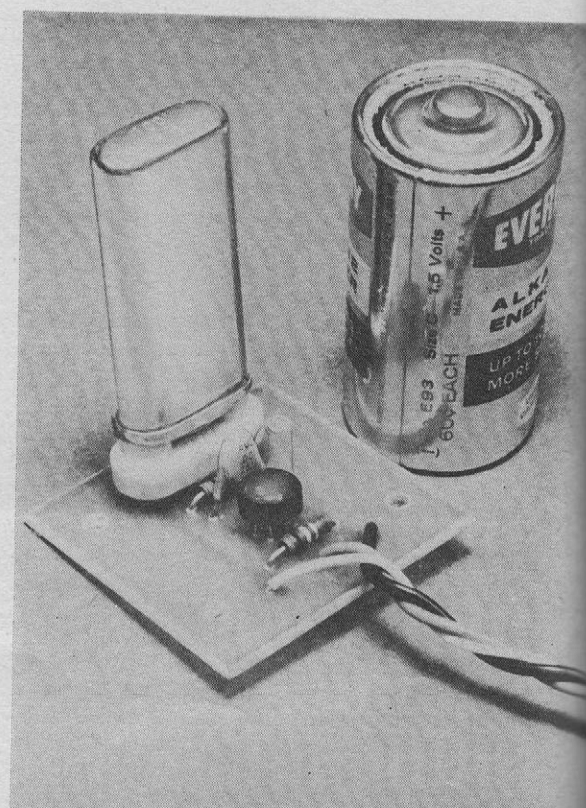
L'IL RICHIE

SIMPLE, STABLE, HARMONIC-RICH CRYSTAL OSCILLATOR IS BUILT AROUND A LOW-COST INTEGRATED CIRCUIT

By DON LANCASTER



L'il Richie is a small one—it's shown here alongside a conventional "C" cell—but the crystal is a 100-kHz bar and is larger than most crystals.

TAKE ONE low-cost integrated circuit, two resistors, one capacitor, and one crystal—combine properly—turn on the power, and you can generate crystal-controlled sine or square waves at any frequency between 100 kHz and 3 MHz, and, with slight modification, the 3- to 10-MHz range. Uses of the "L'il Richie" are as varied as the user's imagination.

Amateur radio operators will find the harmonic-rich output useful as 100-kHz or 1-MHz crystal calibrators. As a bonus, the addition of an output tank circuit creates a flea-power transmitter for field days, antenna testing, and hidden-transmitter hunts.

For AM servicing, just insert a 455-kHz crystal, and you have an i.f. alignment generator. Switch to 500-, 1000-, or 1500-kHz crystals, and you have a handy signal generator for dial calibration, tracking adjustments, or antenna and r.f. stage tuning.

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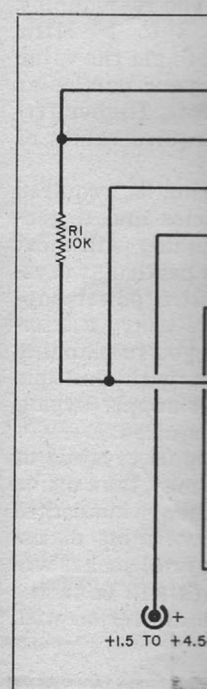

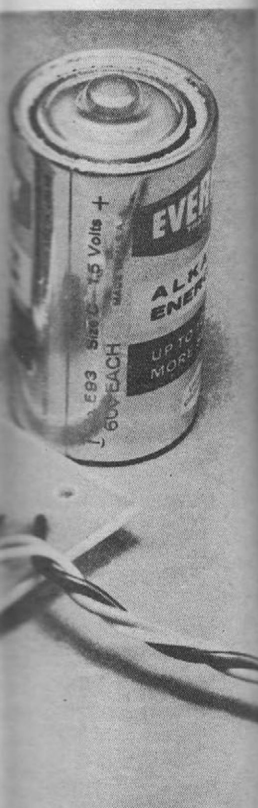

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ed crystal—3.58, 4.5, or 10.7 MHz—and you have a marker or signal generator all set to go. And, finally, the advanced experimenter can use the "L'il Richie" as a stable, crystal-controlled reference clock for electronic counting circuits.

