By Dan Metzger, K8JWR

Build the "No Excuses" QRP Transceiver

With this simple 40-meter transmitter-receiver combo, your dream of operating a "build-it-yourself" ham station will finally become a reality. No exotic parts are required—so warm up your soldering iron!

"Say… you don't happen to have a few FT-37-43 toroids in your junk box, do you? Or maybe a T-50-6? No? …I didn't think so. How about an MC3362 integrated circuit or a 2N3553 RF power transistor? Well…don't feel bad, almost no one else does, either. I guess my low-power transceiver project will just have to wait until I can find the parts…"

I've been through that scenario half a dozen times in the past decade, and it was always a list of special parts that kept me from building my own solid-state ham station. I was sure that even if I ordered all those special parts, a crucial one would be out of stock or I'd blow one up and have to wait two weeks for the replacement to arrive.

Well, potential homebrewers, there are no more excuses; this QRP transceiver uses no—I repeat, no—special parts. There's not a toroid in it. The 12 transistors are all garden-variety 350 mW types and the only integrated circuit is the dirt-common LM386 audio amplifier. The hardest part to scrounge is a transmitter crystal for your favorite patch of 40 meters.

Still not convinced? Here's a list of features to help nudge you off the fence.

- The transmitter and receiver are completely separate. One can be built first and then the other, so the whole project doesn't have to be tackled at once. (The transmitter can be started first. It's easier—and is something to brag about on the air.)
- Power output is an ample 2.5-3 W—about half an S unit below the QRP full-gallon of 5 W.
- The transmitter is VXO (variable crystal oscillator) controlled, to give crystal-controlled frequency stability and the ability to change frequency by a few kHz to get away from interference.
- The receiver uses a superhet design with a crystal filter and offers true single-signal selectivity. (Most "simple" homebrew receivers use regenerative or direct-conversion circuits, which effectively double the perceived amount of interference on the band because they produce a signal on both sides of zero beat.)
- The receiver has audio-derived automatic gain control (AGC) to save the ears when a strong station comes on.
- A frequency counter can be connected to display both transmit and receive frequencies. I used the UniCounter[1] on these examples and it fit right into the case.
- All of the circuits can be built on an unetched copper-clad board using ground-plane construction; you can procure a ready-made board[2] or etch a board using the available pattern and parts-placement guide.[3]

If that's not enough persuasion, I'm not sure what is! Figure 1 shows the two versions I built: a ground plane on the left and a printed-circuit version on the right. Now let's take a look at the innards.

Transmitter Circuit

See Figure 2. Q1 is a crystal oscillator that feeds buffer Q2 and drivers Q3 and Q4. Q2, Q3 and Q4 are untuned switching transistors that switch class C final amplifiers Q5 and Q6 from saturation to cutoff as quickly as possible. The finals are able to put out about 3 W of RF while dissipating only 0.5 W each under continuous key-

[1]Notes appear on page 34.

Figure 1—Two versions of the "No Excuses" QRP transceiver. The "ground-plane" version is at the left; the printed circuit version, at right.

