# Simple Pulsed Crystal Signal Source

## *Find the right frequency.*

by Leslie K. Bartoloth KA1MJP

First, a confession. I'd rather build than operate. Once I finish a project, I'll use it on the air for a few days, then I'll start on the next project.

I build and operate a lot of very simple rigs. My receivers are usually direct conversion (or regenerative!), and I sometimes have a hard time just finding the ham bands, let alone staying inside them. When I'm using a crystal controlled transmitter this isn't a problem, but I sometimes use simple VFO controlled rigs (like a Heath HW-7 or a home-brew transceiver) with inadequate dial calibration. With these transceivers, it's nice to have a crystal controlled spotting oscillator, like the one in Photo A. I just pop a crystal into the "chirper" and dial my receiver until I find the beeping signal source. Then I know I'm right where I want to be.

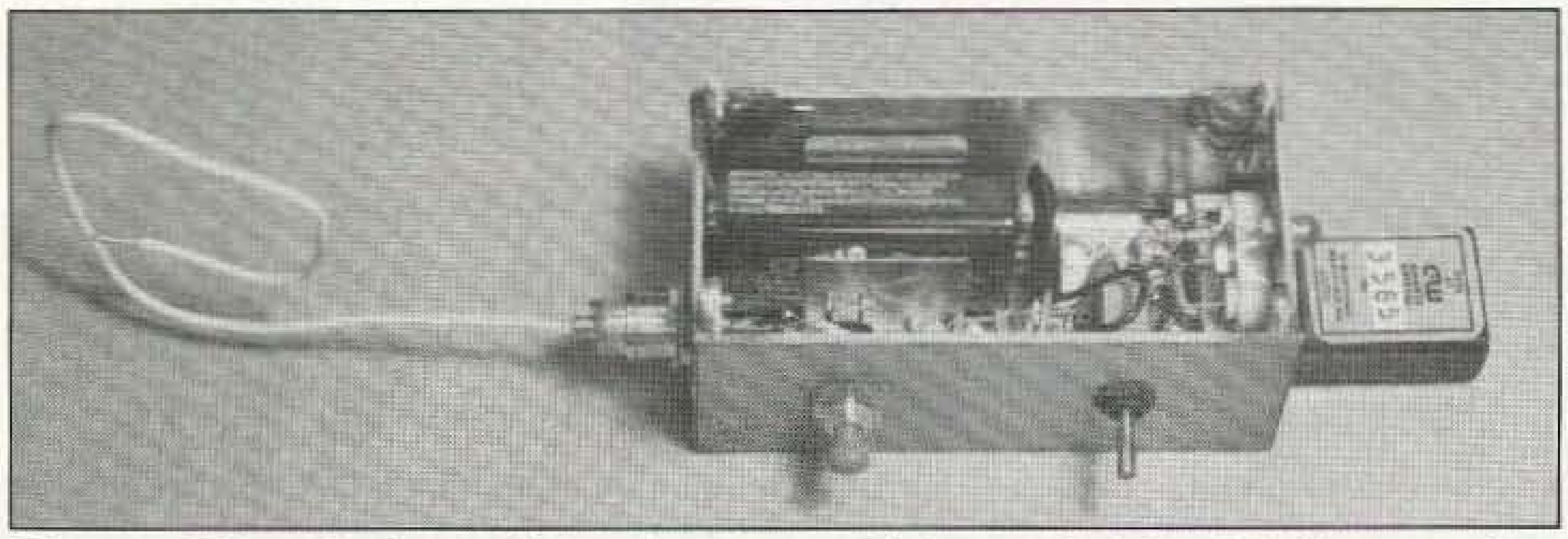

*Photo A. This pulsed crystal signal source can help you find the right frequency in a crowded ham band. The author's prototype was built using the "ugly construction" technique, however a PC board pattern is available (see Figures 2 and 3).*

You can use this pulsed crystal oscillator to find the right frequency on a simple receiver, stay inside the band with an uncalibrated VFO transceiver, or to peak RF filters.

The "chirping" of this oscillator makes it easy to find in my receiver, even on a crowded ham band full of heterodynes. It also has a continuous-on mode so it can be used as a weak-signal source for peaking receiver preselectors and RF filters.

### Circuit Description

See the schematic for the crystal chirper. The circuit couldn't be much simpler; its heart is a JFET crystal oscillator. Transistor Q1 switches the power supply to the oscillator. When Q1 is on, the oscillator runs. Crystal Y1 sets the oscillator frequency; this can be just about any crystal from 1 MHz up through 30 MHz.

