75 Meter Ham DSB Transceiver

Paul R. Jorgenson KE7HR NSS 39382FE

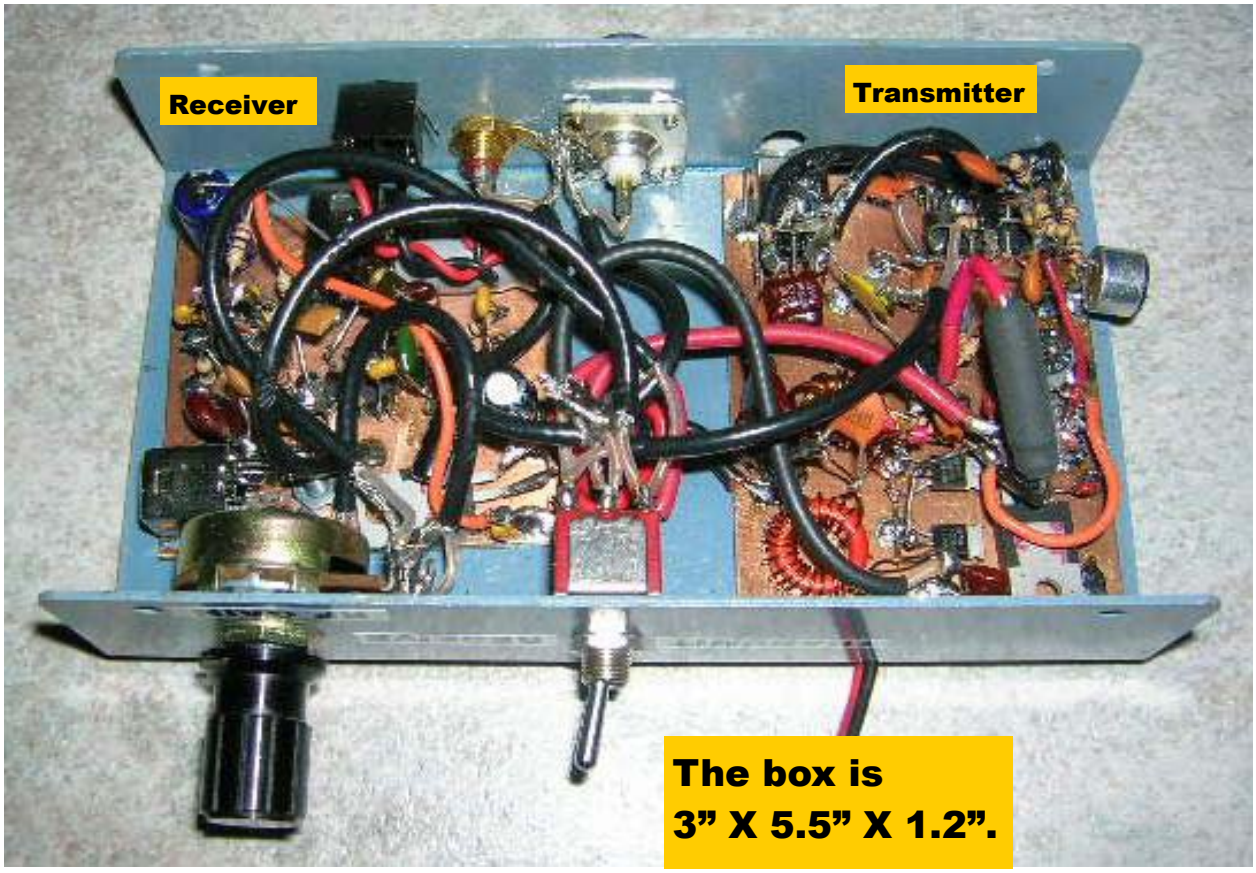
With the success of the 75 and 80 meter ham band experiments that I had done in the past, I wanted to have a simple and inexpensive transceiver to bring underground. The Yaesu FT-817ND is a fine radio, but costs $500 plus. I was looking to get most of the functionality on 75 meter phone with a price tag for building that was more in line with $50. That price point seems to be one that most ham cavers might be able to deal with for their underground communications.

A search of the internet found an amazing array of possibilities. There are several QRP (low power) radio projects that might fill the bill. I chose the "VE7GC Wee Willy 75 Meter DSB Transceiver Project" as the basis for my project. The link to this web page is http://www.qrp.pops.net/willy.htm.

I chose a DSB (double sideband) design for the low parts count, lower complexity, and possibility of completion. SSB (single sideband) transmitters have a parts count that is quite a bit higher to put the radiated power into a single sideband as opposed to radiating both the upper and lower sidebands. At QRP it should not make much difference.