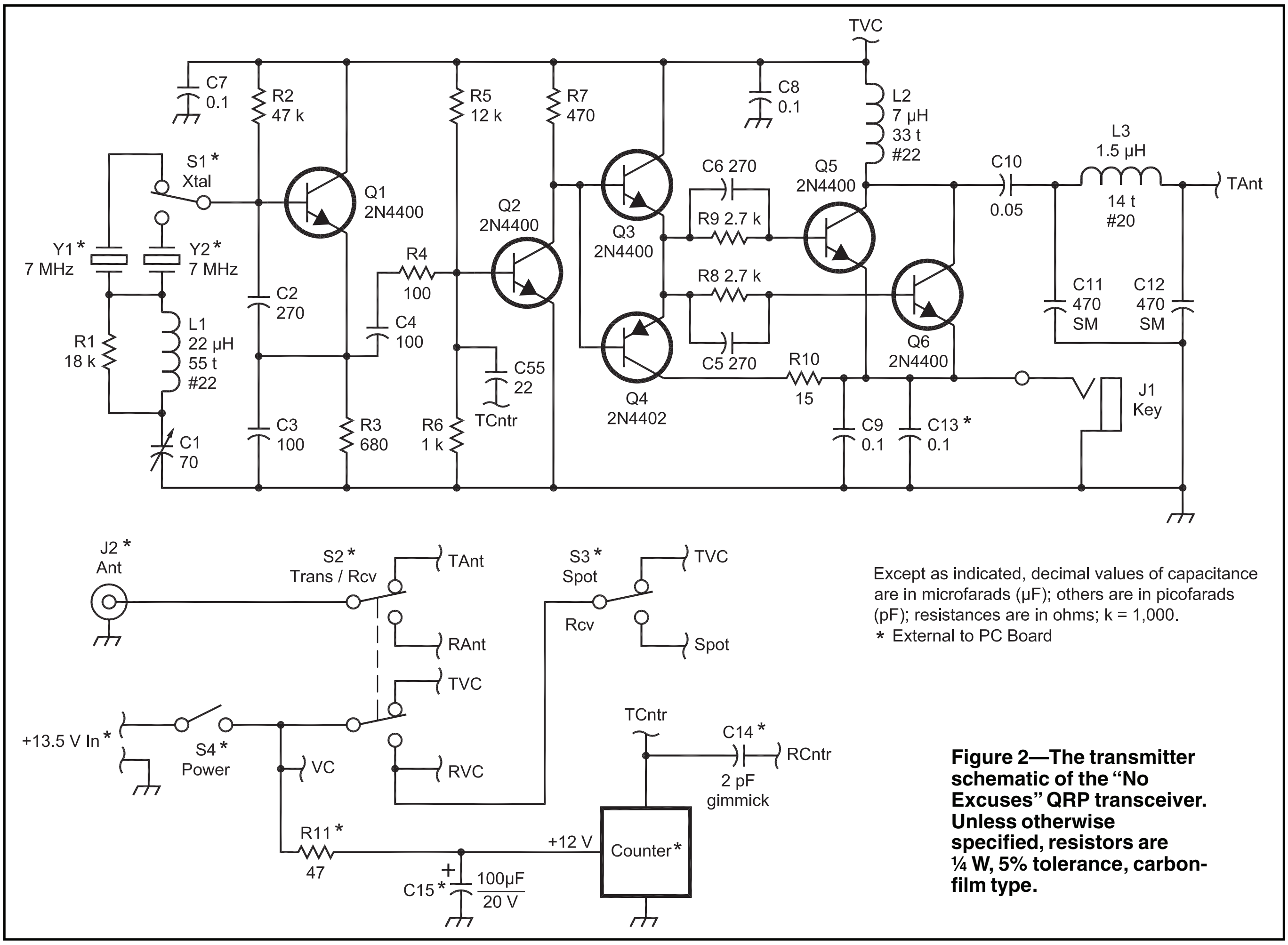


Figure 2—The transmitter schematic of the "No Excuses" QRP transceiver. Unless otherwise specified, resistors are ¼ W, 5% tolerance, carbon-film type.

down condition—which is quite safe if a ½ × ¾" metal plate is super-glued to the flat face of each transistor as a heat sink. The transistors will survive a brief key-down period while feeding a badly matched or disconnected antenna, but I wouldn't make a habit of doing that!

The oscillator and buffer run continuously during transmit, while the drivers and final amplifiers are keyed. The emitter current of Q5 and Q6 consists of square pulses that are rich in harmonics. If this current were flowing in the key leads it would produce considerable RFI, so an additional 0.1 µF bypass capacitor is soldered right across the key jack (J1). In stubborn cases, an RF choke (10 turns of #22 enameled wire wound on a 1 MΩ, 1 W resistor), in series with the key lead may be needed. The Q2-Q6 signal chain is direct-coupled, so it's important that voltage divider R5/R6 biases Q2 *on* in the event of oscillator failure. This keeps Q5 and Q6 *off* so they don't draw excessive current.

The oscillator frequency can be "pulled" below the marked crystal frequency by adjusting capacitor C1 (70 pF) toward maximum capacitance. The amount of "pull" varies from about 1 to 2 kHz to more than 10 kHz, depending on the characteristics of your crystal and whether or not you elect to use L1 and R1 (see below). The crystals from Ocean State Electronics can be offset about 8 kHz if that circuit is used.

Coil L1 (22 µH) is rather critical, and some experimenting may be necessary to find the right value. It was found that a value of 20 µH cut the tuning range in half, while a value of 24 µH put the oscillator in a free-run mode, well outside the ham band. It was also found that slug-tuned coils and coils wound with finer #28 wire did not work well. If experimentation hassles are to be avoided, L1 and R1 can be omitted altogether, replacing them with a short circuit (jumper). The QSY range of the transmitter will be reduced to 1 or 2 kHz, but oscillator stability won't be a problem.

Transmitter Tune-Up

There is nothing to tune in this transmitter save for the aforementioned fiddling with L1 to get the greatest frequency range while maintaining a stable signal. It is worth mentioning that L3 must be wound with #20 wire (or larger) and that C11 and C12 must be silver mica types. If smaller wire is used or ceramic caps are substituted, quite a bit of RF will be lost at the output. It may also be worthwhile to try different transistors at Q1 through Q4. It was possible to raise the RF output by 0.5 W by swapping transistors here and there. If a transistor checker is available (now on many digital volt-ohmmeters,) try to match the betas of Q5 and Q6, in order to equalize the current gain of the parallel final amplifier transistors. These transistors can also be selected for maximum output.

Also, if a 60 MHz oscilloscope is available, observe the waveform at the antenna. It should be a clean, symmetrical sine wave. If it's lopsided, there is second or third harmonic content present. Try minor adjustments to L3, C11 and C12. If a ragged-looking trace is seen, higher order harmonics and RFI are present. Try to improve the grounding or power supply bypassing or use a better-regulated power supply.

