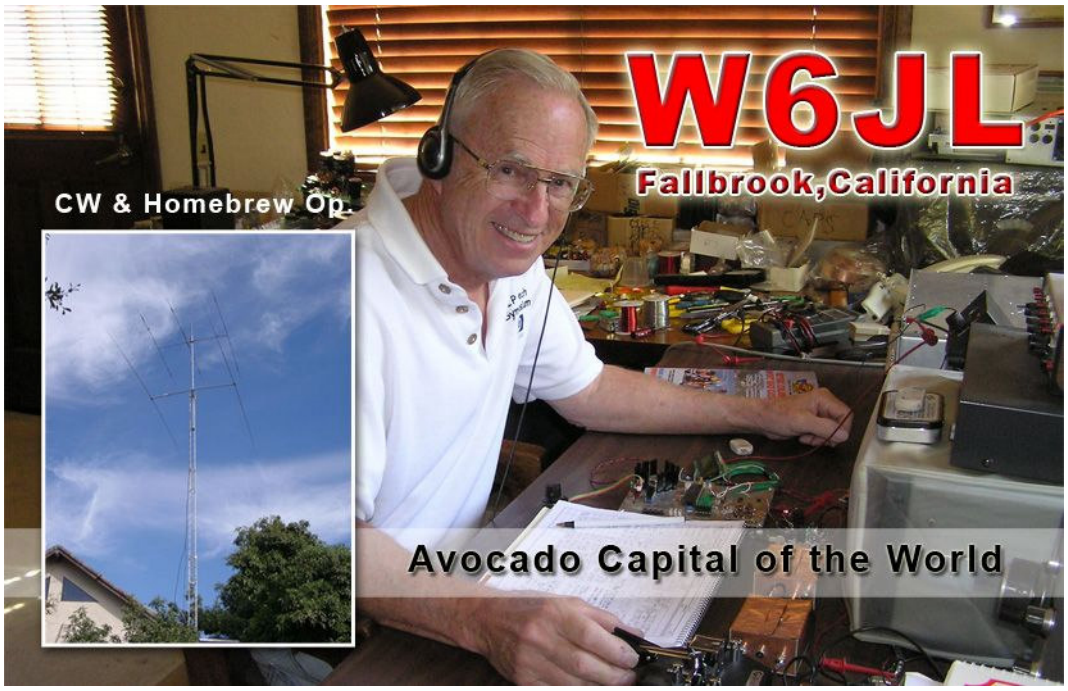
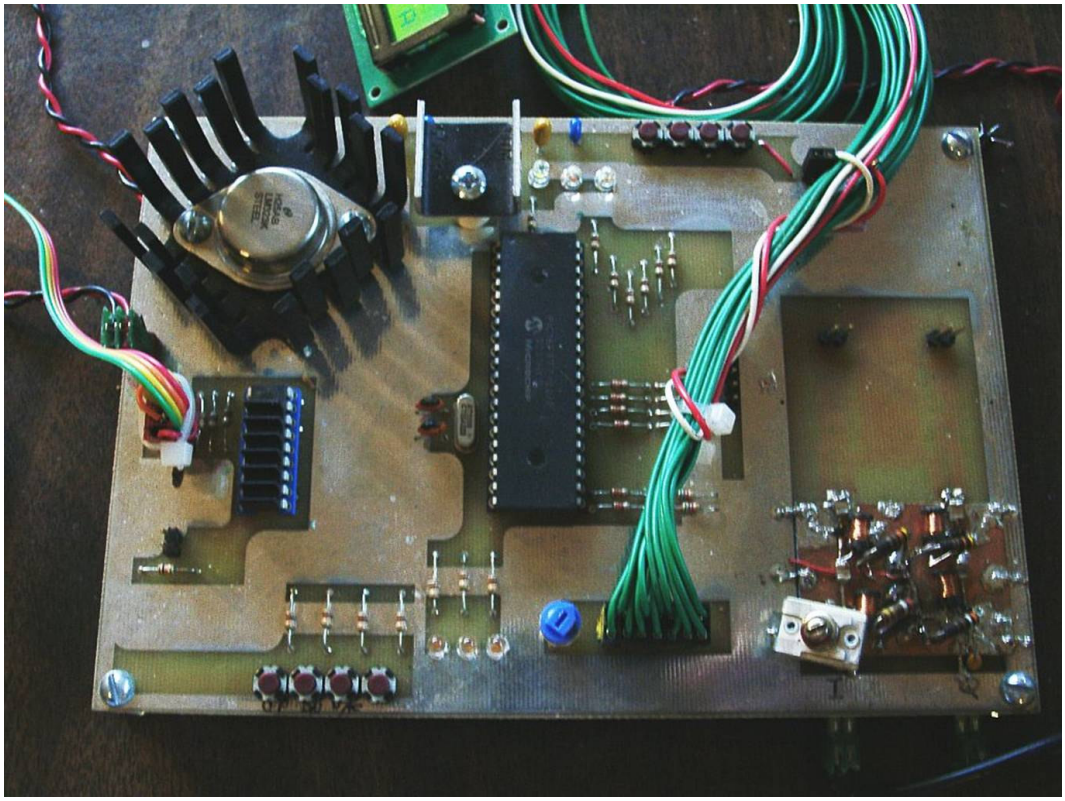
Don Huff, W6JL

