Quick-Charge Auto-Fire Flash Circuit

1 Introduction

Quick-charge auto-fire flash circuit is shown in Fig. 1.

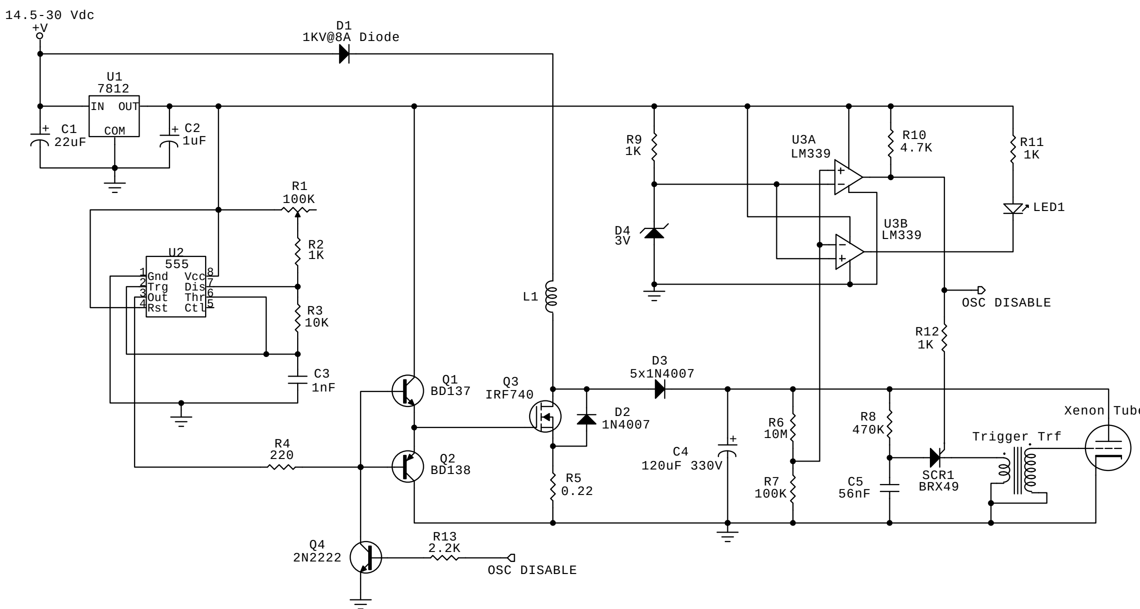

Fig. 1. The circuit.

The circuit uses an IRF740 MOSFET which is rated at a maximum V_{DS} value of 400V. The avalanche voltage is calculated as $V_A \cong 1.3 \times V_{DS\max} = 520$ V. This means that up to about 500V of inductive kickback voltage can develop in the switched coil. More than that will cause the avalanche effect, and turn the MOSFET on. For example, IRF640 doesn't work well with this design because the maximum kickback voltage that can be obtained is about 250V. So I selected IRF740 for this application. It has a special gate drive circuitry consisting Q1 and Q2 for fast turn-on and turn-off. L1 is a hand-wound inductor around a small ferrite rod. Its inductance is about 135 μH. C4 is charged through D3, and when the cap voltage slightly exceeds 300V, the auto-charge circuit takes the control. Comparator U3A generates a high output, and U3B generates a low output. The U3A output is used to trigger the SCR (BRX49) and to turn-on Q4.

Hence the oscillator pulses do not reach the MOSFET gate drive circuitry. This effectively turns the MOSFET OFF. Otherwise, the inverter is capable of charging the cap up to about 500V, and this will sure blow the cap! D3 is five 1N4007s in parallel since the charging current has peak value of several amperes. Meanwhile, C5 is charged through R8. Once the SCR is turned on, all the energy of C5 is dumped on the trigger coil primary and several KVs of high voltage output is generated at the secondary. The secondary lead is directly connected to the Xenon tube and will ionize the gas inside. Now the gas is ionized, becomes a conductive path, and C4 charged to 300V discharges through the flash tube causing an intense flash. Since the SCR driving current is provided by C5, and since R8 is a very large resistor and drains a current less than the SCR holding current, SCR turns off after each fire. C4 starts charging again, and this cycle continues.