I used 'ugly' or 'dead bug' style of construction and built the transmitter and receiver on different scraps of copper circuit board. The VFO (variable frequency oscillator - tuning control) is one from a kit that I built some time ago and seemed perfect for this project. It is housed in a separate metal box (the seemingly ever present mint tin) for shielding. The external VFO can also be changed to a crystal controlled oscillator, a different type of VFO (maybe digital controlled), or maybe a PTO (permeability tuned Oscillator). With so many options, it made sense to use an external frequency source.

Looking at the circuit and reading the text of the project, I wanted to get a little more power out of the transmitter, so opted to modify the amplifier section so that it ran from the 12 volt battery. I used a voltage regulator to keep the voltage safe for the mixer (an NE602). Since I only had some 7805 5 volt regulators on hand, I used the trick of putting a switching diode in the ground lead to raise the output voltage. I used two diodes in the transmitter circuit and one in the receiver circuit. (In the schematics, my changes from the original are noted in red .) This modification allows the transmitter to



put out about double the power that it originally did - about 2 watts. I found that the regulator also needed a bypass capacitor to keep the RF off of the output or there was some instability.

I only had a couple of the 10 MHz transformers without the capacitors in them (around 5 uH inductance) but had a few with the capacitor in them. Trying to remove the little capacitor was a pain and the capacitor was making up for the fact that these cans had a bit less inductance than the other ones. I tried them in the receiver and they worked just fine without having to change the external resonating capacitors any. I get a nice signal peak with these transformers.

One of the last things that I found out about the VFO that I used was that it could not send power to both the transmitter and receiver at the same time - even though the other unit was not powered. The transmitter and receiver both worked fine on the bench, but when they were put into the box both stopped working. Disconnecting the VFO line to the receiver made the transmitter start working again! The TR (transmit - receive) switch now needed to have three poles instead of two. Luckily, the switch that I had to replace the two pole switch also fit in the same area.

VFO in a mint tin.

Tests with the radio and a dipole antenna show that the receiver is a bit wide banded, hearing transmitters off frequency by a bit, but is quite sensitive. The first night I had it put together, I was hearing stations all the way to the east coast from my house in Phoenix. Stations from TX, OK, NM, CO, AZ, NV, and CA were all very loud and required that I turn down the RF gain control for comfortable listening. For portable use, headphones will be the way to go, but for fixed use the bigger speaker has plenty of volume. Speaking of volume, there is no volume control, per se. The audio amplifier is set to a fixed gain. The RF gain control limits the amount of signal getting through the radio and does a nice job of controlling the audio output.

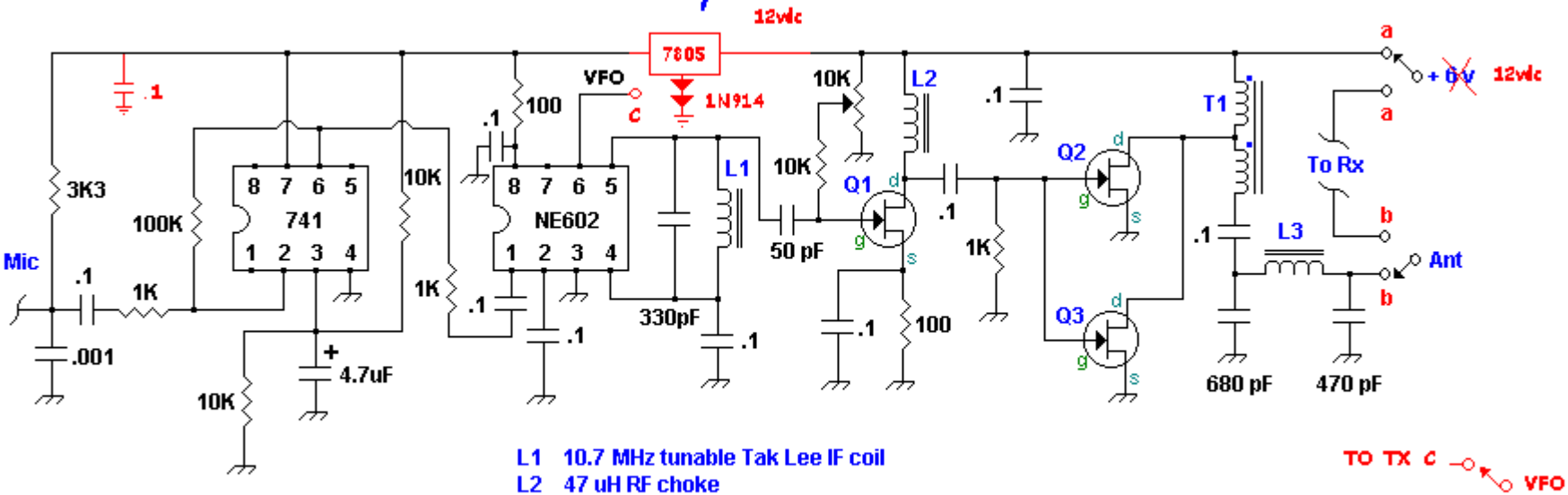
The transmitter has been tested underground. Using a similar power level with the Yaesu FT-817ND has shown that effective communications can be done at least as deep as 220 feet below the surface in dry limestone. I was very pleased. See the article on Grand Canyon Caverns underground radio.