Receiver Circuit

There's nothing fancy to understand here (see Figure 3). Two fixed-tuned cir-

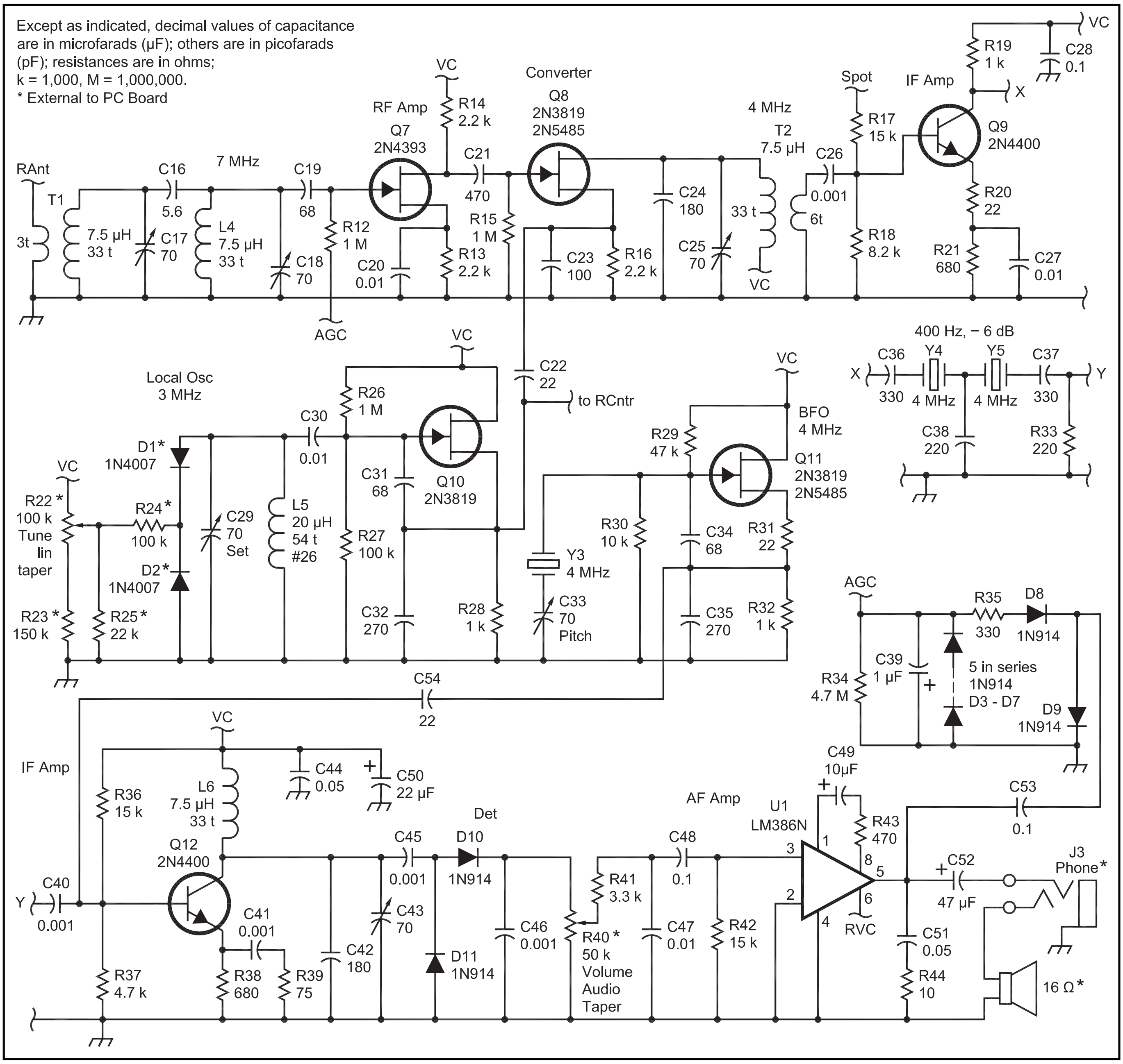


Figure 3—The receiver schematic of the "No Excuses" QRP transceiver. Unless otherwise specified, resistors are ¼ W, 5% tolerance, carbon-film type. Coils are wound of #22 wire, except L5, as noted.

cuits limit the passband of RF amplifier Q7 to signals near 7 MHz. The RF amplifier provides a maximum gain of 5 or 10. The amplified 7 MHz signal is mixed with a 2-V P-P signal at 3 MHz from local oscillator Q10, which produces a 4 MHz difference signal at the output of converter Q8. The 4 MHz IF signal is amplified by Q9, limited to a 400 Hz bandwidth by crystal filter Y4-Y5 and amplified further by Q12.

The beat frequency oscillator (BFO) stage, Q11, runs about 1 kHz above 4 MHz and its signal is combined with the 4 MHz signal in Q12. The nonlinearity of detector diodes D10-D11 causes an audio difference signal of about 1 kHz to appear at the top of volume control R40. The audio is amplified by the LM386 IC and is fed to headphones or a small speaker. A portion of the audio is rectified by diodes D8-D9 to produce a negative dc voltage that biases the gate of RF amplifier Q7. Audio levels above a few volts peak-to-peak, which would be hard on the ears, produce enough negative bias to drive Q7 into cutoff, reducing its gain to one or less, thus keeping the volume below the "pain" level. All receiver circuits except the audio amplifier are powered continuously to minimize frequency drift.

Choosing Receiver Components

Transistors Q7, Q8 and Q11 can be just about any N-channel junction FETs, provided that the drain current drops to near zero with a gate voltage of –2 V or less. If the AGC loop is to keep the volume at a pleasant level, be sure to use a FET for Q7 that cuts off close to –1 V.

