A Junkbox Power Supply for 28 V Relays

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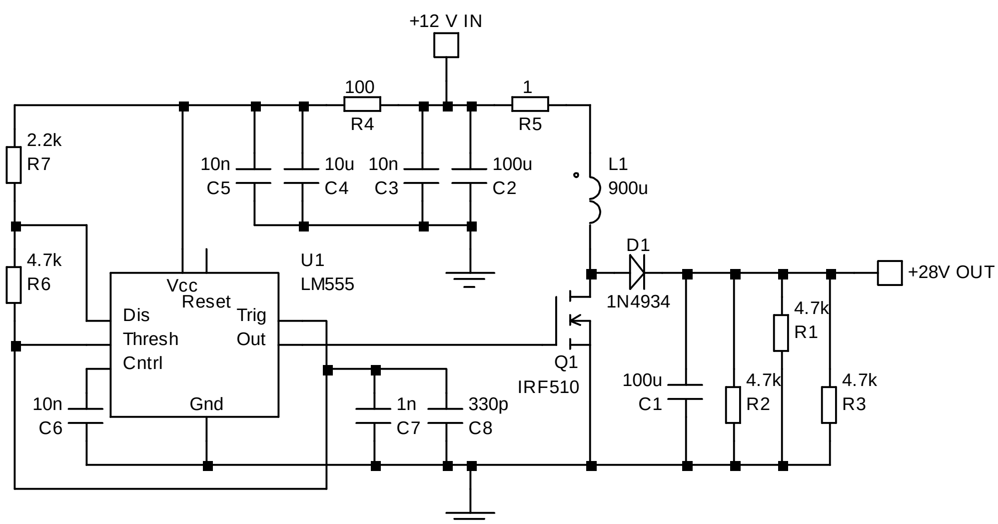
Having acquired a pre-owned 10 GHz transverter, I wanted to quickly put together a simple rig to test it out. I had a 28 V SMA SPDT relays to use for the transmit/receive antenna switching, but I needed a power supply to run it from the 12 V battery supply I would be using for portable operation. Looking at application notes for various switching regulator chips I suddenly realized that, at least in simplified form, the output voltage of a boost converter depended only on the input voltage and the switching duty cycle. This meant, given that the input battery voltage is reasonably constant, I didn't really need regulation to get a stable enough output voltage for a relay, just a constant and controlled duty cycle.

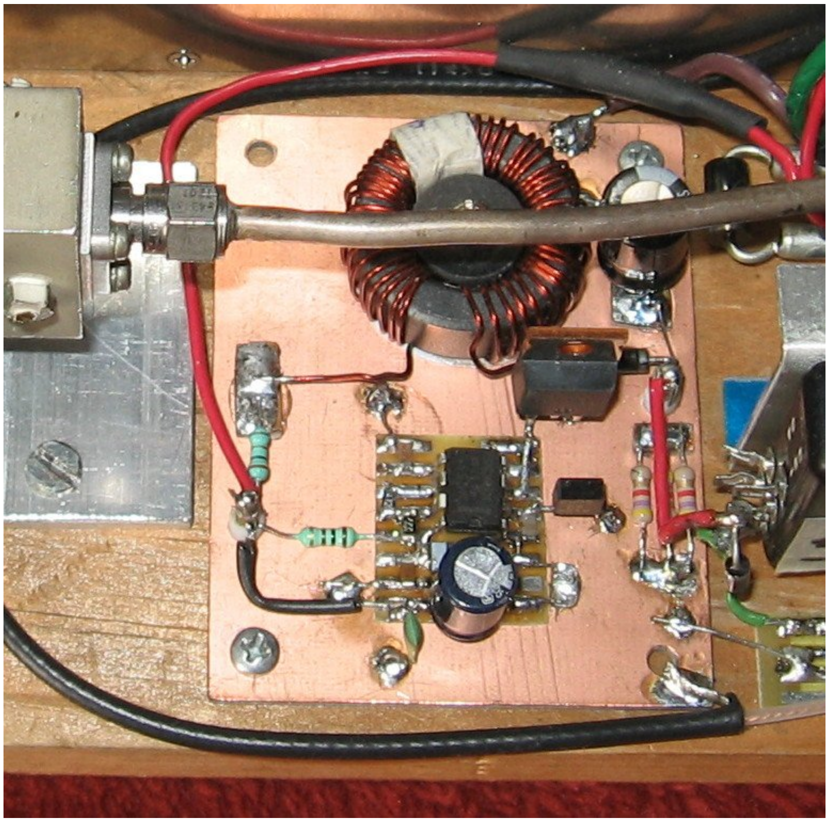
I did some modelling using SPICE software and found that indeed it worked, with a few constraints. The key ones are that there should be a minimum load current to prevent the output voltage from soaring when the relay is not keyed (which means it ends up being less efficient than a real switching regulator), and the inductor value has to be pretty large. The following circuit resulted from the simulation effort. I was able to breadboard it without having to procure any parts, except for the rectifier diode, which is a fast recovery type (but only cost a few cents at a local electronics store). I'll have to admit I lucked out with respect to having a suitable toroid core for the inductor in my desk drawer. It worked, and the 10 GHz transverter supplied most of my QSOs on that band in the ARRL September VHF QSO Party this year and was borrowed by VE3VZ to make a few QSOs in the 10 GHz and Up Contest, as well.

Here is the schematic I used, and a photograph of the breadboad circuit in the rough-and-ready 10 GHz transverter.



Pinout for 555 in standard DIP package:

1 Ground
2 Trigger
3 Output
4 Reset (not used in this circuit)
5 Control
6 Threshold
7 Discharge
8 Vcc



R1, R2 and R3 provide the minimum load current. I used three ¼ W resistors since I had them; you could substitute a single 1.5 kΩ 1 W resistor. R5 is intended to limit the initial turn-on current surge to reduce the stress on Q1, D1 and C1. It may not really be needed. The duty cycle of the switching waveform (and hence the output voltage) is controlled by the ratio of R6 to R7. The switching frequency is controlled by R6, R7, C7 and C8. I used two capacitors in parallel for frequency control just because that made it a bit easier to set it to the frequency for which the power circuitry was designed.