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The Fun-Oscillator

—a simple, goof-proof vfo for your QRP transmitter

Note: A complete kit of parts, including PC board, is available from RADIOKIT, Box 411S, Greenville NH 03048 for $34.95 plus $2.50 shipping and handling.

The Fun-Mitter (February, 1981, *73*) and Fun-Ceiver (July, 1981, *73*) provided the home-brew-oriented amateur with the basic components for a home-brew station setup.

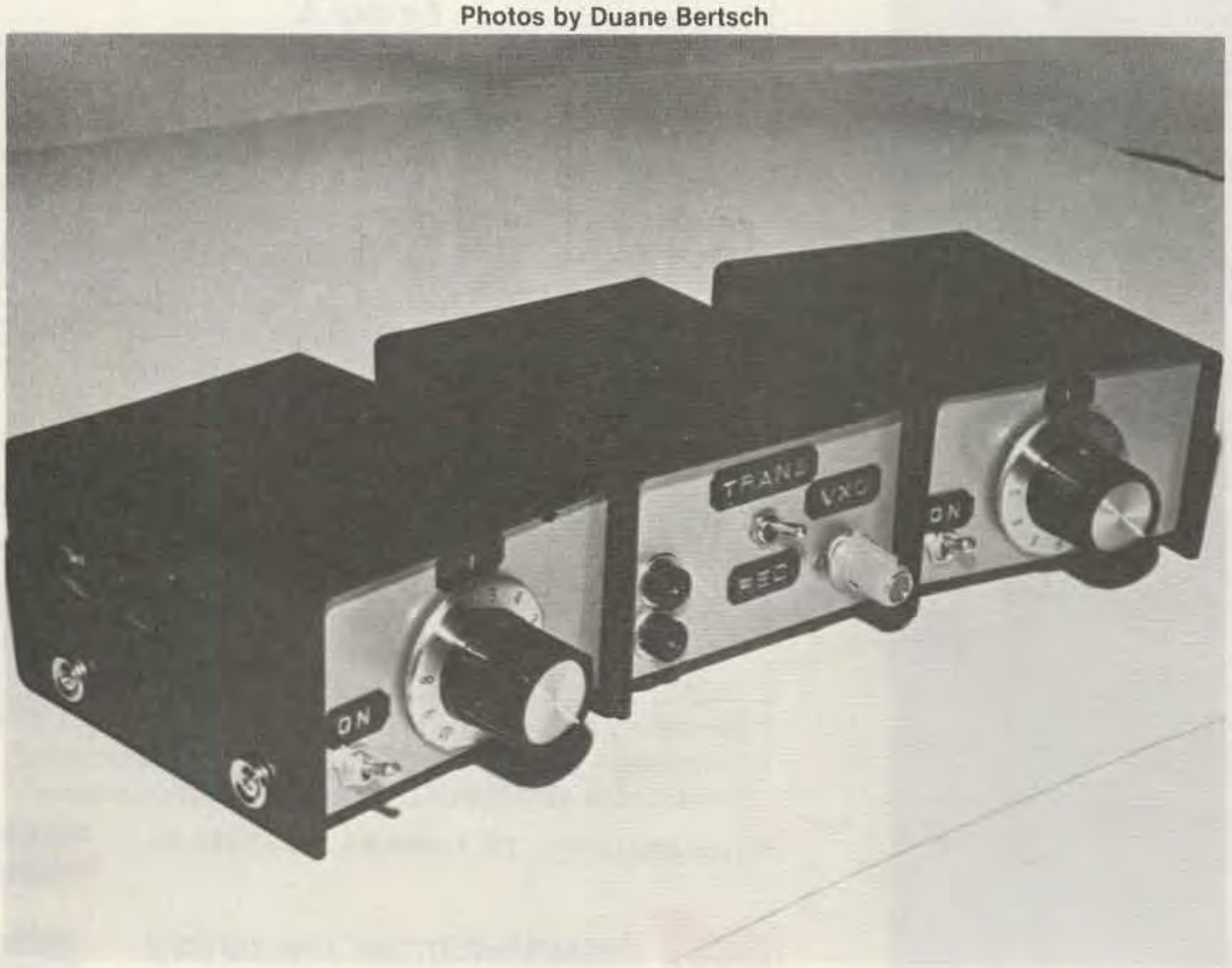
Many amateurs have responded by saying that they need more frequency flexibility for their Fun-Mitters.