How it Works. The two independent gates in *IC1* (Fig. 1) are biased in their class A region using resistors *R1* and *R2*. These two gates are cascaded with *C1* to form a two-stage, RC-coupled r.f. amplifier. Feedback from output to input via *XTAL* produces the desired oscillation, in the form of a square wave very nearly equal to the crystal's series-resonant frequency.

PARTS LIST

C1—1000-pF disc ceramic capacitor—see text
*IC1—µL914 epoxy micrologic dual gate (Fairchild)**
R1, R2—10,000-ohm, ¼-watt carbon resistor
XTAL—Series resonant, first-overtone crystal, 100 kHz to 3MHz with C1 as listed; to 10.7 MHz with selected value for C1
*Misc.—1½" x 1⅜" single-sided PC board,** socket to fit XTAL with mounting screw, solder terminals (3), solder*

*Data sheet and distributor list are available from Fairchild Semiconductor, 313 Fairchild Drive, Mountain View, Calif.

**Complete kit, including printed circuit board, but less crystal and socket, is available from Southwest Technical Products Corp., Box 16297, San Antonio, Texas 78216, for $1.75, postpaid in the U.S.A.

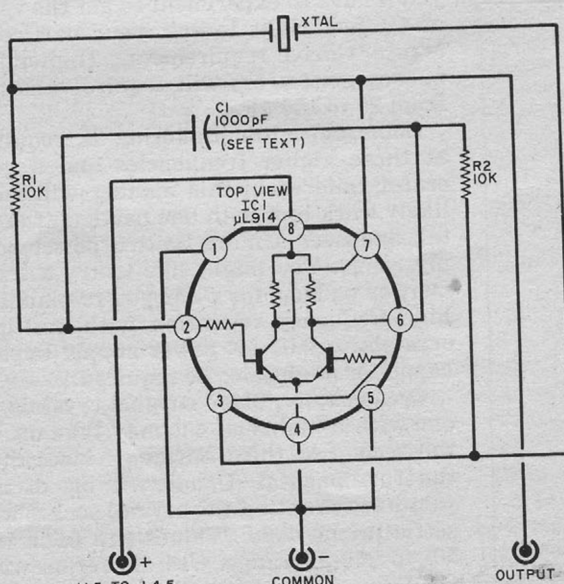


Fig. 1. The IC contains the bulk of the multivibrator circuit. The only external components are bias resistors R1 and R2, feedback capacitor C1, and the frequency controlling element, XTAL. Output is a square wave at the crystal frequency. The d.c. level required for operation is not critical—between 1.5 and 4.5 volts.

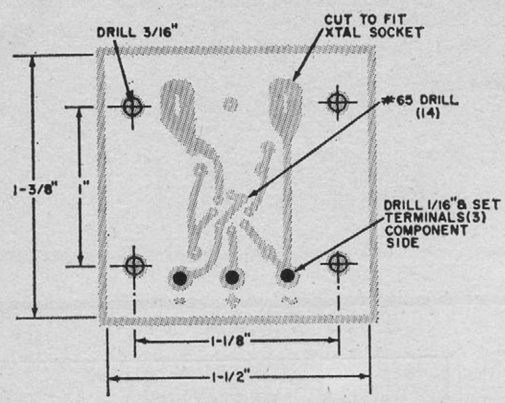


Fig. 2. Make the printed board as shown here. It is best to use a PC for this oscillator as stray capacitance found in most point-to-point assembly might cause spurious oscillation at frequencies other than that of the crystal.

The entire circuit requires only five low-cost parts and can be powered by any convenient supply from a single penlight cell (1.5 volts) up to 4.5 volts d.c.

Construction. Any neat construction technique can be used for this circuit, but long leads or sloppy construction can produce a device whose frequency may not entirely depend upon the crystal used. A complete kit, including the printed circuit board, is available from the source indicated in the Parts List, but if you want to do your own PC layout work, just follow Figs. 2 and 3.

