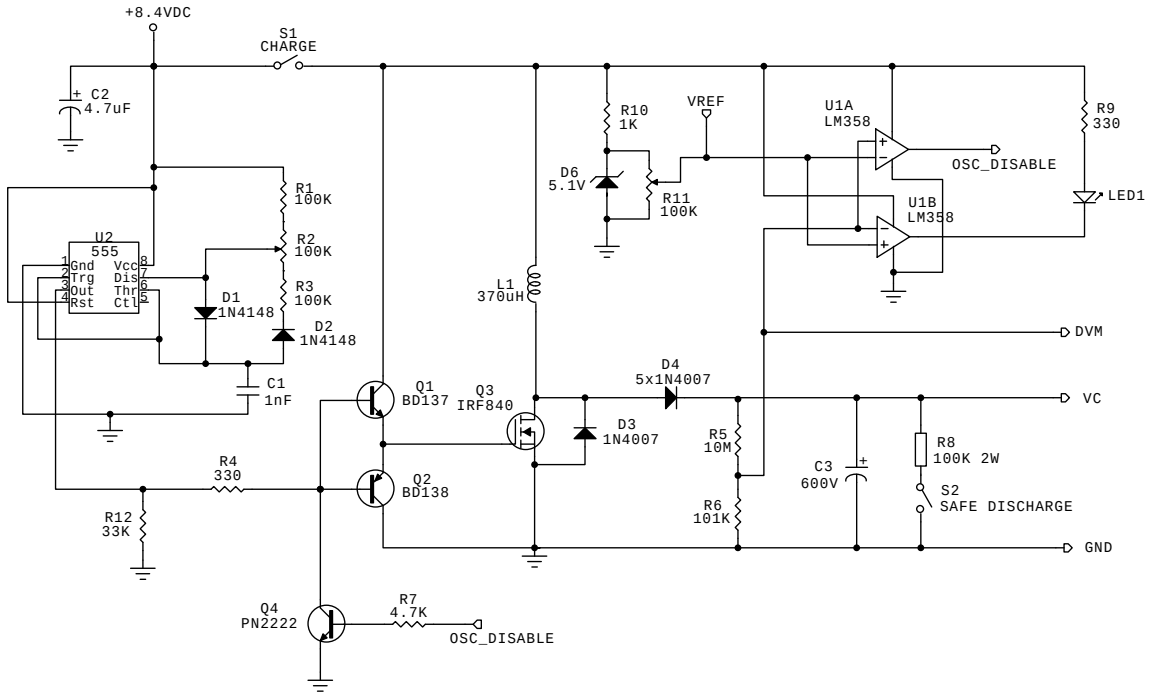
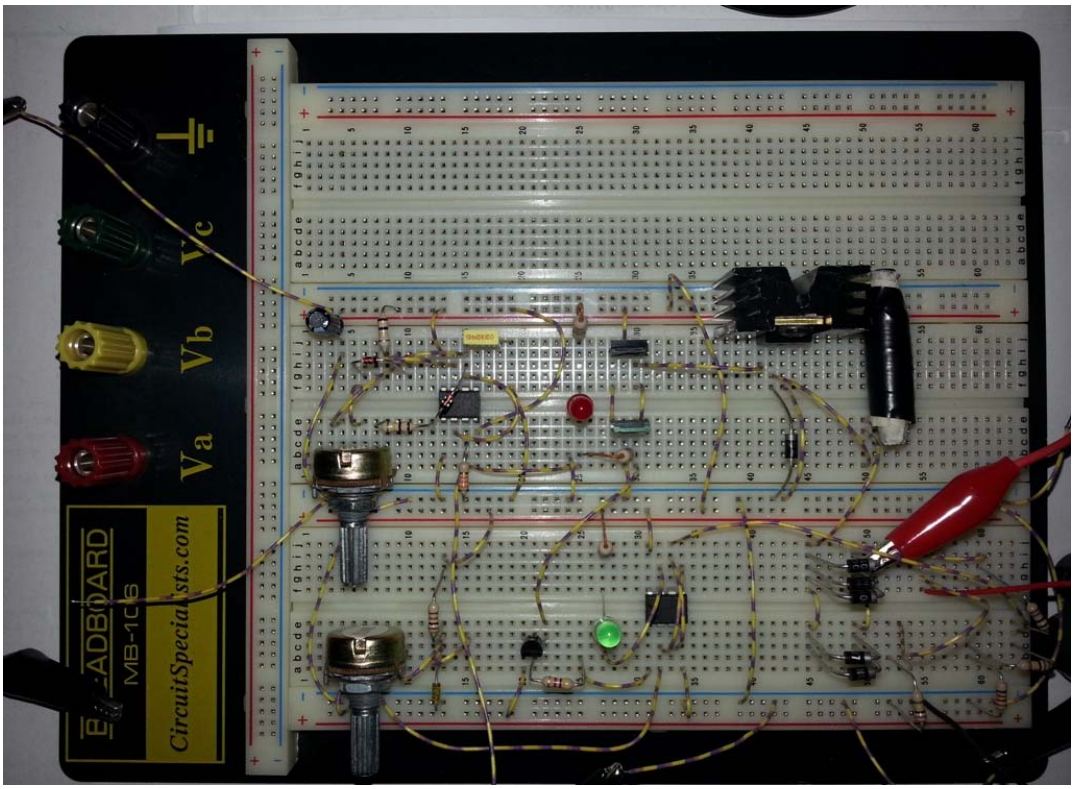
High-Voltage Capacitor Charger