The simple vfo described in this article is the result of those requests. It allows greater frequency excursions than the simple vxo circuit of the Fun-Mitter to provide approximately the same frequency coverage as the companion receiver. The vfo follows the same guidelines as the two previous articles and should be as easy (or easier) to construct and to get operational.

For those unfamiliar with my earlier articles, this series of articles focuses on simple, easy-to-construct, easy-to-operate gear with all parts available from local Radio Shack outlets. Size and appearance of the vfo match the transmitter and receiver to provide a nice looking station package.

Of utmost importance is the fact that no modifications have to be made to the Fun-Mitter to use the vfo. It simply plugs in where the crystal was (unless C_{opt} was installed). This allows for either crystal or vfo operation of the Fun-Mitter. Also, it can be constructed for either 40 or 80 meters. It provides about 70 kHz of coverage on 40 meters and about 50 kHz on 80.

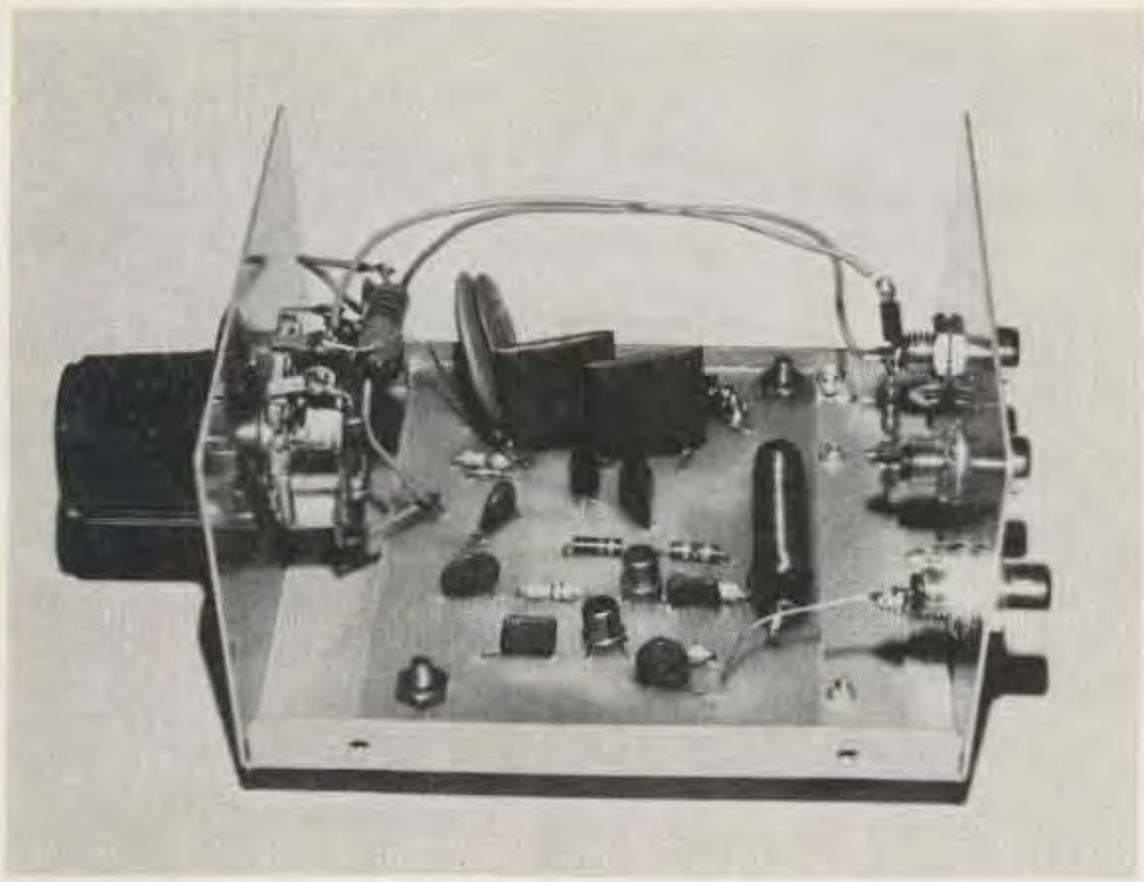
Photos by Duane Bertsch



A Fun-Station!