8/16/2008



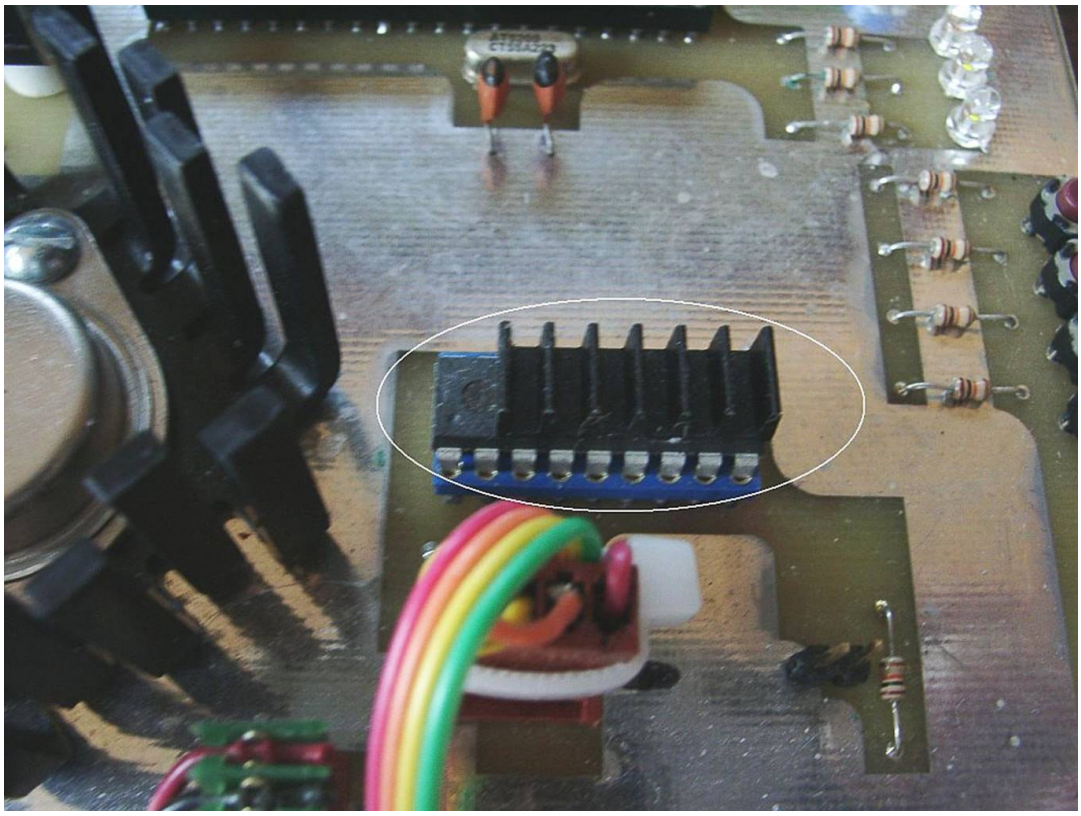
Here is my IQ-VFO DDS board. It's a pre-production prototype from AA0ZZ.



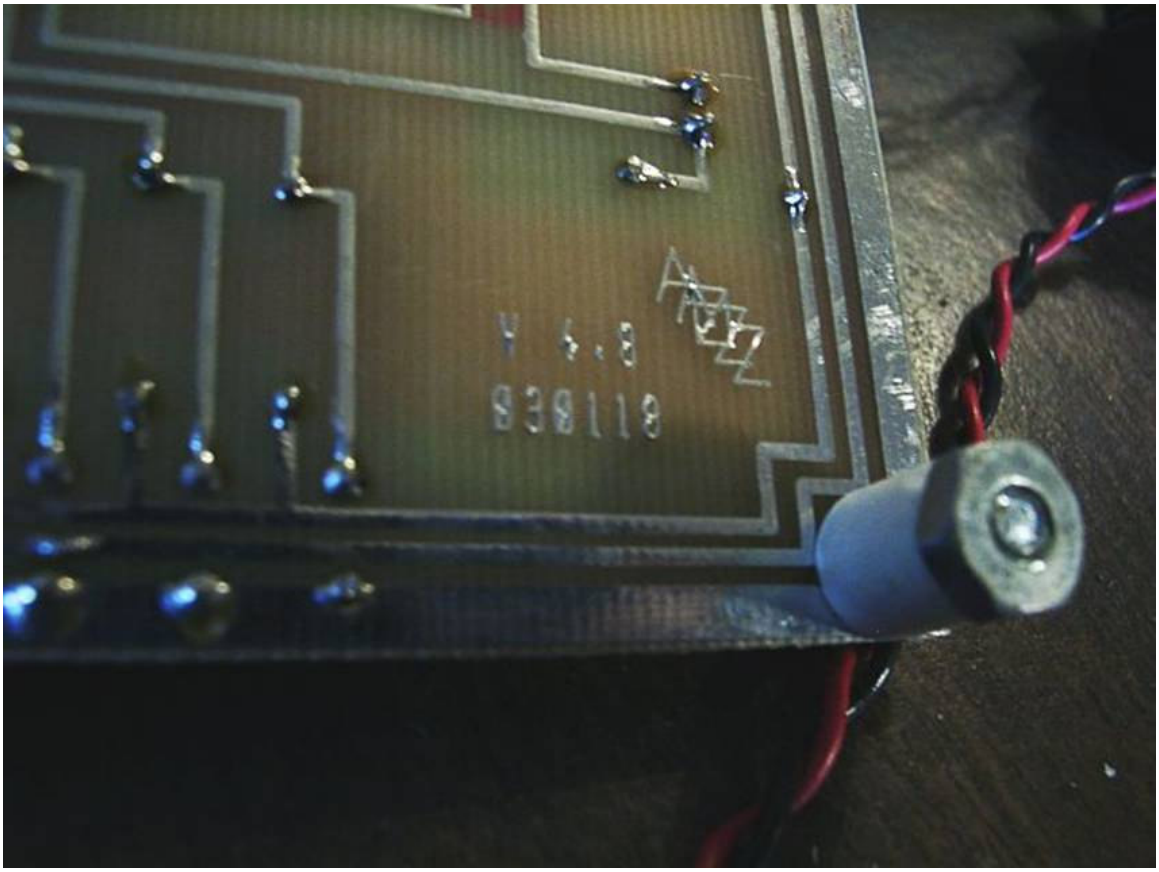
My output amps are non-standard, custom amps. I use IQ-VFO MAR-4 output amps, two per phase. These amps were give-aways from a big bowl at the Mini Circuits booth at Dayton one year so I snarfed up a few. Note compression trimmer, which is an RF phase tweak. This is how I get to 60 dB of opposite sideband suppression (along with 1% or better matching of R's and C's in the phase shifters and diplexers) - at least on