Note that *IC1* is mounted with the positive power lead centered on the flat of its epoxy case (pin 8). And be sure that the crystal holder pins and the crystal socket match, as some older crystal holders have different pin diameters and spacings.

After assembly and inspection, insert a crystal of below 3 MHz, and perform an initial checkout using 3 volts from two flashlight cells. If you're planning on using crystals from 3 to 10 MHz, you'll have to experiment to get the value of *C1* just right to suit your particular crystal's drive requirements. Higher frequency generators will require values of from 20 to 100 pF.

Some capacitor tinkering is required at these higher frequencies and a generator tailored in this manner will most likely work best with one particular crystal, and over a more limited power supply range. You might like to try a trimmer, or padder, for *C1* if you're planning high-frequency operation with multiple crystals. A 0.01-μF power supply bypass capacitor might also be required.

Occasionally, older surplus crystals or one with an unusual cut may take off on the second or third harmonic instead of the fundamental. Usually, a bit of capacitance shunting the crystal socket will settle things down. Values will be in the 50- to 200-pF range. Use discretion with

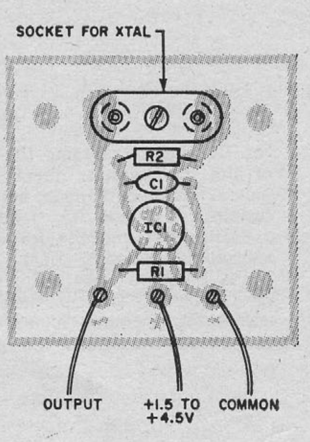
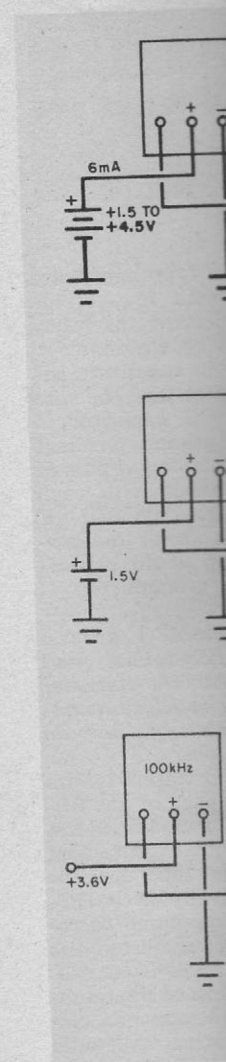


Fig. 3. Component assembly on the printed board. Note that the IC has one flat side and that pin 8 on this flat side is connected to the positive battery terminal.