The Circuit

The vfo should be the most goof-proof of all three pieces of gear as evidenced by the schematic of Fig. 1. The basic frequency-determining portion of the vfo is identical to the vfo of the



Internal view of vfo.

Front view of the completed Variable Fun-Oscillator.

Fun-Ceiver. This allows for ease of understanding and construction as well as similar frequency range.

Before I began this series, I developed a set of guidelines for the items to be designed. Based on this criterion of setting goals in advance, I developed the following goals for the simple vfo.

- Good performance (no chirp, minimal draft, clean waveform)
- Simple construction (PC board use, less than four hours total build time, minimum parts count)
- Cost—less than $20 with new parts
- Minimal modification to the Fun-Mitter
- Full output from the Fun-Mitter
- No variable capacitors or inductors

The final version of the vfo meets the above goals.

Only three transistors are used in the vfo, one as the oscillator (Q1), one as a class-A amplifier (Q2), and one as an emitter-follower buffer (Q3). This final version of the vfo went through three revisions from the original form. This was necessary to maintain good performance while still keeping things simple. The original design included only two transistors, but at times chirp was detected on the transmitted signal. The main advantage of the circuit of Fig. 1 is that only one tuned circuit is used (L1). This means modifying only one inductor!

Q1 operates as a parallel-tuned Colpitts oscillator with L1, CR1, CR2, C1, C2, and C3 being the frequency-determining components. The oscillator is tuned by varying the voltage at the junction of the two diodes. This, in turn, varies the capacitance of the diodes which varies the frequency of the oscillator. L1 is a modified Radio Shack 10-μH rf choke. It is modified, as described later, to provide the needed inductance. The last few turns of the modified choke are spread out over the choke body to provide an easy means of setting the oscillator frequency.

As mentioned in the receiver article, the capacitors needed to build a stable vfo are not easily found at Radio Shack. NPO-type capacitors from a large variety pack again are used in parallel and series combinations to obtain the needed capacitance for C1, C2, and C3. Silver-mica or polystyrene capacitors will give even better results.

Output from Q1 is taken through a coupling capacitor, C4. This capacitor should be kept as small as possible to isolate the oscillator from load variations which can cause chirp. The capacitor is attached to the next stage, Q2, a class-A amplifier. This amplifier raises the level of the signal to the level needed to drive the Fun-Mitter.

Q2 is direct-coupled to the final stage, Q3, an emitter follower. This stage provides excellent isolation between the oscillator and the transmitter as well as providing an impedance match between the two. Without Q3, as in the original design,