my favorite band, 40M. An S9+ signal is inaudible on the other side of zero beat; 60 dB is a long ways down. The distortion products are what you hear at that level of suppression. In practical terms, 40+dB of suppression is adequate for most operation, and this is easy to achieve.

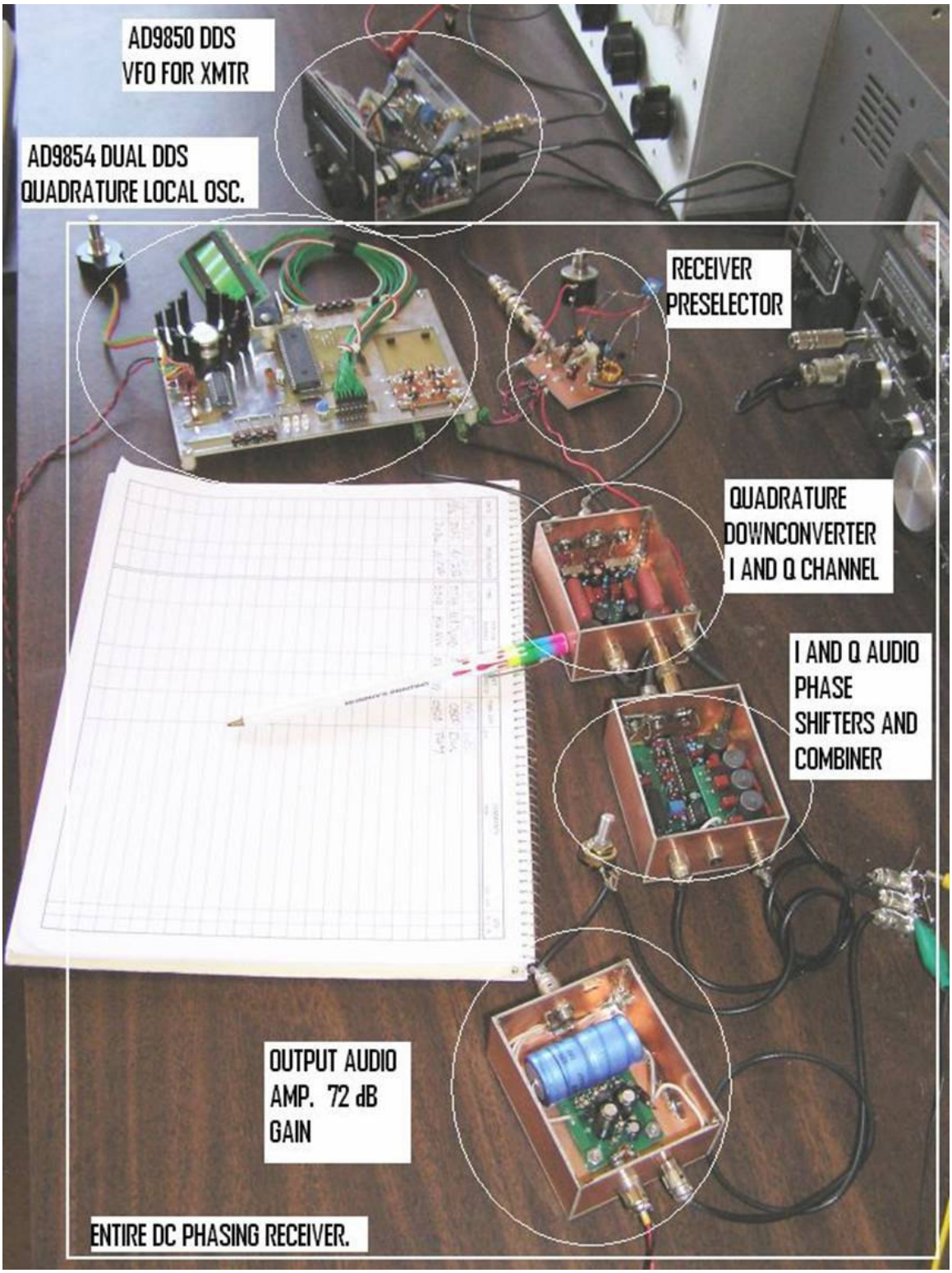
The IQ-VFO uses an AD9854, (which you, AA0ZZ, soldered), along with the output level tweaking pot. I had added the extra ground straps, etc way back when, but they were not necessary.



