Power LED Driver

1 Basic DC Driver Circuit

A constant-current power LED driver circuit is shown in Fig. 1. Q1 is turned on by R1 and acts as a variable resistor. Q2 is an "over-current" switch and R2 sets the maximum current. For the power LEDs that I use, the 1W circuit draws about 440mA from the DC source, which corresponds to about 0.44V VBE threshold voltage for PN2222A. The 5W circuit draws about 1.33A and this also corresponds to about 0.44V VBE threshold. The circuit can be operated using two 18650 Li-Ion batteries in series. A heatsink is required for IRF540 and the IR LED, especially for 5W operation. For the 1W driver circuit, the voltage drop Vf on the LED is about 1.67V.

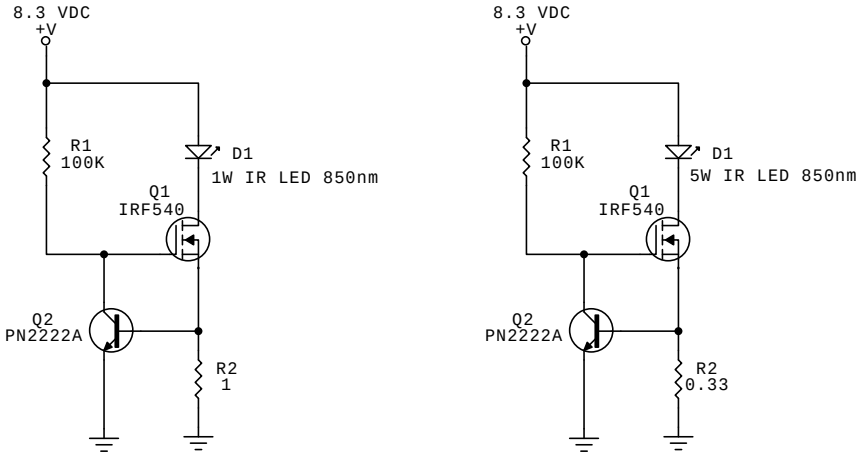

Fig. 1. A constant-current power LED driver circuit.

Current limiting resistor (R2 in Fig. 1) may be hard to find and may not have the desired precision, especially for large currents. So I designed the circuit shown in Fig. 2. A fixed resistor of 1Ω is used as the current sensor. The voltage drop on this resistor is compared with a reference voltage to set the current.

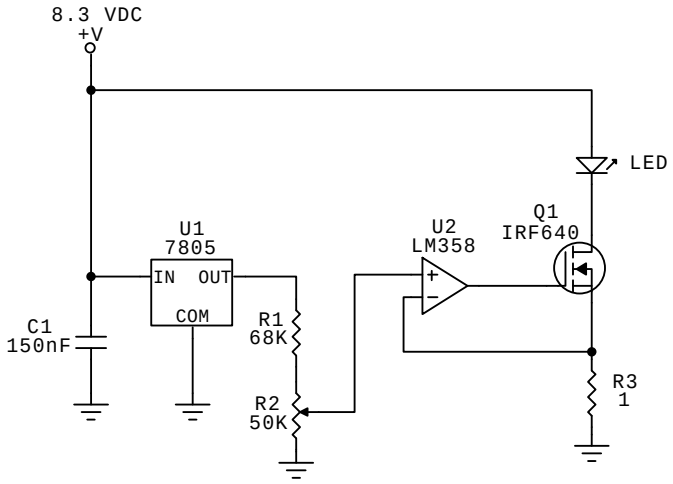

Fig. 2. This circuit uses the voltage drop on R2 (let's refer it as VREF) to limit the drain current of Q1. The drain current is limited to VREF/R3. For example, VREF can be set to 1V for ID=1A. This circuit works nicely for ID from about 10mA to 1.7A.

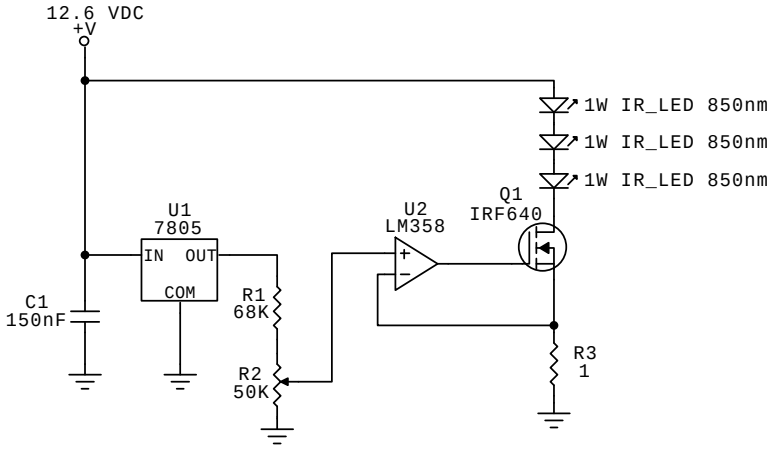

Fig. 3. Three 1W IR LEDs are connected in series. This circuit uses a 12.6VDC supply (three 18650 batteries are in series). 8.3VDC design shown in Fig. 2 is not working properly for the three LED design because lower supply voltage cause MOSFET to be in the linear operation mode. Power supply can be lowered down to 10V.

I built a driver circuit using the architecture shown in Fig. 3. Three 5W 850nm IR LEDs are connected in series. DC power supply is formed by four 18650 batteries in series. LED current is adjusted for 1400mA using R2. The new circuit is shown in Fig. 5.

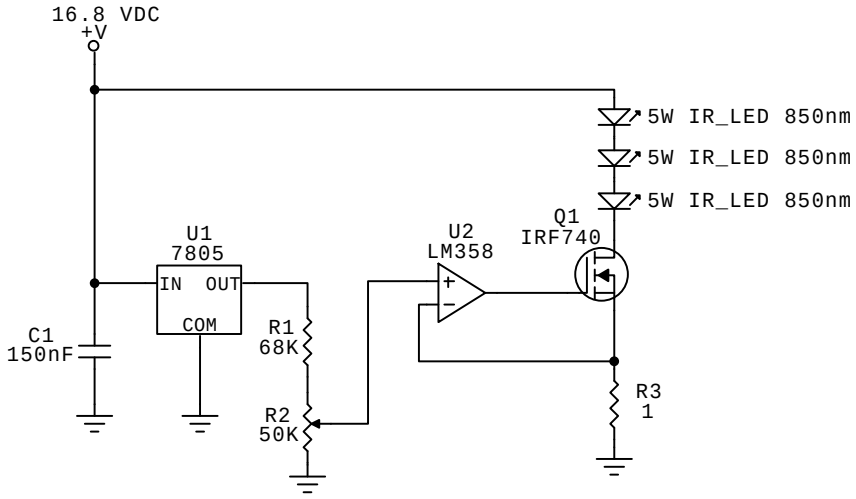

Fig. 4.

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