Switch S1 provides a high at the base of Q1, switching it on and causing the oscillator to run continuously. I use this mode when I'm optimizing filters. Switch S2 (a momentary pushbutton) applies power to U1, a 555 timer IC connected as an astable multivibrator. The 555 runs at about five pulses per second, switching Q1 (and the crystal oscillator) on and off five times per second. I use the pulse mode when I use the oscillator as a spotter with my simple QRP rigs. It can be hard to stay in band with an uncalibrated transceiver, but once I spot the beeping oscillator, I know I can tune a bit to one side or the other and still be legal.

Because the RF oscillator does not run unless Q1 is switched on, and the 555 does not run unless power is applied through S2, the chirper draws no current when it is not in use. An ON/OFF switch is unnecessary, and a single 9-volt battery lasts a long time

### Construction

Almost any construction technique will work with the chirper. I prefer "ugly construction," with all the components mounted up on one side of a scrap of PC board (as shown in Photo A). You could also use a Radio Shack prototyping board, or use the printed circuit board layouts in Figure 2 and 3.

I built the prototype inside a printed-circuit board enclosure, but shielding is not critical. In fact, you don't really want to shield this project! It's a signal source, after all, and you want the signal to get out and into your receiver. I built an earlier version inside a glass jar, and it worked great, even without the wire "antenna" shown on the prototype in Photo A.

I used crystal sockets for both FT243 and HC6 crystals in my prototype. I've had very good luck with crystals from CW Crystals, in Marshfield, Missouri. If you use these crystals, you'll only need an FT243 socket. You can also use alligator clips as a "socket" if you keep the leads short.

### Parts Substitution

The parts shown in the schematic are simply the parts I used in my prototype. A wide range of parts values and types can be substituted for them. Q1 can be a 2N3904, 2N2222, or 2N4401 (or just about any other "generic" NPN transistor). Q2 can be a 2N5484 or 2N4416 instead of the MPF102 shown. U1 can be a plain-vanilla 555 (it may have numbers like NE555 or LM555, but it's the same part either way), or you can use the CMOS 7555 for even lower power consumption. At the low duty cycle of the chirper, you don't really need the more expensive CMOS part.

Any small-signal diodes will work as replacements for the 1N914s. 1N4148s are a good choice, and again, the generic Radio Shack parts will work here. The bypass capacitors (the 0.01 µF caps connected from the emitter of Q1 and the junction of the two

*Continued on page 30*

**Parts List**

| | |
|---|---|
| Q1 | 2N3904 transistor |
| Q2 | MPF102 FET |
| U1 | NE555 timer IC |
| R1 | 1k resistor |
| R2 | 3.3k |
| R3,R5,R6 | 10k |
| R4 | 100k |
| C1,C2 | 0.01 µF capacitor |
| C3 | 10 µF electrolytic |
| C4,C5 | 100 pF |
| SW1 | SPST switch |
| SW2 | momentary contact switch (normally open) |
| RFC1 | 10 µH RF choke |
| XTAL | see text |
| D1,D2 | 1N914 diode |
| LED1 | red LED |

A blank PC board is available for $4 + $1.50 shipping per order from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