Figure 4 shows a simple test circuit for determining each FET's cutoff voltage. Many different FETs are labeled "2N3819," and some have gate turnoff voltages of –5 V or more. (Conversely, some may be suitable for this project; hence the usefulness of the tester.) The tester won't be necessary if some 2N4393s are used, as these already have the required low gate cutoff voltage and experimentation probably won't be necessary.

Table 1
Parts List

For part numbers in parentheses, OS = Ocean State Electronics, 6 Industrial Dr, Westerly, RI 02891; voice 800-866-6626, fax 401-596-3590; **www.oselectronics.com**.

C1, C17, C18, C25, C29, C33, C43—7-70 pF ceramic trimmer (OS TC-777).
C2, C5, C6, C32, C35—270 pF disc ceramic (OS CD270-1).
C3, C4, C23—100 pF disc ceramic (OS CD100-1).
C7, C8, C9, C13, C28, C48, C53—0.1 µF monolithic (OS CM104).
C10, C44, C51—0.05 µF ceramic disc (OS CD05-5).
C11, C12—470 pF silver mica (OS CSM470).
C14—Gimmick capacitor made of twisted wire.
C15—100 µF, 25 V electrolytic (OS CEA100-25).
C16—5.6 pF disc ceramic (OS CD5.6-1K).
C19, C31, C34—68 pF disc ceramic (OS CD68-1).
C20, C27, C30, C47—0.01 µF disc ceramic (OS CD01-5).
C21—470 pF disc ceramic (OS CD470-1).
C22, C54, C55—22 pF disc ceramic (OS CD22-1).
C24, C42—180 pF disc ceramic (OS CD180-1).
C26, C40, C41, C45, C46—0.001 µF disc ceramic (OS CD001-5).
C36, C37—330 pF disc ceramic (OS CD330-1).
C38—220 pF disc ceramic (OS CD220-1).
C39—1 µF, 50 V electrolytic, axial (OS CEA1-50).
C49—10 µF, 25 V electrolytic, axial (OS CEA10-25).
C50—22 µF, 25 V electrolytic, radial (OS CEA22-25).
C52—47 µF, 25 V electrolytic, axial (OS CEA47-25).
D1, D2—1N4007 (OS 1N4007).
D3-D11—1N914 (OS 1N914).
J1, J3—Key and earphone jacks, ¼-inch (OS 30-412). Bend to keep circuit open or use smaller 3.5-mm size (OS 30-702J).
J2—Antenna chassis connector, SO-239 style (OS 25-5630) or smaller BNC style (OS 27-8460) or RCA-type phono style (OS 30-428).
J4—Binding posts for 12 V power (OS 90-799, black; OS 90-800, red).
L1—22 µH (55 turns #22 enameled wire wound on a "New Home" type sewing machine bobbin).
L2, L4, L6—7.5 µH (32 turns #22 enameled wire on sewing machine bobbin).
L3—1.5 µH (14 turns #20 enameled wire on sewing machine bobbin).
L5—20 µH (54 turns #22 enameled wire on sewing machine bobbin).
Q1, Q2, Q3, Q5, Q6, Q9, Q12—2N4400 (OS 2N4400). or 2N4124 or similar NPN (see text).
Q4—2N4402 (OS 2N4402), or 2N4126 or similar PNP.
Q7—2N4393 (OS 2N4393), or similar N-channel JFET with 1 V gate cutoff voltage.
Q8, Q11—2N5485 (OS 2N5485), or selected 2N3819 or similar N-channel JFET with –2 V gate cutoff voltage (see text).
Q10—2N3819 or MPF105 (OS 2N3819).
R7—470 Ω, ½-W carbon film resistor.
R22—100 kΩ linear potentiometer (OS P100K).
R40—50 kΩ audio taper potentiometer w/switch (OS PAS50K).
S1, S3—Min SPDT switch (OS 10002).
S2—Min DPDT switch (OS 10012).
S4—SPST switch, part of R40.
T1—7.5 µH (32 turns #22 enameled wire wound on a "New Home" sewing machine bobbin, with 3-turn primary wound over top).
T2—7.5 µH (32 turns #22 enameled wire on sewing machine bobbin, with 6-turn secondary wound over top).
U1—LM386N audio amplifier IC (OS LM386N).
Y1—Crystal, 7.040 MHz (OS CY7040).
Y2—Crystal, 7.030 MHz (OS CY7030).
Y3-Y5—Crystal, 4.000 MHz (OS CY4).

Miscellaneous
Transistor sockets (12), (OS T3400); IC socket (1), (OS LP8); knobs (3); crystal socket (FT-243 type), OS CS243 (HC6/U type) (OS CS6U); Octal socket (OS STM8). 3" × 7" × 5" (HWD) chassis box for the printed circuit version (or larger for the ground-plane version).

The three receiver crystals should all be of the same type, from the same manufacturer and production lot. Crystals with different characteristics will probably not work well together, even if they are all marked 4.000 MHz.

The receiver is tuned by varying the reverse bias voltage on a pair of ordinary rectifier diodes; this varies their junction capacitance. Common 1N4004s will work, but it was found that the 1 kV PIV 1N4007s were more temperature stable. ("varicap" diodes were tried, too, but the 1N4007s worked just as well). Some experimenting may be necessary to find a pair of diodes that give the desired tuning range. It is important that the tuning potentiometer, R22, has a resistance curve that varies smoothly or the tuned frequency will jump erratically. Test this potentiometer on a digital volt-ohmmeter by picking a few random resistance values and see how difficult it is to repeatedly set the pot to exactly those values on the meter. It is possible to eliminate the diode tuning scheme altogether, by lifting diode D1's anode lead or by not installing R22 through R25, D1 and D2. An air-variable capacitor of about 50 pF can then be wired across C32 in order to tune the receiver.