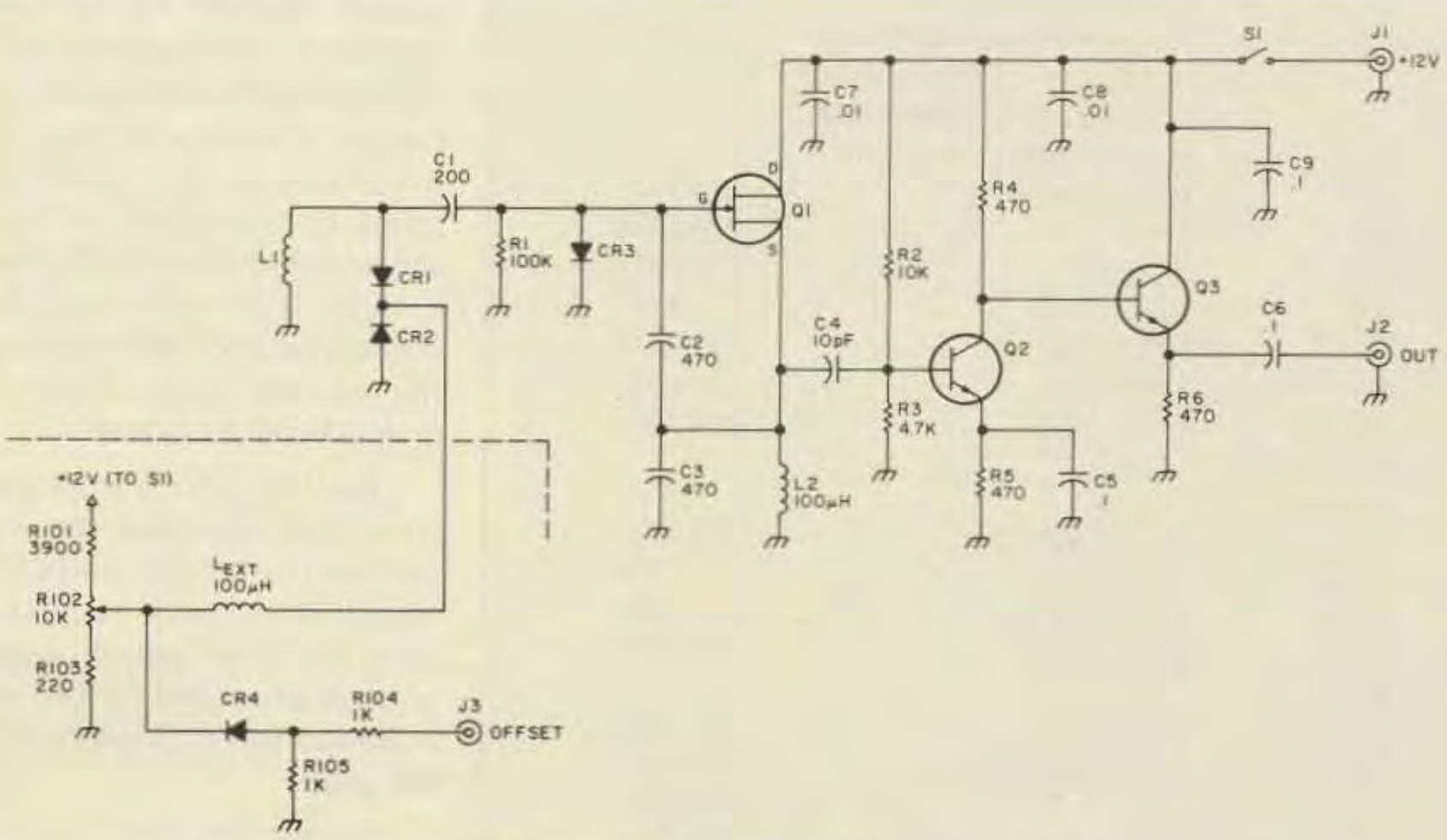
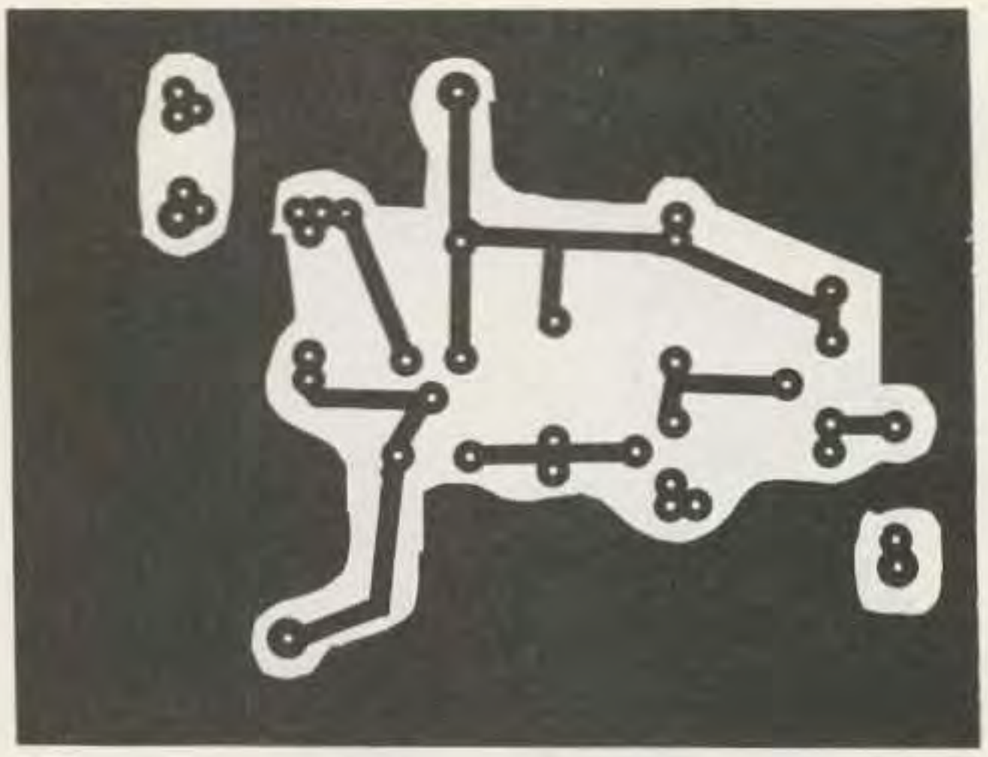