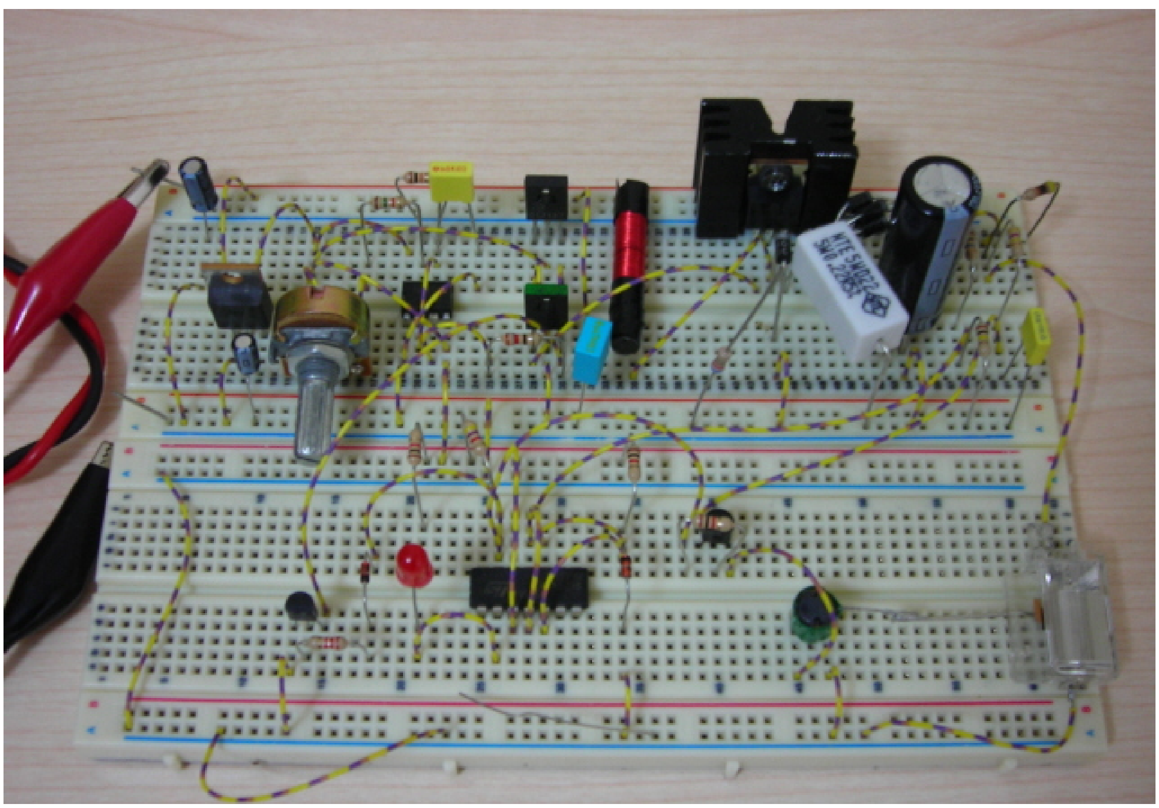

Fig. 2. The circuit on breadboard.