Coil Winding

All of the coils for this project are wound on plastic bobbins made to hold the lower thread in "New Home" brand sewing machines. These bobbins are readily available from most sewing stores for about 50 cents each. The bobbins have holes in the sides that you can feed the wire ends through to keep the coil from unwinding. There are no tapped coils in this project, no bifilar windings and nothing else to confuse the builder.

Two of the receiver coils require the winding of a few turns over the main winding to make a transformer, and for that two more holes will have to be drilled to let the extra wire leads out, but that's about as complicated as it gets. The coils can be wound by hand, but a simple coil winder will make things neater and the winding easier. The coil winder used to wind these coils consists of a 3/16 × 4-inch bolt with a crank made from a piece of coat hanger soldered to the bolt head, one nut to cinch the bobbin and a second nut (held in a vise) to hold the bolt and coil steady as the crank is turned. The coil winder in use can be seen in the photograph (Figure 5). Figure 6 shows the number of turns to wind for any value of inductance up to 35 µH and is useful if you experiment with L1 and the other coils.

Receiver Alignment

Adjust C29 for a 3 MHz signal from the local oscillator using a frequency counter at the source of Q10 or a general-coverage receiver tuned to 3 MHz. Then check for a 4 MHz signal from BFO Q11 in the same manner. Now, as trimmers C17, C18, C25 and C43 are adjusted, some signals, or at least some band noise, should be audible. Adjust these trimmers for maximum volume. An antenna should be connected for these adjustments.

If self-oscillation (a loud "screech") is heard, increase the value of R20 to 33 or 47 Ω to reduce the gain of stage Q9. Tune in a CW signal for maximum volume, regardless of pitch. Now adjust trimmer C33 for the desired pitch. The signal on the other side of zero beat should be barely audible if the circuit has been adjusted correctly.

At night, short wave AM broadcast stations may be heard in the back-

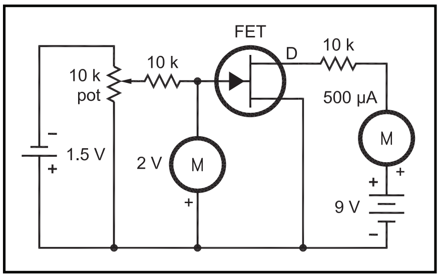


Figure 4—FET test circuit for selecting FETs (may not be necessary; see text). Adjust the potentiometer for a drain current of 10 µA and read the gate cutoff voltage on the voltmeter.

Put the "No Excuses" on 30

Here are the circuit changes necessary to put the "No-Excuses" Transceiver on 30 meters. Please note the parts revisions in Table A. The same circuit board can be used; it will accommodate all of the necessary changes.

To eliminate the varactor circuit in order to save a few components and revert to a more traditional tuning method, either lift the anode of diode D1 (the side that connects to the gate of Q10) or remove R22, R23, R24, R25, D1 and D2. The receiver is then tuned with a 40 pF air-variable capacitor in parallel with C32. Diode tuning can still be used if the builder desires, however.

There are several powerful shortwave broadcast stations just below the 10 MHz band. The 2 element crystal filter in the IF stage has an off-frequency feedthrough that is only 32 dB down from the passband and those AM signals may come crashing through. Quite a bit of relief can be obtained by adding a low-Q series-resonant circuit at the crystal filter output. The filter, comprised of a 6.8 µH inductor in series with a 150 pF capacitor, can be installed across R33. It does not impair normal 4 MHz signals fed through the crystal elements, but it greatly attenuates the off-frequency signals coupled through the crystal holder capacitance.

Table A
Parts Needed for 30-Meter Version

C2—180 pF disc ceramic.
C3—68 pF disc ceramic.
C5, C6—100 pF disc ceramic.
C11, C12—330 pF silver mica.
C16—3 pF disc ceramic.
L3—1.0 µH, 11 turns #18 enameled wire on "New Home" sewing bobbin.
L4—5.2 µH, 28 turns #22 enameled wire on bobbin.
L5—5.2 µH, 28 turns #22 enameled wire on bobbin (oscillator will then be at 6.1 MHz).
R1, L1—Replace with a single 100-Ω resistor. The frequency shift will then be +4 to +5 kHz.
T1—5.2 µH, 28 turns #22 enameled wire on bobbin, 2-turn secondary wound over top.
Y1, Y2—Use 10.1 MHz crystals (OS CY1010) (OS CY1011) (OS CY1015) or (OS CY1012).

The transmitter output is 2.5 W on 30 meters. I worked 32 states in 6 weeks with a dipole 25 feet up—and winter propagation hadn't even started yet. So go ahead, get on a new band!

ground. This occurs when two extremely strong stations are exactly 4 MHz apart; their signals mix and get into the IF. This type of interference can be minimized by careful adjustment of C17 and C18.