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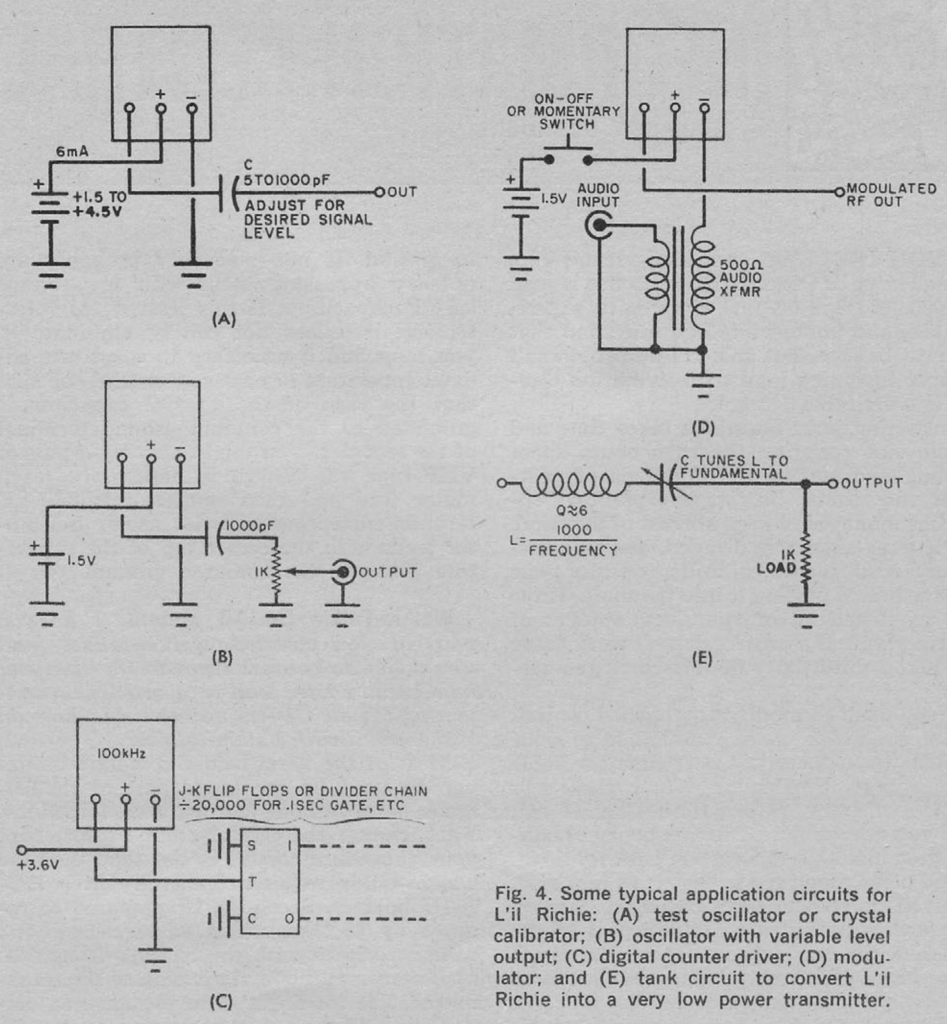

Fig. 4. Some typical application circuits for L'il Richie: (A) test oscillator or crystal calibrator; (B) oscillator with variable level output; (C) digital counter driver; (D) modulator; and (E) tank circuit to convert L'il Richie into a very low power transmitter.

this capacitive loading, for the generator will now oscillate either with or without the crystal in place.

Operating Hints. Figure 4 shows some circuits you might like to try. In the test oscillator or crystal calibrator in Fig. 4(A), an output capacitor (*C*) is selected to get the desired signal level. If you want a continuous output level adjustment range, use the circuit shown in Fig. 4(B). The digital clock and divider connection is shown in Fig. 4(C); a coupling capacitor is not required here.

On-off switching, keying, or audio modulation are added with the circuit in Fig. 4(D). Or, if you want a sinusodial output instead of a square wave, just add a series-resonant tank circuit to the output, tuned to the crystal frequency, as shown in Fig. 4(E).

The generator's output voltage will be slightly less than the supply voltage. Expect around 1.2 volts peak-to-peak with penlight cell operation, and perhaps 4 volts for a 4.5-volt supply. Total circuit drain is less than 6 mA with the higher supply voltage. —30—

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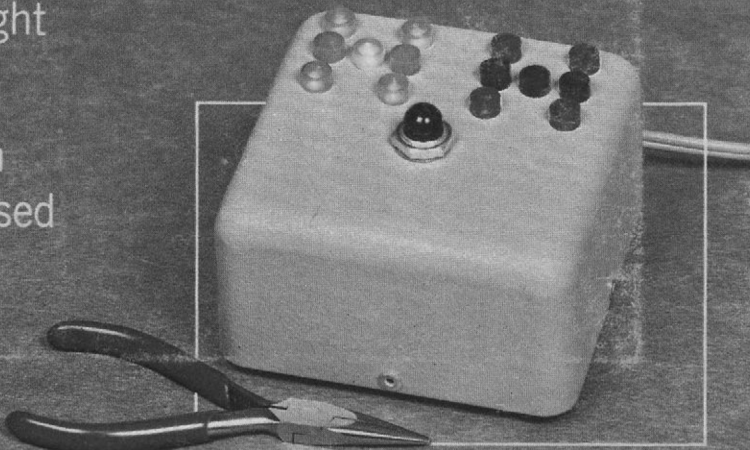

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