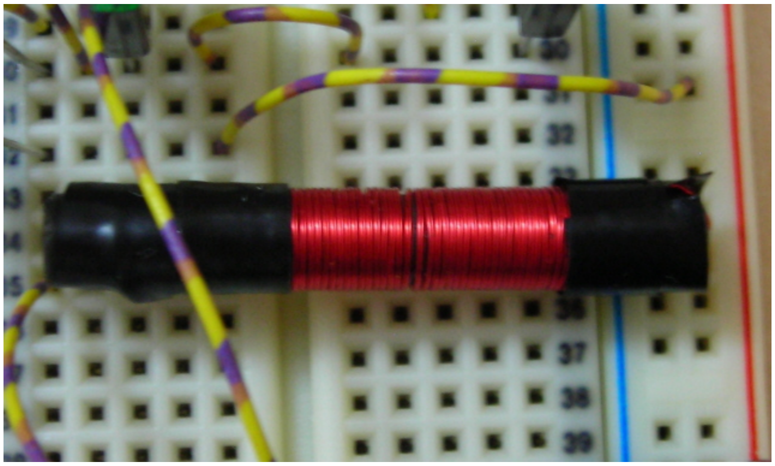

Fig. 3. Close view of L1. The ferrite rod is 36mm long and has a diameter of 4.5mm. The measured inductance is about 132μH, and the DC resistance is about 2.2Ω.

The firing rate for the flash depends on the dc supply and, the oscillator frequency and the duty cycle (as set by R1). As the supply voltage gets higher, the flash fires faster. I have observed flash rates of about four-five flashes per second (fps) when the dc source was 24Vdc. That is 16-20 times faster than the single-shot circuit (4 sec per charge). However, when the circuit was fed by 12Vdc, the flash rate was reduced to about 1-2 fps. It can be made even slower by adjusting R1. This is still a good achievement, if not a breakthrough. R5 can be omitted because it is placed to sample the source current. The flash rate decreases as the MOSFET gets hot (lower drain current and lower kickback voltage). This is more evident especially at higher dc supply voltages. The amount of kickback voltage is reduced and charging becomes slower.

For practical applications, a 12Vdc supply is universal and the circuit can be modified as shown in Fig. 4.

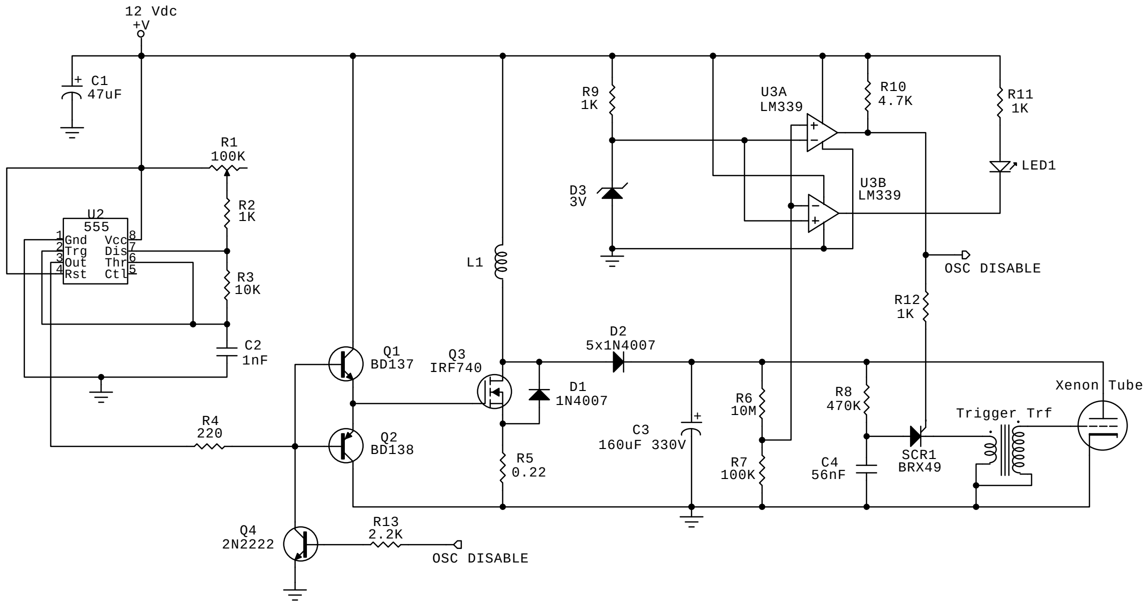

Fig. 4. The circuit with 12V operation.

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