BY DOUG DeMAW, W1FB

DOUG'S DESK

CONSTRUCTION PROJECTS, TECHNIQUES, AND THEORY

Low-Power Thrills For Less Than Ten Bucks

Now and then we authors receive letters which reinforce our faith that some amateurs still tinker and build. Also, despite the growing belief that CW is passé and should be phased out of amateur radio, many experimenters, ragchewers, and contesters still prefer the CW operating mode. A letter from Al Ayling, F6IDU/W6LFM, contained proof that he built the single-stage QRP transmitter I described in *CQ* in the December 1994 issue. Al added some frills to the circuit. He has been loaning his little rig to other OMs in France in an effort to encourage them toward QRP operating.

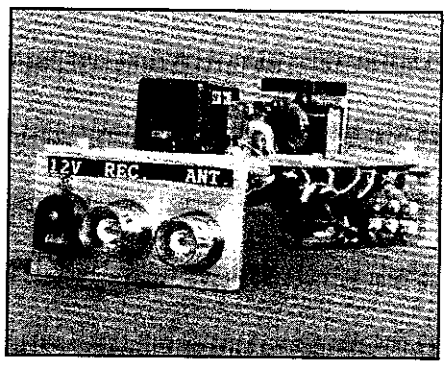

Photo A– The F6IDU QRP transmitter is a modified version of the one described in "Doug's Desk" of December 1994.

This month we will examine the F6IDU version of the W1FB QRP transmitter. Perhaps you will be inspired to duplicate the circuit and try your hand on 40 meters with only 50 MW of RF energy. Surprising distances can be spanned with that level of power if a quality antenna is used.

Circuit Details

Fig. 1 shows the F6IDU transmitter circuit. I had added S2 to permit removal of DS2 during transmit. Although it consumes only 5 MW of RF power, no power should be sacrificed when the maximum power is only 50 MW. I changed the C and L values in the Q1 collector circuit. The original *CQ* circuit used a low-pass filter with a Q of 1. The new values (C2, C3, C4, and L1) are designed to match the Q1 1400 ohm collector impedance to 50 ohms as a tunable pi network with a Q of 8. Efficiency and harmonic suppression have been improved

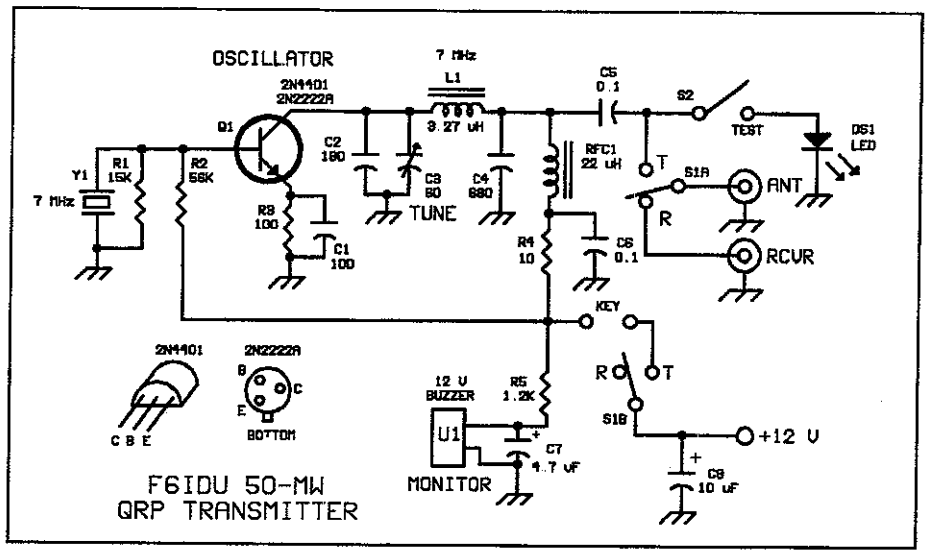

Fig. 1– Schematic diagram of the 50 MW QRP transmitter. Decimal value capacitors are in µF. Others are in pF. C3 is a 60 pF ceramic or plastic trimmer. Polarized capacitors are electrolytic or tantalum. Resistors are 1/4 watt carbon composition. DS1 is a small red LED. L1 has 28 turns of No. 24 enam. wire on an Amidon T50-6 (yellow) toroid core. RFC1 is a miniature Mouser 22 µH RF choke. S1 is a DPDT mini toggle switch. S2 is a SPST mini toggle switch. U1 is a 12 volt buzzer such as a Mouser No 539-PB1622P. Y1 is a fundamental 7.0 to 7.1 MHz quartz crystal.

with these values. C9 is adjusted for resonance at the operating frequency.

