTIFICATION





CONSTRUCTION

Download the electronics construction manual

To learn how to construct circuits on PCBs download the Electronics Construction Manual from Mitch-Electronics using the link below. This document shows you how to install all electronic components used in MitchElectronics kits. The list below shows the sections relevant to this kit so do not worry if you see component sections in the document that don't come with this kit!

www.mitchelectronics.co.uk/electronicsConstructionManual.pdf

Relevant sections in the electronics construction manual

Resistors

Capacitors

Diodes

Transistors

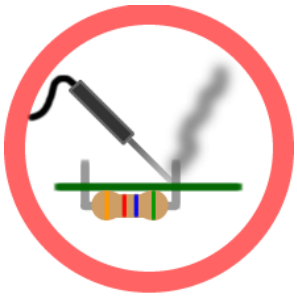
ICs

Wires

IMPORTANT INFORMATION

RoHS Compliant Kit (Lead free)

Low Voltage Kit



Caution! Soldering Required