It was possible to get a 0-100 calibrated knob to read the received frequency to within 2 kHz over the range 7010 to 7055 kHz by using the following procedure:

1) Temporarily replace R23 and R25 with 200 kΩ potentiometers. Set them to mid-range.

2) Adjust R22 for maximum voltage (highest frequency). This will occur 30 to 50 degrees before full clockwise rotation. Set the knob to read the maximum desired frequency (7070 kHz in this case).

3) Adjust R22 for minimum voltage (not necessarily fully counterclockwise) and adjust R23 so the receiver picks up the lowest desired frequency (7000 kHz in this case).

4) Set the R22 dial for mid-range (7035 kHz in this case) and adjust R25 so the receiver picks up that frequency.

5) Repeat steps three and four until the calibration is satisfactory. Remove the potentiometers; measure their values and solder in the appropriate fixed resistors for R23 and R25.

Frequency Readout

When the SPOT switch is thrown, the transmitter's oscillator and driver are on and the receiver's sensitivity is greatly reduced by removing the bias from IF amplifier Q9. This allows the transmitter signal to be heard at a comfortable volume. Learning how to adjust the transmitter frequency for the pitch that "zero-beats" with a desired station will come quickly. A frequency counter isn't absolutely necessary, but it is convenient.

On receive the counter will read 3040 for 7040 kHz, but that shouldn't present a problem. The receiver oscillator signal is coupled to the counter by bringing a piece of hookup wire from the source leg of Q10 close to the counter input wire, or twisting the wires together for a turn, if necessary. This forms a "gimmick" capacitor of 1-2 pF. On transmit, the 22 pF from the base of Q2 couples a signal to the counter that overpowers the weakly coupled receiver input and the counter reads the transmitted frequency.

Construction Notes

The first version of this radio was actually built on a couple of solderless breadboards. The second, a "ground-plane" version, was built on an unetched piece of copper-clad board, 4½ × 6½-inch in size, and housed in a 3×7×5-inch (HWD) aluminum box. See Figure 7. (It all fit, but a bigger box would have been better.)

The photographs show how chips of copper-clad board about 3/16-inch square are super-glued to the copper surface to form the connecting points. The unetched board forms a "ground plane" beneath the circuit and aids in decoupling adjacent stages. This version uses an air variable

Figure 5—Winding the coils using the author's winding fixture (see text). A third hand is helpful!

for both transmitter and receiver frequency control, with a vernier drive on the receiver tuning capacitor. It also uses a front-mounted crystal socket, with the UniCounter mounted on the back panel with a bundle of wires connecting the front-mounted display to the counter electronics. This version works well, but some of the parts are hard to find and some of the wiring is a little difficult. The third version uses an etched circuit board available from FAR Circuits,[4] and fits easily into the 7×5×3-inch box (Figure 8). Circuit board artwork is available for those wishing to "roll their own" board. This transceiver uses an easy-to-find trimmer capacitor for transmitter frequency control; a piece of 1/8-inch diameter rod is soldered to its screwdriver slot so a knob can be used. It also uses a potentiometer with common diodes (1N4007), which are used as "varicaps" to tune the receiver. It dispenses with the vernier drive and the air-variable capacitor. The pin arrangement of the transistors on the circuit board is always E-B-C (S-G-D for FETs), reading clockwise when viewed from the bottom.

The receiver frequency tends to drift 100 Hz or so if air currents pass over the diodes, so keep its box closed. If a small air variable is available, you may want to consider using it rather than the diodes