The circuit described here uses an IRF840 MOSFET which is rated at a maximum V_{DS} value of 500V. The avalanche voltage is calculated as $V_A \cong 1.3 \times V_{DS\max} = 650\,\text{V}$. This means that up to about 600V of inductive kickback voltage may develop in the switched coil. More than that will cause the avalanche effect and turn the MOSFET ON. The circuit is shown in Fig. 1. Reference voltage (VREF) is used to set the final voltage across the capacitor by R11. For example, a 4.27V reference indicates a charging voltage of 427V since the capacitor voltage is sensed by a 100:1 resistive divider network. If the collector of Q4 is detached from the gates of Q1 and Q2, a maximum charging voltage of about 600V is achieved.

For the circuit in Fig. 1, R2 adjusts the duty cycle. C3 is composed of two photoflash capacitors (160μF/330V) in series, making C3 an 80μF/660V capacitor. It's observed that the capacitor is charged faster when the duty cycle is higher. L1 is a handwound inductor around a ferrite core using three layers of 0.5mm magnet wire. Measured inductance of L1 is about 370μH.



(a)



(b)

Fig. 1. (a) The circuit and (b) components on board.

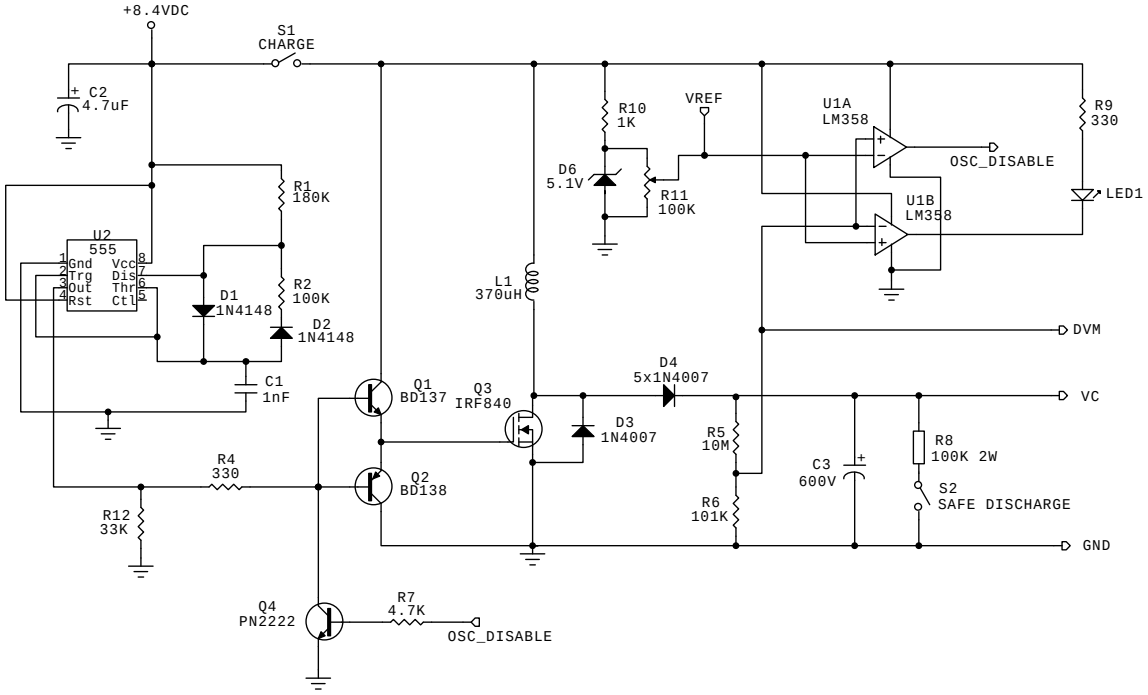


Fig. 2.

The circuit in Fig. 1 has been improved by eliminating R2 and the new circuit is shown in Fig. 2. For this one, 555 output is ON for 130μs and OFF for 80μs. Thus the period and frequency are 210μs and 4762Hz, respectively.

This circuit can be used to charge a capacitor up to about 600 VDC for HV discharge experiments.

For questions or comments:

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