F6IDU added U1 to provide cheap and easy sidetone monitoring. U1 is a 12 volt buzzer that can be purchased from Mouser Electronics[1] and some surplus vendors. Al added C7 to lower the buzzer frequency. He included R5 to minimize the current taken by the buzzer. S1A/S1B provides manual T-R switching.

Q1 is a simple oscillator that is similar to a design by W7ZOI.[2] C1 establishes the feedback. A C1 value is chosen to ensure reliable oscillator starting when Q1 is keyed. Some experimentation may be required in accordance with the activity of the crystal used at Y1. C3 is adjusted for a chirpless signal, consistent with maximum output power. A miniature DPDT toggle switch is suitable for use at S1.

Construction Notes

Photos B and C show how F6IDU constructed his QRP transmitter. Some of the components in fig. 1 are missing in the photos because I added them to the circuit after I received his information. Al

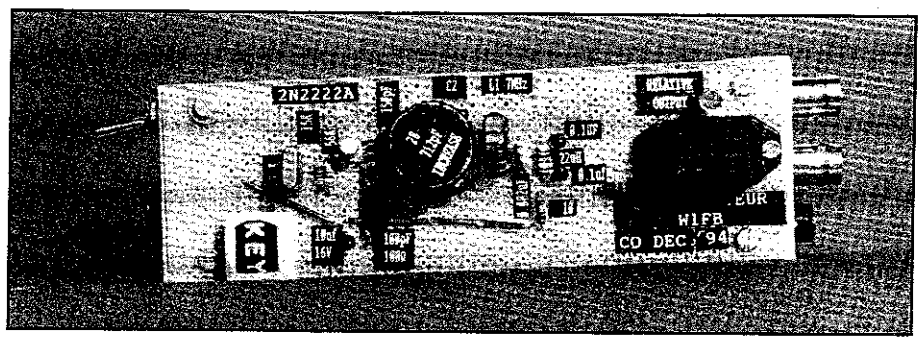

Photo B– Top view of the F6IDU QRP transmitter built on perf board.

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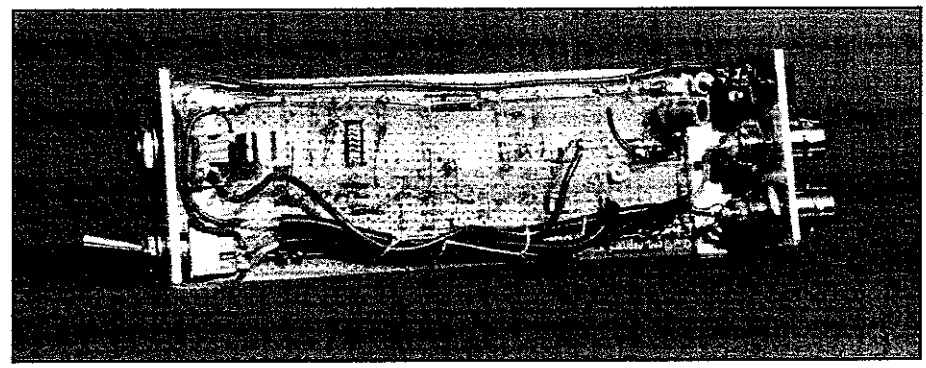

Photo C– Underside view of the F6IDU transmitter.