## Crystal Signal Source *Continued from page 14*

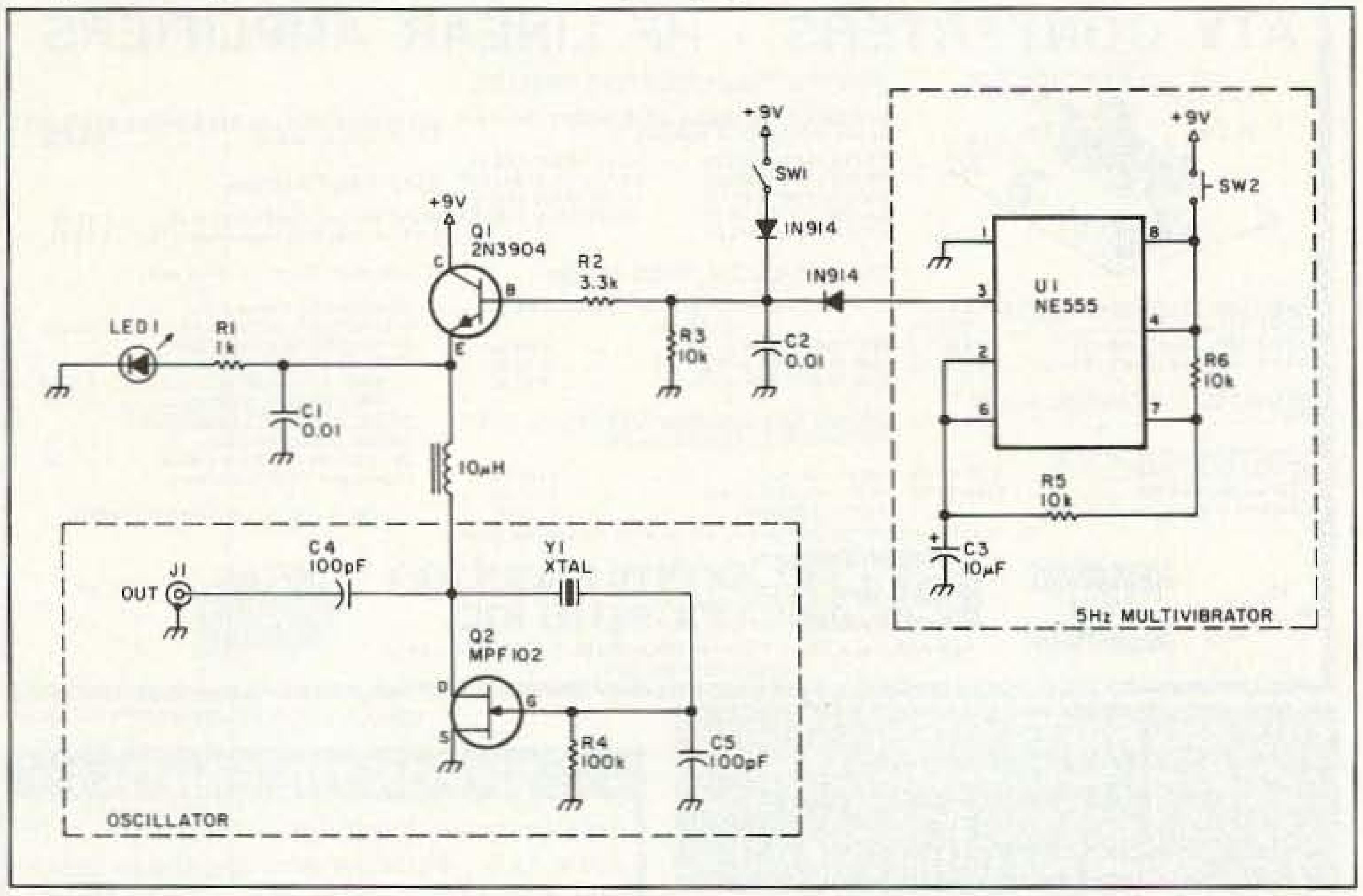


*Figure 1. The "crystal chirper" circuit. Its heart is a simple JFET Pierce crystal oscillator.*

diodes to ground) can be any value from 0.001 to 0.1 μF.

The RF choke can be just about any value from 10 μH through 2.5 mH. The 100 μH choke Radio Shack sells works fine, although it's a bit large for a small project. If you want to wind a smaller choke, 15 turns of number 24 or 26 wire on an FT37-43 or FT50-43 ferrite toroid produces a choke in the neighborhood of 100 μH.

The 10k resistors and 10 μF capacitor connected to the 555 are fairly critical—they set the pulse rate of the 555 circuit. You can change their value slightly if you'd like faster or slower pulses. Reducing the resistance or capacitance will speed up the oscillator; increasing either will slow it down.

Even the supply voltage is not critical. The circuit will operate anywhere from about 6 volts up to 18 or so.

### Adjustment and Calibration

There's not much to adjust on this project. It should work the first time you turn it on. Plug a crystal into the circuit and switch on S1. If you have an oscilloscope, check for RF at the output jack.

If you don't have an oscilloscope, you can use a receiver to test the chirper. If you built the project in a shielded enclosure, you'll need a small wire "antenna" like the one shown in Photo A. If your version of the chirper is unshielded, place the project near your receiver and tune around near the crystal frequency. You should hear a steady tone when S1 is switched on, and a pulsed tone when you switch S1 off and press S2. The LED should also light steadily when S1 is on, and flash when you press S2.