I put heat sink on 16F84 because it felt fairly warm.

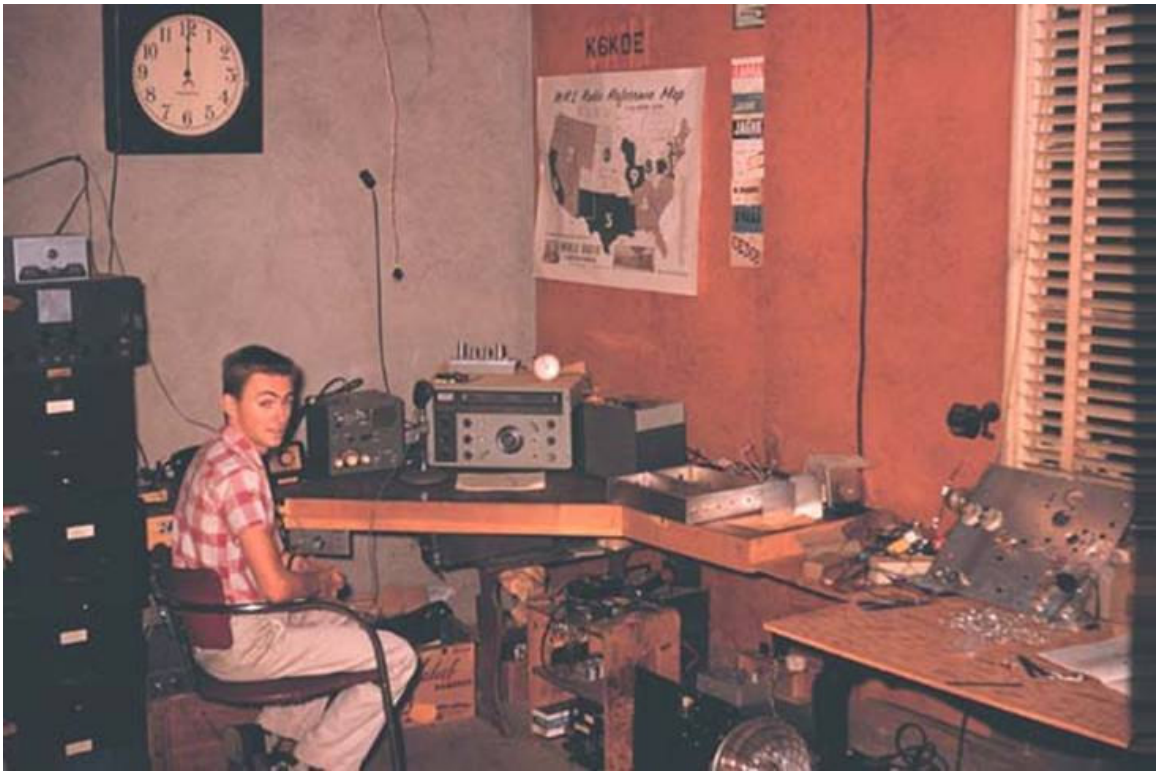


My board version.



My station currently in use. It has an R2PRO/IQ-VFO receiver and a separate DDS VFO transmitter. The DDS VFO in the transmitter uses a circuit board from FAR Circuits with an AD9850 DDS. It runs SIGGEN software by AA0ZZ / AA0ED.

KW amp with keyed AD9850 DDS VFO as driver. From QRPP to QRO in one step. The AD9850 VFO has two stages of Class A amp to boost output to 0.1W (+20 dBm). I am keying both of these amps for CW. 0.1W (+20dBm) from VFO gives 650W output. Amp is a pair 6CL6's in class A passive grids, driving a pair of 4CX250B's in AB1.



I was K6KDE in1957. That's my Heath DX-100B under construction on the bench.

Operating R2PRO station. Hand steady on the encoder knob for the IQ VFO. I don't usually get around to the cosmetic details of cabinets, enclosures, etc. I prefer to see and have access to the guts of the rig while I am using it :o).

Antennas at W6JL. I spend 99% of my time on 40CW, so the upper antennas get little or no use.

This station now has many hundreds (thousands?) of hours of daily CW operation and it's a joy to use.