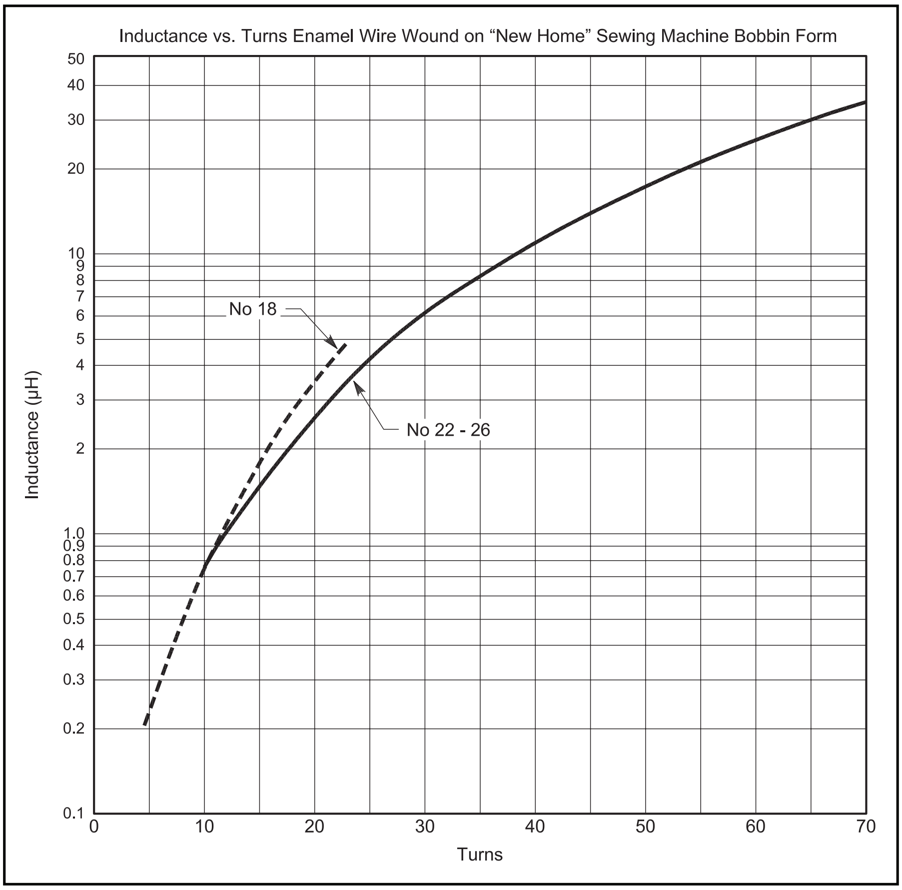


Figure 6—Inductance versus turns, for coils used in the "No Excuses" QRP transceiver.

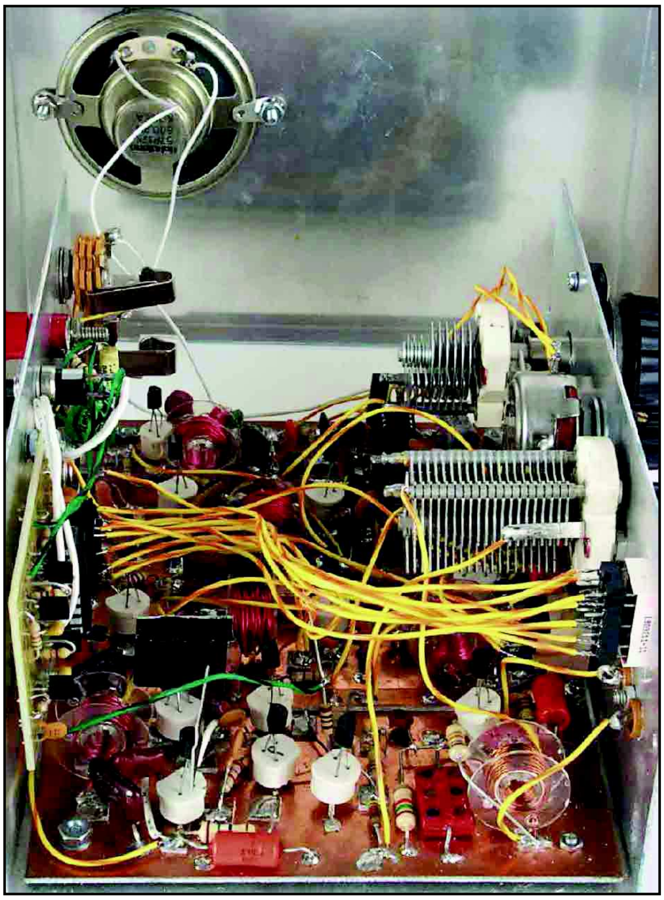
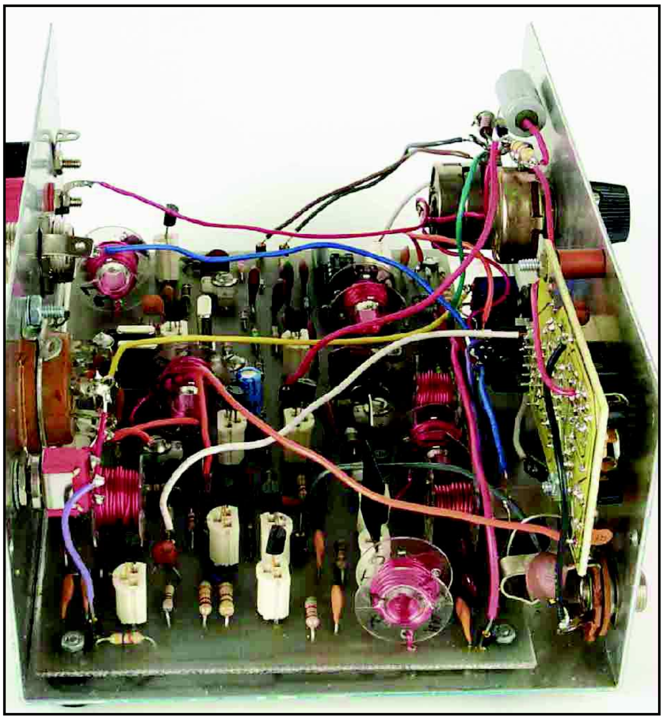


Figure 7—Inside the "ground-plane" version. A small speaker can be seen mounted to the cover, as well as the "remoted" display for the UniCounter (see text) and the air-variable capacitors.

Figure 8—Inside the printed circuit version. An octal tube socket accommodates two crystals; these are switch selected. The UniCounter can be seen mounted on the front panel.



to control the receiver's frequency the old-fashioned way. The final version uses an octal tube socket that holds two old-style FT-243 crystals and a switch to quickly change between them. HC6/U crystals with a suitable socket can be used. If the modern HC-18 type crystals with wire leads are used they can be soldered in without a socket.

The antennas and keys at this station are set up for use with tube-type radios, so a large SO-239 antenna connector and ¼-inch key and headphone jacks were used to stay compatible with the rest of that equip-ment. A smaller BNC or a less costly RCA-type phono connector for the antenna can be used, as well as the smaller 3.5-mm jacks for the key and headphones. They are listed in the parts list—see Table 1.

