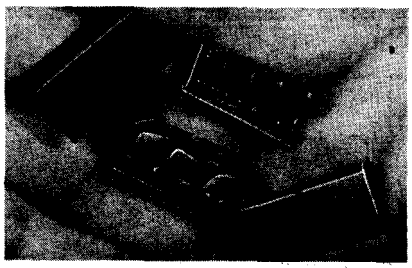
PROJECT OF THE MONTH

MINIATURE DC-DC UPCONVERTERS

The subject of the June 1978 Experimenter's Corner was voltage multipliers made from a network of diodes and capacitors. If you read that column, you'll recall that voltage multipliers provide an easy



Two multipliers on DIP headers.

way to obtain high-voltage dc from low-voltage ac.

Voltage multipliers are easy to miniaturize. The photo shows two compact multipliers assembled on miniature dual in-line (DIP) headers. The upper circuit has four diode-capacitor pairs connected as a voltage quadrupler; the lower has eight diode-capacitor pairs. With their plastic covers installed, each of these circuits occupies no more space than a 16-pin DIP!

Figure A shows the circuit diagram and construction details of the four-stage multiplier in the photo. A cascade voltage multiplier chain like the one shown in Fig. 5 in the June 1978 column was used in the eight-stage circuit. Ideally, each additional diode-capacitor stage should add the approximate value of the input voltage to the output voltage. In practice, the actual output voltage is affected both by the size of the capacitors and the frequency of the input voltage.

The four-stage circuit uses 4.7-µF miniature tantalum capacitors and has an open-circuit multiplication factor of 2.5. The eight-stage circuit uses 0.005-µF ceramic capacitors and has an open-circuit multiplication factor of 3.5. These multiplication factors were measured by applying a lOO-kHz square wave to the input of each multiplier.

Prototype of **circuit in Fig.** *B.*

You can drive either of these miniature multipliers with an audio-frequency oscillator made from an op amp, 555 timer or a few gates connected as an astable multivibrator. Refer to the June 1978 column for sample oscillator circuits.

Meanwhile, you might want to build the self-contained upconverter circuit shown in Fig. B. This circuit includes its own oscillator made from the four gates in a single 4011 and a six-stage multiplier. I assembled the prototype version of the circuit on a small perforated board only twice the length of a 16-pin DIP, but you can modify the construction to suit your requirements and the space available.

If you want to miniaturize the circuit, use perforated board with small copper solder pads at each hole (Radio Shack 276-152 or similar). *Before* installing the components, thread Wire-Wrap wire between the various holes where the IC will be installed in accordance with the circuit diagram. The wires should be laid flat against the top side of the board.

After the wires are in place, insert the IC into the board (over the wires) and carefully solder each of its pins to the appropriate solder pads and Wire-Wrap wires. Be sure to use proper CMOS handling and soldering methods to avoid damaging the IC.

Complete assembly by installing the resistor and capacitor of the 4011 oscillator and the diodes and capacitors of the multiplier. The prototype circuit is shown in the photo. The resistor and the six diodes are hidden under the various capacitors.

This circuit multiplies a 3-to-15 volt dc input by a factor of approximately 5 (no load). It's therefore ideal for miniature circuits employing avalanche detectors, four-layer diodes and other components requiring from 15 to 75 volts. 0

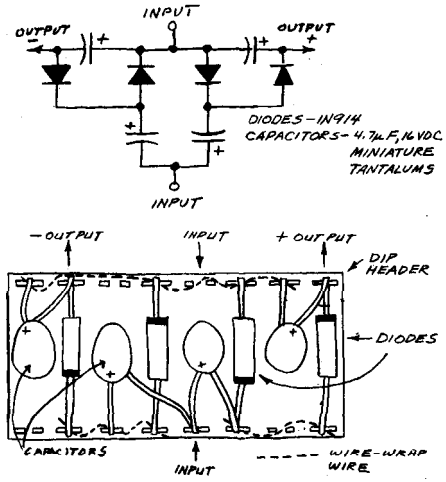


Fig. *A. Circuit diagram and construction details of 4-stage miniature voltage multiplier.*

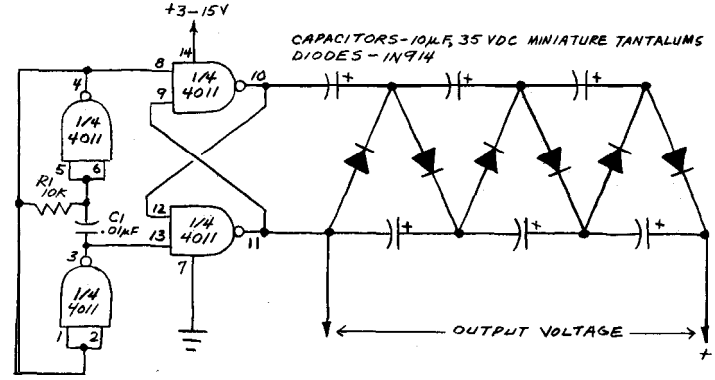


Fig. B. Miniature dc-dc upconverter circuit.