I just finished building a new QSK system for this R2PRO RCVR/QRPP-to-QRO XMTR setup. The QSK is instantaneous and slick, and I can independently adjust the volume of my own signal (R2PRO runs all the time of course), down to S2 or so. This is how QSK is supposed to be, but I've yet to use a commercial rig that works to my satisfaction in that respect. (Most of them turn the receiver off with the key down and you get only a sidetone, not your actual signal). As always, if you want it your way (especially at your price), you have to

build it yourself! Nothing new there, eh?

Oh yes, one other thing regarding flexibility. My XMTR is continuously adjustable in output from under 1W to over 650W. (Another feature not avail store bought….) I often back off to 1W or so and become QRP, but ONLY when the other guy has a decent signal to copy at that level. I often tell the QRP-only ops that the "Challenge of QRP" lies not with the transmitting station, but with the receiving op, who is sometimes struggling to copy just a whisper in the noise. :o). Since most any 100W transceiver can be turned down to QRP levels, I question the value of a store-bought dedicated QRP-only rig. Seems like a lot of $$ per watt to me, better spent on parts for homebrew multiple dedicated rigs, be they QRP and/or QRO! And I admit I am not too empathetic with the QRP-with-tiny-antenna ops who seem intent on minimizing ERP!

By the way, I have made all mods now to my satisfaction in your 16F628 and 16F877 source code in the IQ-VFO. I'm noticing that it is easy to drop things (screwdriver, banana, cereal, etc into the IQ-VFO as it sits in front of me. This has necessitated a few re-programmings of the PICs. Golly, maybe I am going to have to (gasp!) put it in some kind of box? Nahhh.. As it is now, I can warm my left hand by placing it over the smoking hot bias resistors which run the four MAR-4 MiniCircuits MMIC's that boost the IQ VFO output to 10mW (+10 dBm). This drives the QRO amp directly to 650W out (power gain is 6500, or 38 dB; love the gain of those pentodes and tetrodes).