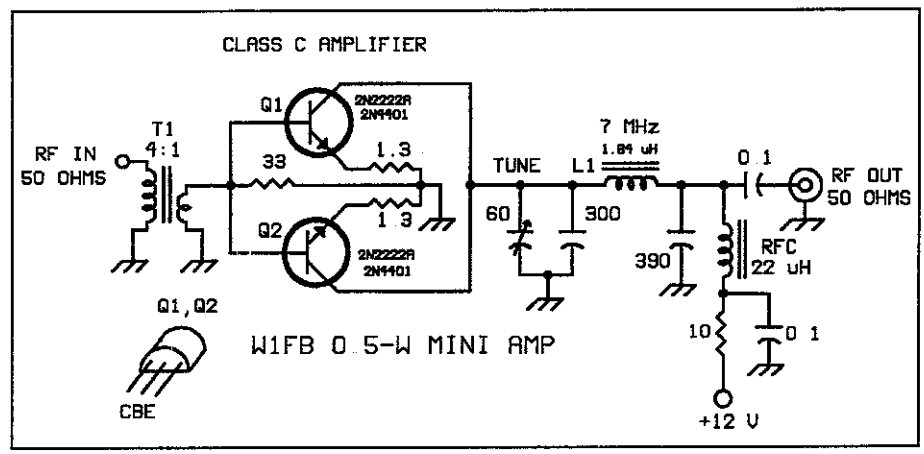

Fig. 2– Schematic diagram of an add-on amplifier that produces up to 500 MW of RF output power when driven by the fig. 1 circuit. Decimal-value capacitors are disc ceramic and are in µF. Others are in pF. The tuning capacitor is a 60 or 100 pF plastic or ceramic trimmer. The 300 and 390 pF capacitors are silver mica or polystyrene. Resistors are 1/4 watt carbon composition. L1 has 21 turns of No. 26 enam. wire on an Amidon T50-6 toroid. RFC is a miniature RF choke. T1 has 16 turns of No. 26 enam. wire on an Amidon FT-37-43 ferrite toroid. The secondary has 8 turns of No. 26 wire.

used perf-board construction. Aluminum end plates serve as panels. Dymo tape labels identify the components. All signal leads should be as short and direct as practicable.

Tune-up and Operation

The antenna should present a 50 ohm load for the transmitter. A Transmatch may be used to ensure an SWR of 1:1. QRP antenna tuners and SWR indicators are described in *W1FB's QRP Notebook*, 2nd edition.[3] Nary a milliwatt should be wasted when using this low a power!

With the antenna connected and S1 in the transmit position, close S2 and observe the LED on key closure. Adjust C3 for maximum LED brilliancy. Turn off S2 and proceed to call CQ or reply to someone else's CQ.

Any receiver may be used with the fig. 1 transmitter. Connect the receiver antenna jack to the antenna jack on the QRP transmitter. S1 of fig. 1 may be changed to a three-pole, two-position wafer or slide switch to permit muting the receiver. A speaker lead may be opened for this purpose if the receiver audio output stage has an 8 ohm resistive load for a termination when the speaker is disconnected.

Build a 7 dB Add-On Amplifier

Impatient QRP operators may find the 50 MW challenge too much to accept in terms of stations worked per a given number of CQs. Another 7 dB of signal strength can be gained by adding the fig. 2 amplifier after the fig. 1 circuit. It uses two 2N4401 or 2N2222A transistors in parallel. The 1.3 ohm emitter resistors serve as ballasting devices to prevent either of the transistors from hogging the current if they are not matched pairs. The little amplifier operates in class C to provide up to 0.5 watts of output power. This equates to a 7 dB signal increase—slightly more than one S unit. If DS1 of fig. 1 is used as a tuning indicator, it will require a resistor between it and the output port of the add-on amplifier. Otherwise the LED may burn out. Use

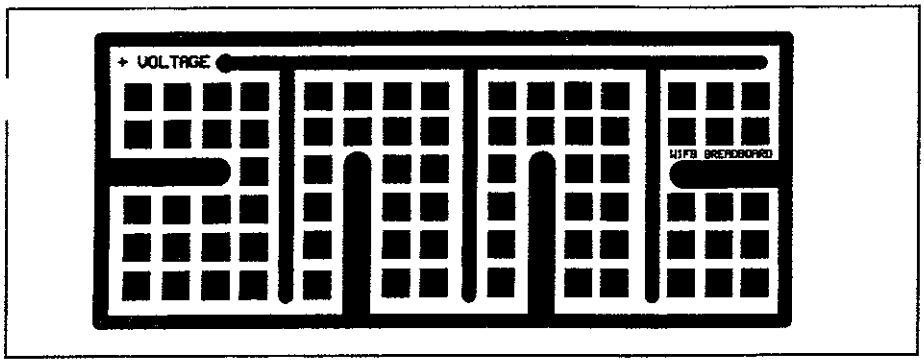

Fig. 3– Scale etching pattern for the general-purpose PC breadboard.