Modifications

This transceiver was run from a well-regulated 13.5 V dc supply so there was no need to re-regulate the voltage to the receiver frequency control pot, R22. If mobile power, battery power or an unstable dc source is used, a 10 V Zener diode or a 78L08 regulator to "clamp" that voltage should be employed.

Several hams have suggested using easier to find 3.58 MHz crystals instead of the 4 MHz crystals. That wouldn't present a problem; however, the receiver frequency would not read out nicely on the counter. The UniCounter has a programmable offset that would solve that problem, but then the counter wouldn't read right while transmitting.

Forty meters can be called the "7/24 band." Except during a rare solar storm it's open for business day and night, summer and winter, during all 11 years of the solar cycle. It's doubtful that can be said of any other HF ham band. Still, some folks have asked if the "No Excuses" rig could be put on other bands.

For 80 meters you'd have to add some turns to the RF coils to move the tuned circuits to 3.5 MHz and use fewer turns on L5 to move the oscillator to 7.5 MHz. For 30 meters the local oscillator should run at 6.1 MHz and the RF coils should have fewer turns to cover 10.1 MHz. The sidebar provides details for building a 30-meter version of this project.

Considering my experiences with "varicap" tuning, it would be preferable to use an air variable capacitor in the local oscillator for operation on frequencies other than 7 MHz. You shouldn't attempt operating at 14 MHz or higher with this design, as that would require frequency doubling in the transmitter and a rather different circuit. It would also be pushing the limits of these common garden-variety transistors.

On the Air

How does the "No Excuses" rig perform on the air? The receiver is quite sensitive if you use a proper antenna. Most anything can be heard on the receiver that a modern, solid-state transceiver can hear. It doesn't do that well with short, random-length wires and other nonresonant antennas, so use a proper antenna and cut it to frequency.

Overall, the receiver tuning is more critical and the QRM filtering isn't quite as good as a modern commercial receiver. The transmitter gets consistent praise for having a clean, stable signal with good keying characteristics.

If you are new to low-power operation you may experience some frustration when the station calling CQ always seems to answer someone else with a stronger signal. One just has to learn to "tail-end" ongoing QSOs or call on an open spot near the 40 meter QRP calling frequency of 7040 kHz.

This little transceiver has afforded many hour-long ragchews and 599 reports from stations within a 500-mile radius, using a dipole antenna at 25 feet. Contacts with the West Coast (from near Detroit) tend to last about 10 minutes and draw 459 reports, but they are not rare. And four or five times, very late on a cold winter night, I've worked Western Europe on the low end of 40 meters.

I hope your interest has been sparked. Whatever you do, don't wait to get started. Build this simple—yet useful—circuit to put your own homebrew station on the air. You'll be surprised with its capabilities!

Notes

[1]R. Stone, KA3J, "The UniCounter—A Multipurpose Frequency Counter/Electronic Dial," *QST*, Dec 2000, pp 33-37.

[2]A printed-circuit board is available from FAR Circuits, 18N640 Field Ct, Dundee, IL 60118-9269; tel 847-836-9148. Price: $12.

[3]A circuit board pattern and a parts placement guide are available on the *ARRLWeb* at www.arrl.org/qst-binaries/NoExcusesXcvr1202.pdf.

[4]See Note 2.

Dan Metzger, K8JWR, was licensed as a high-school freshman in 1958 and has held the same call sign ever since. He holds a bachelor's degree in electrical engineering and a master's degree in education from the University of Toledo (Ohio). He has held engineering positions at Magnavox, Toledo Scales and Owens-Illinois, and for the past 35 years has been teaching electronics at Monroe County Community College (Michigan).

Dan has written six textbooks, including Electronics Pocket Handbook, Electronics For Your Future, *and* Microcomputer Electronics. *His construction articles have appeared in* Electronics World, Radio-Electronics *and* Popular Electronics *magazines. As this article implies, he is active primarily on 40-meter CW. Dan can be reached at 6960 Streamview Dr, Lambertville, MI 48144,* dmetzger@monroe.lib.mi.us.

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Price: $69.95. For more information, contact Elk Antennas at 2680 Cherry Ln, Walnut Creek, CA 94597; tel 925-933-3242; rgaschk@constant.com.

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◊ Is your QSL card collection a mess? RadioWarehouse is pleased to present the QFile QSL Storage and Management System, said to enable the active amateur to store and file QSL cards for easy retrieval and recordkeeping. QFile consists of 340 5×8 inch, tabbed, Mylar reinforced index card dividers preprinted with all 335 current DXCC entities and 5 additional blanks. Each divider is printed on the front with a recordkeeping grid for each band (160-2 meters), making it handy for submitting awards. The system can help properly sort your QSL cards when sending them to the Outgoing Bureau. QFile dividers will fit into a standard 5×8 index card box, available at any office supply store, or even a spare shoebox or two. The DXCC edition is now shipping, and the Worked All States version will be available in the first quarter of 2003. QFile is manufactured and distributed exclusively by RadioWarehouse, LLC and can be ordered securely online at www.radio-warehouse.com or via telephone/fax at 704-321-2300. Introductory price is $49.95 plus shipping/handling. Mailing address is PO Box 77001, Charlotte, NC 28271-7000.

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