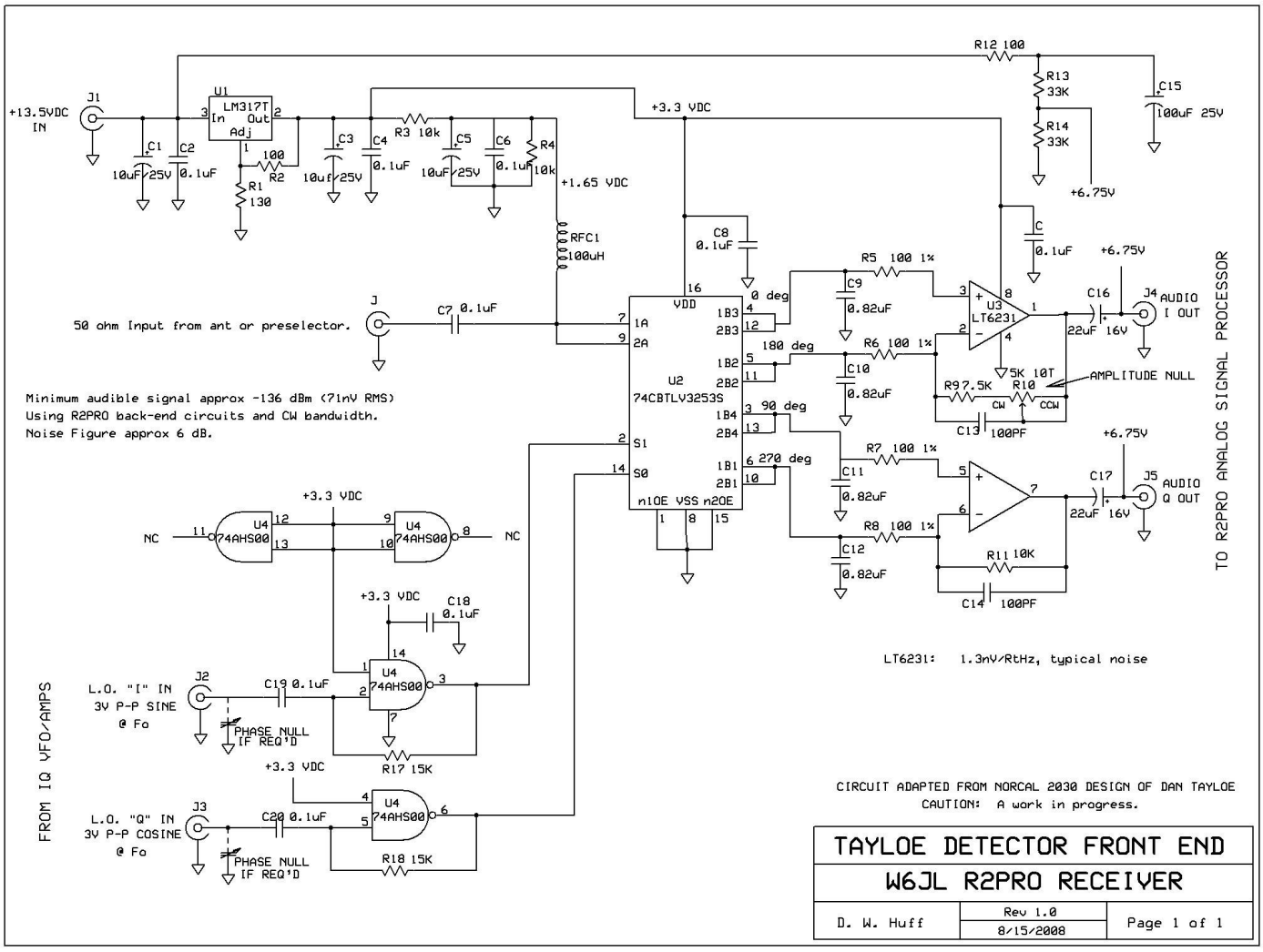
IQ-VFO / R2Pro / Tayloe Mixer

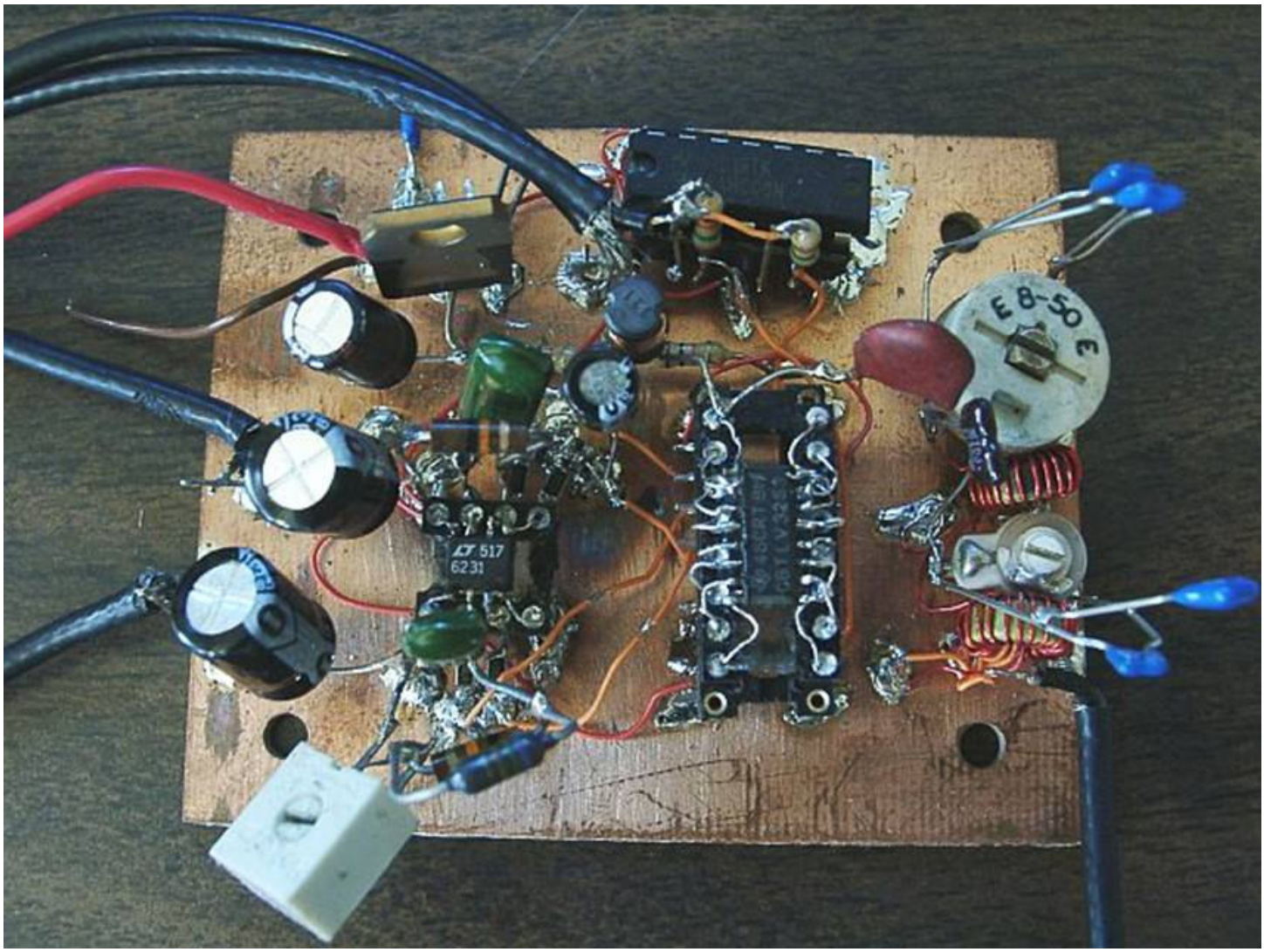
I've been having some fun here lately. I recently built up a Tayloe Detector, an amazing circuit which as you probably know was invented by Dan Tayloe, N7VE and used in his design of the Norcal 2030 transceiver. His elegant circuit is being widely used in Europe too, in many nifty homebrew designs there. I've coupled it with your IQ VFO (the Tayloe does not require the high level LO that ring mixers/diplexers combo requires, another distinct advantage of the Tayloe circuit, among a few others). Using your IQ VFO I can get 60 dB of opposite sideband suppression, and with no RF gain whatsoever ahead of the Tayloe, the receiver hears -136 dBm (that's 71 nV RMS, folks). It can hear the thermal noise of a 50 ohm resistor when you connect it to the receiver input. The noise figure is about 6 dB using the LT6231 (1.3nV/RtHz noise opamps) in the output of the Tayloe. The performance is outstanding.