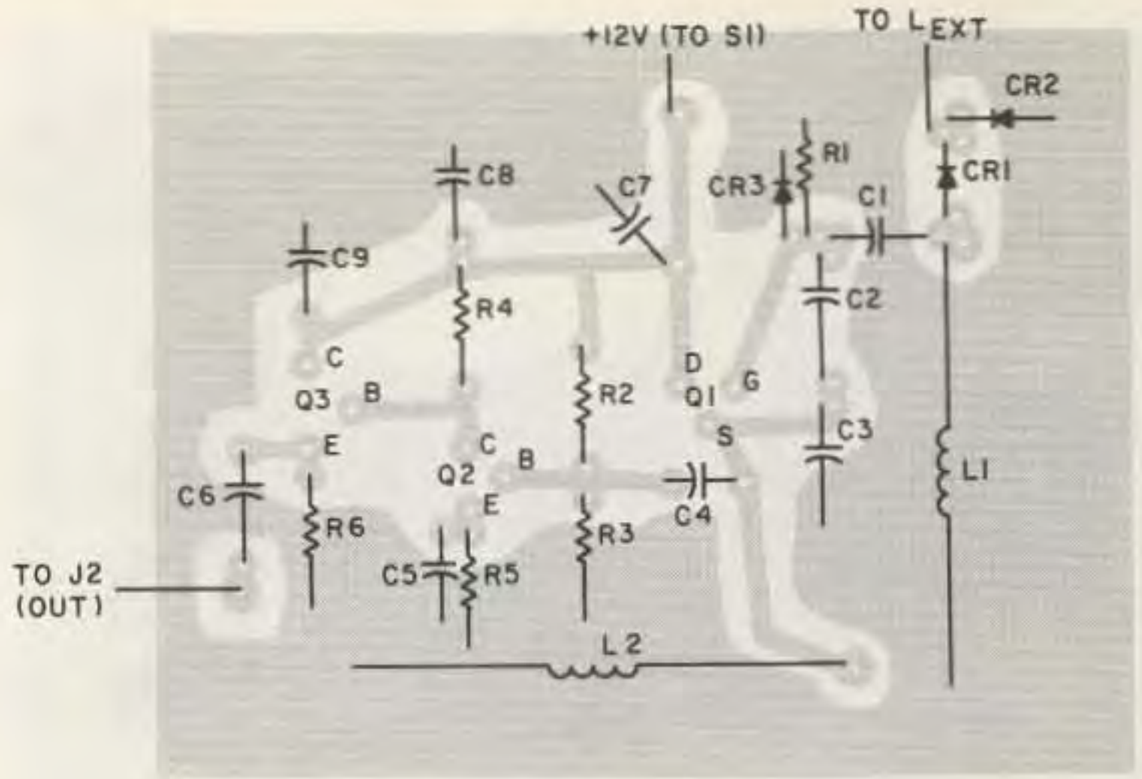