If you have S1 switched on, don't expect the circuit to pulse when you press S2. The two 1N914 diodes make an OR gate—either pulses from the 555, or steady DC through S1 will turn on the oscillator. Once S1 is on, pulses are simply ignored. If you have any problems, check your solder connections, and then make sure supply voltage is flowing to all the appropriate points in the circuit.

If the LED comes on when S1 is on, but it does not flash when you press S2, something is wrong with the 555 oscillator. Once you have the LED behaving, if there's still no output, check your connections in the crystal oscillator portion of the circuit. Then, try a different crystal; some older FT243 crystals can become corroded and stop working. Next, if the supply voltage at the drain of Q2 seems adequate, and you've tried a few different crystals, try substituting a different transistor for Q2. Finally, experiment with the value of the 100 pF capacitor from the gate of Q2 to ground.

I had fun building this project, and I use it often. I'm sure you'll find it easy to build, and it will be a valuable addition to your test bench or operating table. Now that you'll be right on frequency, put that simple transceiver on the air! 73

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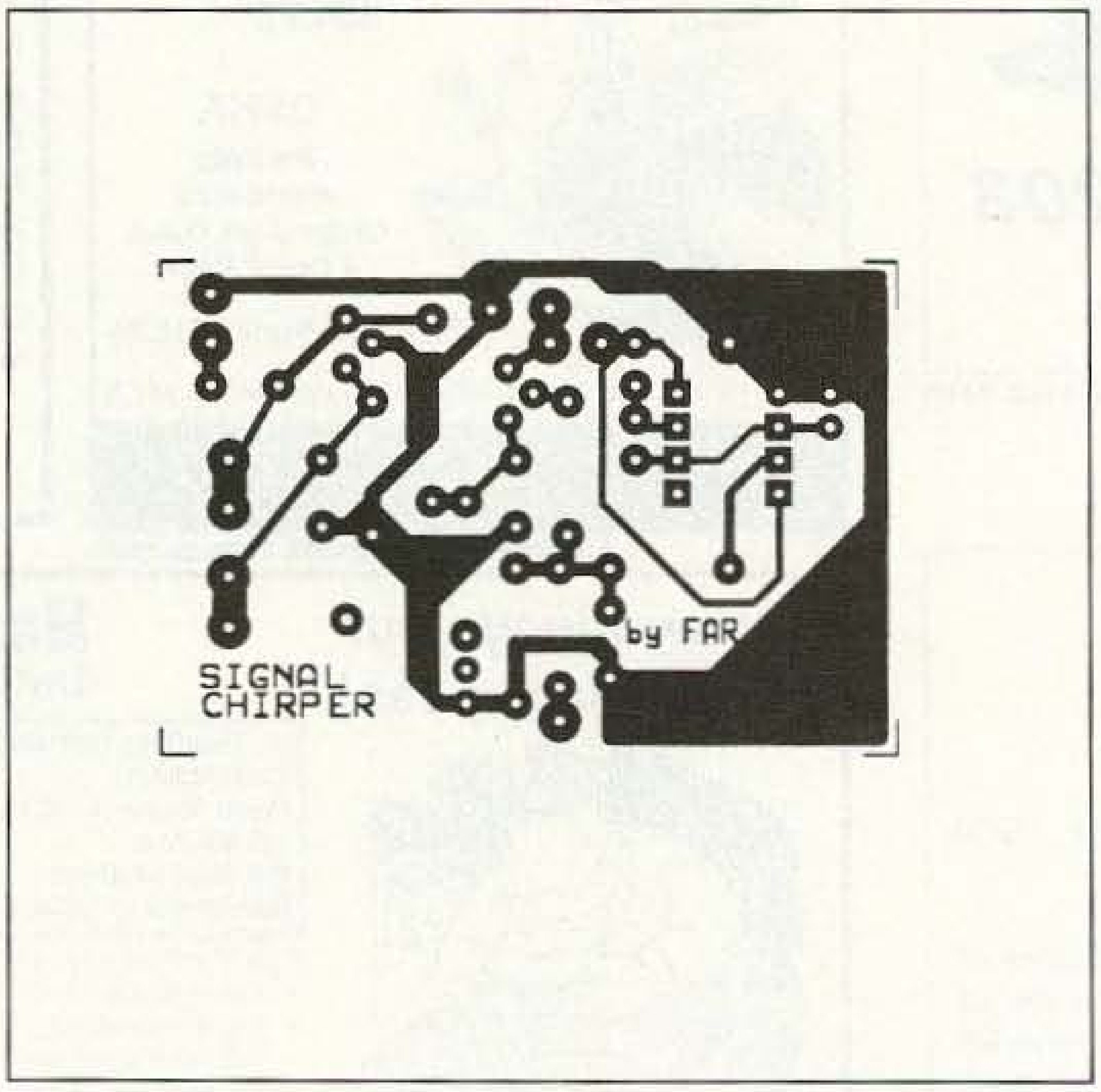