The little electret microphone is mounted to the circuit board. It pokes through the end of the box surrounded by a rubber grommet. The radio is a 'handheld' (box size is 3" x 5.5" x 1.2") and does not weigh much more than some larger transceiver microphones! This is a ham band transmitter, so only those with a General Class or higher license can transmit with it!

For this little radio, I had to buy very few parts (a well stocked Junk Box), but If I had to buy all of the parts new, I expect that the $50 price target would be pretty close. Variations in boxes and some components can keep the cost down.

Schematics modified from http://www.qrp.pops.net/willy.htm.
Changes in RED.

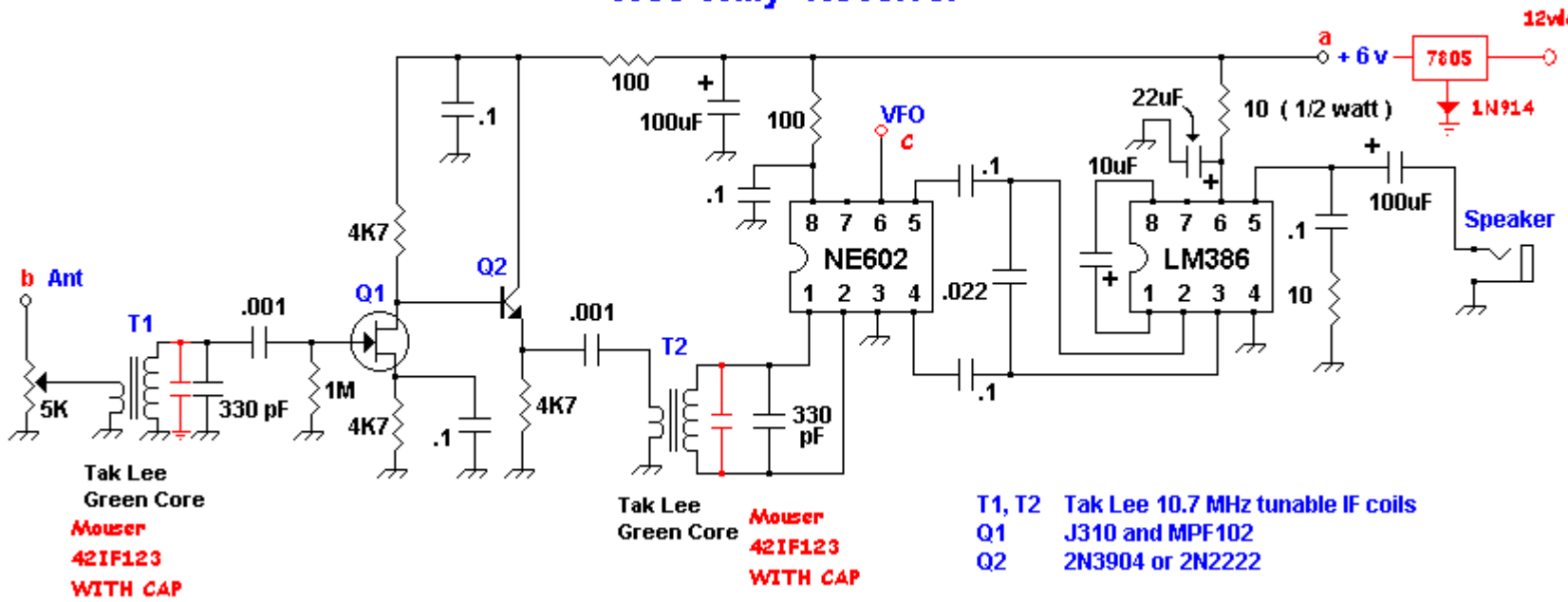
Wee Willy Transmitter



L1 10.7 MHz tunable Tak Lee IF coil
L2 47 uH RF choke
L3 22 turns # 24 AWG on a T50-2 Powdered Iron Core
T1 T1 is 6 turns Bifilar wound #24 wire on FT37-77 core
Q1 - Q3 VN10 nJFETs

TO TX C
TO RX C
VFO

Wee Willy Receiver



T1, T2 Tak Lee 10.7 MHz tunable IF coils
Q1 J310 and MPF102
Q2 2N3904 or 2N2222