Fig. 1. Schematic of vfo.



PC layout for vfo.



Component location.

PC boards for the vfo are available from the author for $7 ppd. PC boards for the previous articles also are available as follows: Fun-Mitter—$7 ppd; Fun-Ceiver—$7 ppd; Filter—$3.50 ppd.

Parts List

Designator	Value	Radio Shack Part Number
C1	200 pF NPO (approx.)	272-801
C2, C3	470 pF NPO	272-801
C4	10 pF (use two 4.7 in parallel)	2-272-120
C5, C6, C9	0.1 μF	272-135
C7, C8	0.01 μF	272-131
CR1-CR4	1N914 On 80 meters, for CR1 and CR2, use two 1N914s in parallel for each (piggyback)	276-1122
J1-J3	phono jack	274-346
L1	80m: Two 273-101 inductors in series; one with no turns removed, one with 10 turns removed 40m: 10 turns removed from 273-101 inductor. For both 80 and 40 m the last 3 turns of the modified inductor should be spread out over rest of the form	
L2	100-μH inductor	273-102
Q1	FET	276-2035
Q2, Q3	RS2033	276-2033
R1	100k, 1/4-W	271-1347
R2	10k, 1/4-W	271-1335
R3	4.7k, 1/4-W	271-1330
R4-R6	470Ω, 1/4-W	271-1317
Not on PC board:		
L_{ext}	100-μH inductor	273-102
R101	3.9k, 1/4-W	271-1329
R102	10k linear pot	271-1721
R103	220Ω, 1/4-W	271-1313
R104, R105	1k, 1/4-W	271-1321
S1	SPST switch	275-612
case		270-251
knob		274-392

the vfo is not stable when the transmitter is keyed.

CR4 is used to shift the frequency of the vfo when the transmitter is not in use and you are listening to the receiver. It does this by changing the voltage at the junction of CR1 and CR2, which shifts the oscillator frequency. Without this feature, the vfo signal would appear on the listening frequency and make listening impossible!

Construction

The construction of the vfo is intended to be goof-proof. It is built on a 2¼" × 3" single-sided board just as the transmitter and receiver were. It cannot be overemphasized that the circuit should be built on a PC board. Nearly all of the problems that readers had in building the previous two pieces of gear were due to breadboard or point-to-point construction. If you are an inexperienced homebrewer, it is fairly easy to make mistakes when wiring the circuit apart from a printed circuit board.

I built my vfo in an enclosure that matches the enclosures used for both the transmitter and receiver. Also, the front-panel layout was made compatible to enhance the appearance of the gear.

As can be seen in the photographs, the tuning potentiometer (R7) is mounted on the front panel. The associated resistors and inductor (R6, R8, L3) are also mounted on this potentiometer, and wires run from there to the appropriate circuit points.

The rear panel contains three jacks. One is for the vfo output signal, and one is for the vfo offset. The connection between the vfo and transmitter should be made with coaxial cable (RG-174 or RG-58).

Operation

The vfo is best operated with a battery rather than an ac supply. This eliminates any possibility of ac hum on the transmitted signal. It also helps improve frequency stability. Two 6-volt lantern batteries in series will power the vfo for a long period of time. If the Fun-Mitter is powered by batteries, the needed 12 volts can be tapped from those batteries.

Tuning and operation are very easy: Only one adjustment needs to be made—setting the vfo on frequency. This is accomplished in the same manner as was done in the receiver. Using a separate receiver, listen on the frequency you want the low end of the vfo to be set on (for example, 7100 kHz). Drape a length of wire near the vfo and attach the other end to the receiver

antenna input. With the vfo on and warmed up, slowly spread or compress the last few turns of L1 until the vfo signal is heard in the receiver. This adjustment should be done with the tuning potentiometer (R7) fully counterclockwise. Finally, verify that the vfo covers approximately 70 kHz if built for 40 meters and 50 kHz if built for 80. That's all there is to the adjustment.