*Figure 2. The PC board foil pattern for the pulsed signal source.*

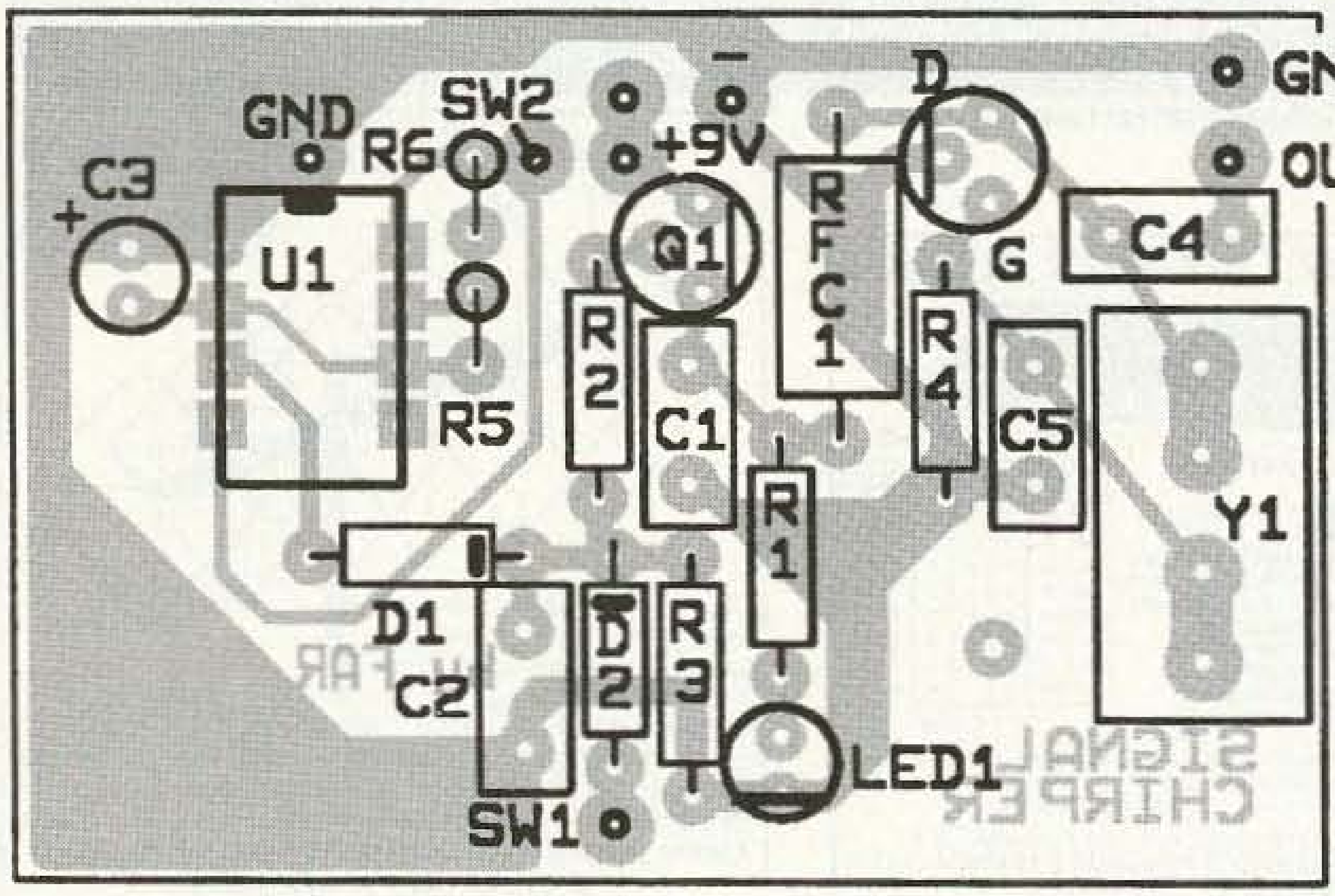


*Figure 3. PC board parts placement.*