PROJECT OF THE MONTH

BY FORREST M. MIMS

MINIATURE DC-DC CONVERTER

The LM3909 was originally designed as an LED flasher, but has many other applications. One that I've enjoyed experimenting with is a miniature power supply that allows a tiny watch battery to power a neon lamp or even a powerful semiconductor-laser pulser. Both these applications require 70 to 150 volts at relatively low current.

Figure A shows the circuit of the LM3909 dc-dc converter. In operation, the LM3909 rapidly switches *Q1* on and off at a rate determined by *C1*. The transistor can be considered a switch in series with choke *L1* and resistor *R2*. Each time *Q1* switches off, the magnetic field set up by the current flowing through *L1* collapses and induces a high voltage across the inductor. This voltage is rectified and stored in *C2*.

The LED is a bonus feature of the circuit. It glows to indicate when the circuit is operating. The neon lamp and 15,000-ohm series resistor shown in Figure A are optional. They provide a visual indication that the circuit is producing 70 or more volts. When powered by a 1.2-volt nickel-cadmium or 1.35-volt mercury "button" cell, the circuit produces enough voltage to flash the lamp when it is connected across capacitor *C2*.

If you don't like the orange glow of a neon lamp, try a *green* neon lamp (Radio Shack 272-1106 or equivalent). This lamp has a phosphor coating on its inside surface that glows green when illuminated by the radiation produced inside the lamp. In any case, be sure to use a quality lamp because some of the surplus neon lamps I've tried do not work well.

The key components of the circuit are *L1* and *R2*. In the prototype circuit, I used a miniature Essex choke with an inductance of 1000-µH for *L1*. This choke is about the size of a ¼-watt carbon composition resistor. If this choke is used, the resistance of *R2* should be between 75 and 85 ohms.

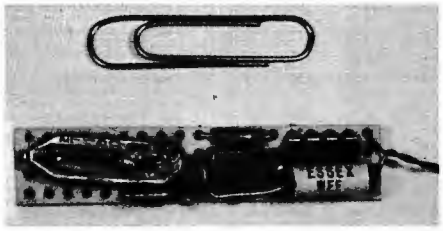

Fig. C. Photo of prototype version of the dc-dc converter.

If you can't find this choke, experiment with others until you find one that produces enough voltage to light a neon lamp. You'll find that many different chokes will produce a useful output. One version of the circuit that I built uses a miniature 33-mH choke (Aladdin) with excellent results. The 1979 Allied catalog (401 E. 8th St., Fort Worth, TX 76102) lists a number of subminiature r-f inductors on page 145 that should work fine.

If you don't use the 1000-µH choke specified, you'll need to experiment with the value of *R2*. As the inductance is increased, *R2*'s value can be decreased. Actually, *R2* is not even necessary beyond a few millihenries.

Assembly of this circuit should present no problems once you've selected a choke and determined the resistance of *R2* (if it is necessary). I used a piece of perforated board with copper solder pads at each hole. Figure B is a pictorial view of the assembled circuit.

Begin by inserting the components into the top side of the board and interconnecting their leads with wrapping wire. Then solder all the connections to their respective solder pads. Figure C is a photograph of the complete prototype. This circuit includes a neon lamp and series resistor to illustrate its operation as a dc-dc converter. Don't forget that the circuit has many other possibilities.

For example, most semiconductor lasers require current pulses of many amperes for proper operation. The circuit in Figure A can power a four-layer-diode laser pulser with ease, especially if *L1* has an inductance of 10 to 35 mH. Recently, I built a midget laser transmitter using the circuit in Fig. A as a power supply (*L1* = 33 mH, no *R2*). The circuit is completely self-contained and includes lens, mercury "button" cell and switch in a 0.5" × 3" (1.3 cm × 7.6 cm) brass tube. If there is sufficient interest, I'll describe its construction as a future Project of the Month.

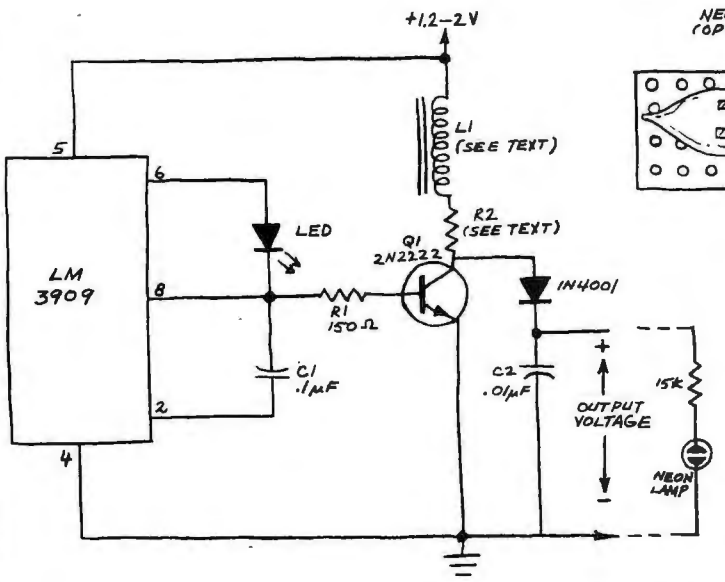

Fig. A. Miniature dc-dc converter circuit diagram.

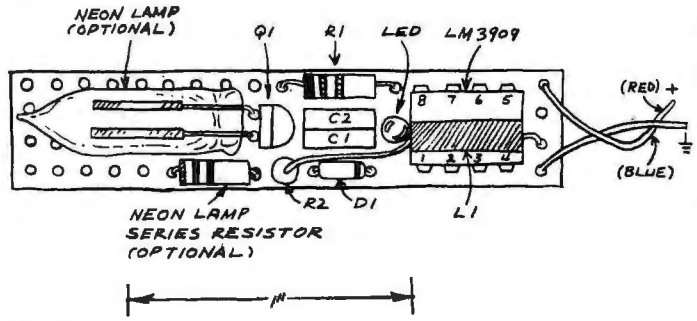

Fig. B. Arrangement of components on the board for the converter.