To operate the vfo, two connections need to be made—one to the transmitter crystal socket and one from the vfo offset input to J3 of the Fun-Mitter. (This jack was added to provide receiver mute operation for the Fun-Ceiver.)

If C_{opt} was not included in the Fun-Mitter, then the vfo signal can be applied directly to the crystal socket terminals (see Fig. 2). If C_{opt} was included, remove its connection and connect that terminal of the crystal socket to ground. An inspection of the Fun-Mitter schematic will reveal that even this step is not necessary if a method can be derived to connect the shield of the vfo cable to ground of the Fun-Mitter. Alternatives such as a rear-panel phono connector on the Fun-Mitter also can be used. A plug can be made easily from two ½" to ¾" lengths of #12 gauge copper wire. Solder the vfo signal and ground leads to these wires and plug them into the appropriate crystal socket pins.

Once the vfo is plugged in and turned on, verify that the transmitter operates as it did before. With the vfo in use and all connections in place, the vfo signal should be heard only when the transmitter is in the transmit mode (due to the vfo offset feature). Zero-beat the vfo with the transmitter in the transmit position and the key down. Remember that when using a direct-conversion receiver, you must zero-beat the correct side of the signal you are listening to.

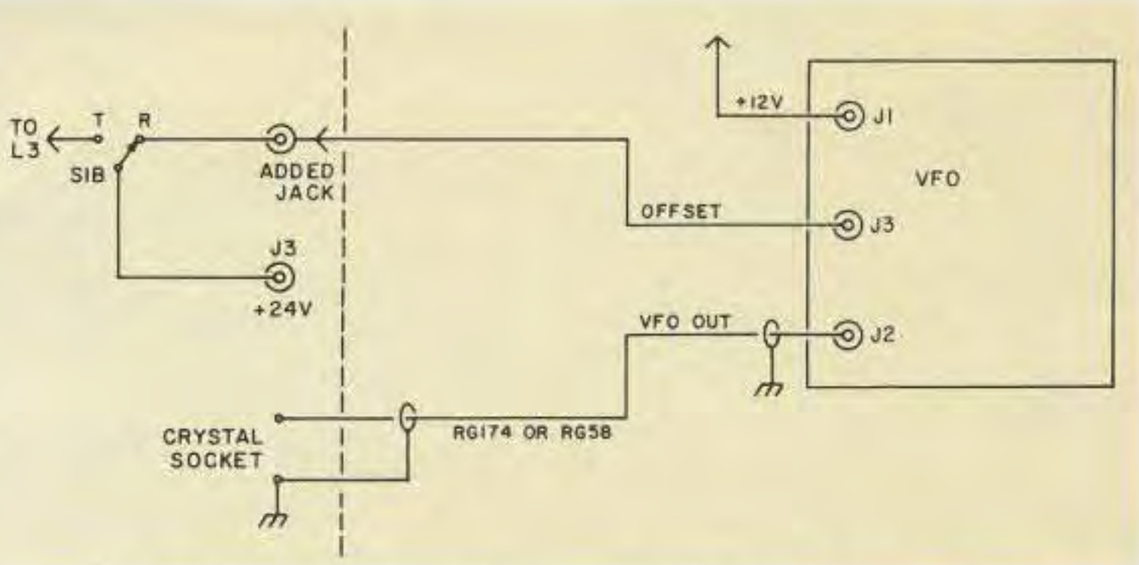


Fig. 2. Connections between vfo and Fun-Mitter.

Crystal operation still can be used by simply removing the vfo leads and plugging the crystal back in.

It should be possible to use the vfo with low-power solid-state transmitters other than the Fun-Mitter. However, modifications may be necessary to the transmitter if the oscillator is not configured as in the Fun-Mitter.

Conclusion

The vfo should be simple to build and goof-proof in its operation. Many more contacts now should be possible due to the ability to move to the frequency the other station is on. This series will be continuing in the months to come with additional goof-proof projects. Meanwhile, enjoy the Variable Fun Oscillator! ■