Here is the schematic of my Tayloe implementation used in my modified R2PRO. It is highly leveraged from Dan Tayloe's design for Norcal's 2030 QRP transceiver. The IQ VFO supplies I and Q Local Oscillator as usual, on the signal frequency, from the MMIC amps which normally would drive the dual ring balanced mixers in the conventional R2PRO front end. The Tayloe Detector outputs I and Q audio directly to the R2PRO's "Analog Signal Processor", as Rick KK7B calls it :o). (Otherwise known as audio phase shifters and summer circuits). Everything from the I and Q inputs into the audio phase shifters, to the output of the R2PRO is conventional R2PRO circuits. You need to bias the inputs of the R2PRO's audio phase shifters to 6.5V, as I don't have direct coupling from the downconverter (Tayloe) as is done in the R2PRO. This is shown on my schematic. The parts I am using in the Tayloe use 3.3V devices, so I can't run them at 12V or higher to allow direct coupling to the audio phase shifters.

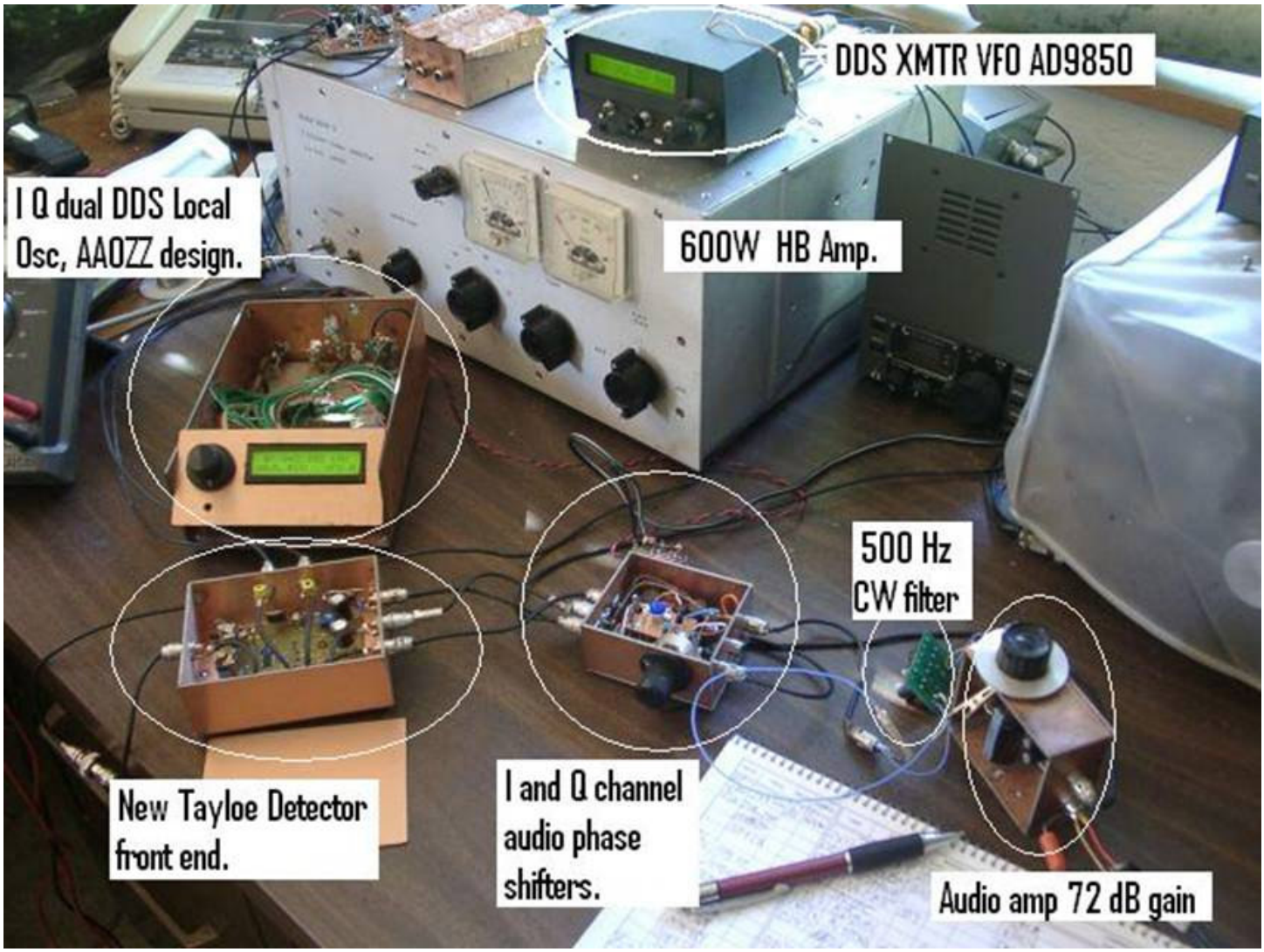
I show no input preselector, as any one of many will do, 50 ohms in and out It works fine with no preselection at all except for the 2L yagi, at my QTH, but always a good idea to have a preselector in there. The 2-3 dB loss of a preselector is inconsequential, since this front end is overkill quiet (and sensitive) anyway, for HF. Feeding RF from a signal generator directly into the input of the Tayloe, I can hear clearly a signal that is at -136 dBm, with no RF amplification whatsoever. I can also detect (a fraction of a dB increase), the thermal noise of a 50 ohm resistor when it is connected to the input of the Tayloe. The estimated Noise Figure of the complete receiver is about 6 dB, determined mainly by the low noise audio preamps used (I'm using the LT6231, which is 1.3 nV per root Hz noise at 1 KHz, typical). The noise figure of my unmodified R2PRO is more like 20+ dB. The opposite sideband suppression so far is not quite as good as the regular R2PRO is over the SSB audio