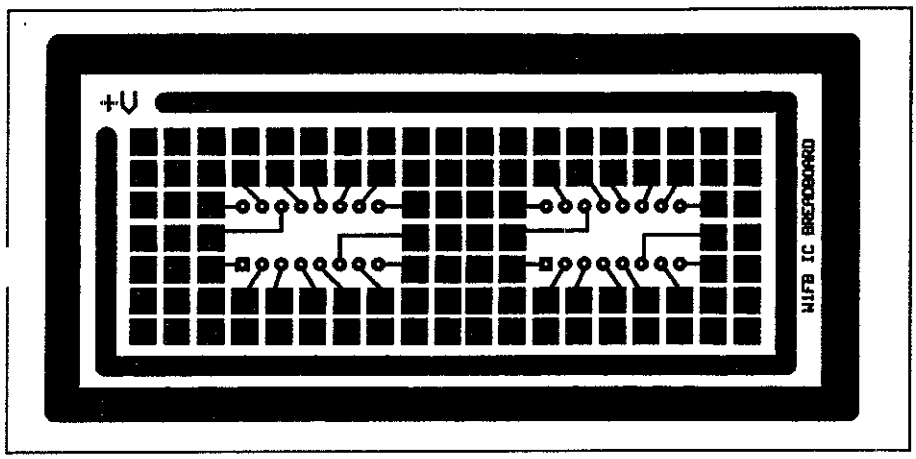

Fig. 4– Scale etching pattern for a breadboard that has two 16-pin DIP IC sites.

a resistor value that barely allows the LED to illuminate when the key is closed. Typical values range from 100 to 330 ohms. Adjust pi-network trimmer C3 for maximum output power. A QRP SWR bridge may be used as a more sensitive output tuning indicator in lieu of the LED.

Keep all leads short and direct. The 1.3 ohm resistors should be mounted as close to the Q1 and Q2 emitters as possible.

An Alternative Construction Method

Although perf board is fine for constructing projects of this type, some builders prefer to use PC boards. I designed two PC breadboards that are excellent for all manner of prototype and finished circuits. Figs. 3 and 4 contain scale artwork for both breadboards. The fig. 3 board is for general construction when ICs are not used. Two 16-pin IC sites are found on the fig. 4 breadboard pattern. Any DIP IC from 8 to 16 pins may be mounted on this board. There are ample isolated pads for mounting other components as well. The user may opt for a single- or double-sided PC board format, depending upon his or her requirements. The double-sided board provides a ground plane for enhancement of circuit stability. Double-sided boards are not recommended for VFO or RF filter circuits, due to the capacitors that are formed between the conductors on one side of the board and the ground plane on the opposite side of the board. Etched and plated breadboards, as seen in figs. 3 and 4, are available.[4]

Summary

I hope this article inspires you toward heating your soldering iron, building a simple, inexpensive rig, and trying your hand at QRP operation. Only a modicum of patience and operating technique are required for making contacts at the 50 or 500 MW power levels. More important, if you build these circuits you will experience a sense of accomplishment when that first station answers your CQ.

Footnotes

1. Mouser Electronics, 2401 Hwy. 287 North, Mansfield, TX 76063-4827 (800-346-6873).

2. W. Hayward and D. DeMaw, *Solid State Design for the Radio Amateur*. The ARRL, Inc., Newington, CT 06111.

3. D. DeMaw, *W1FB's QRP Notebook*. The ARRL, Inc., Newington, CT 06111.

4. FAR Circuits, 18N640 Field Court, Dundee, IL 60118 (847-836-9148).

73, Doug, W1FB