range, but still peaks at 70+ dB, however falls to 45+ dB at some audio frequencies. I think this is due to the fact that the R2PRO has bandpass diplexers, which add to the effective sideband suppression of the rig. This can be improved I am sure using the Tayloe, with better matching in the audio phase shifters, but with CW filter switched in, it is really a non-issue so I've done nothing about it yet. When you consider how much the Tayloe replaces (Dual ring mixers, dual matched LC diplexers, discrete low noise dual audio preamps, high level LO now not required, etc), it is really an amazing circuit. Add to that it acts like a tracking narrow bandwidth filter, centered on the signal frequency, with an effective Q of several thousand, but without ringing.



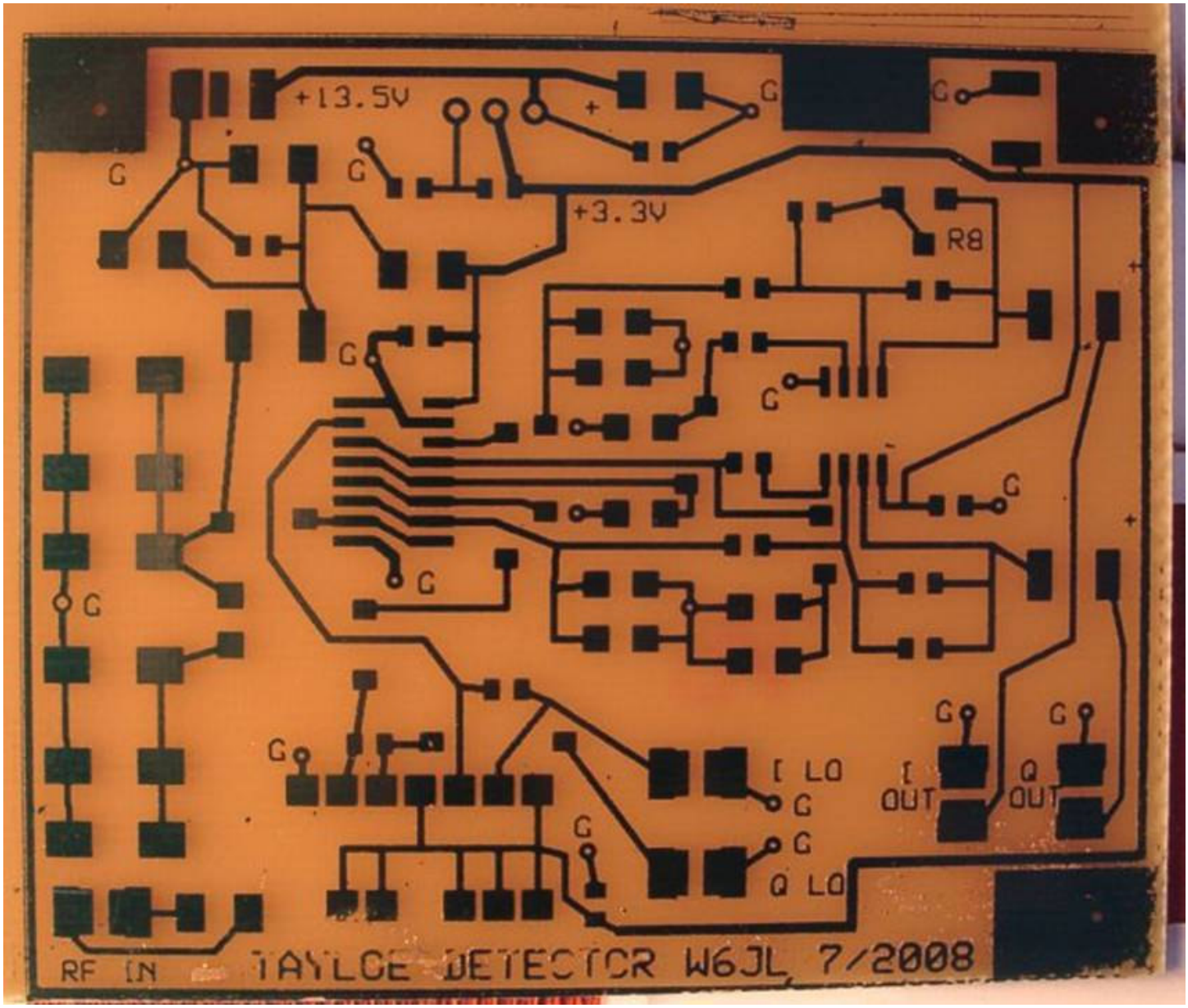


Tayloe Detector – Ugly style!

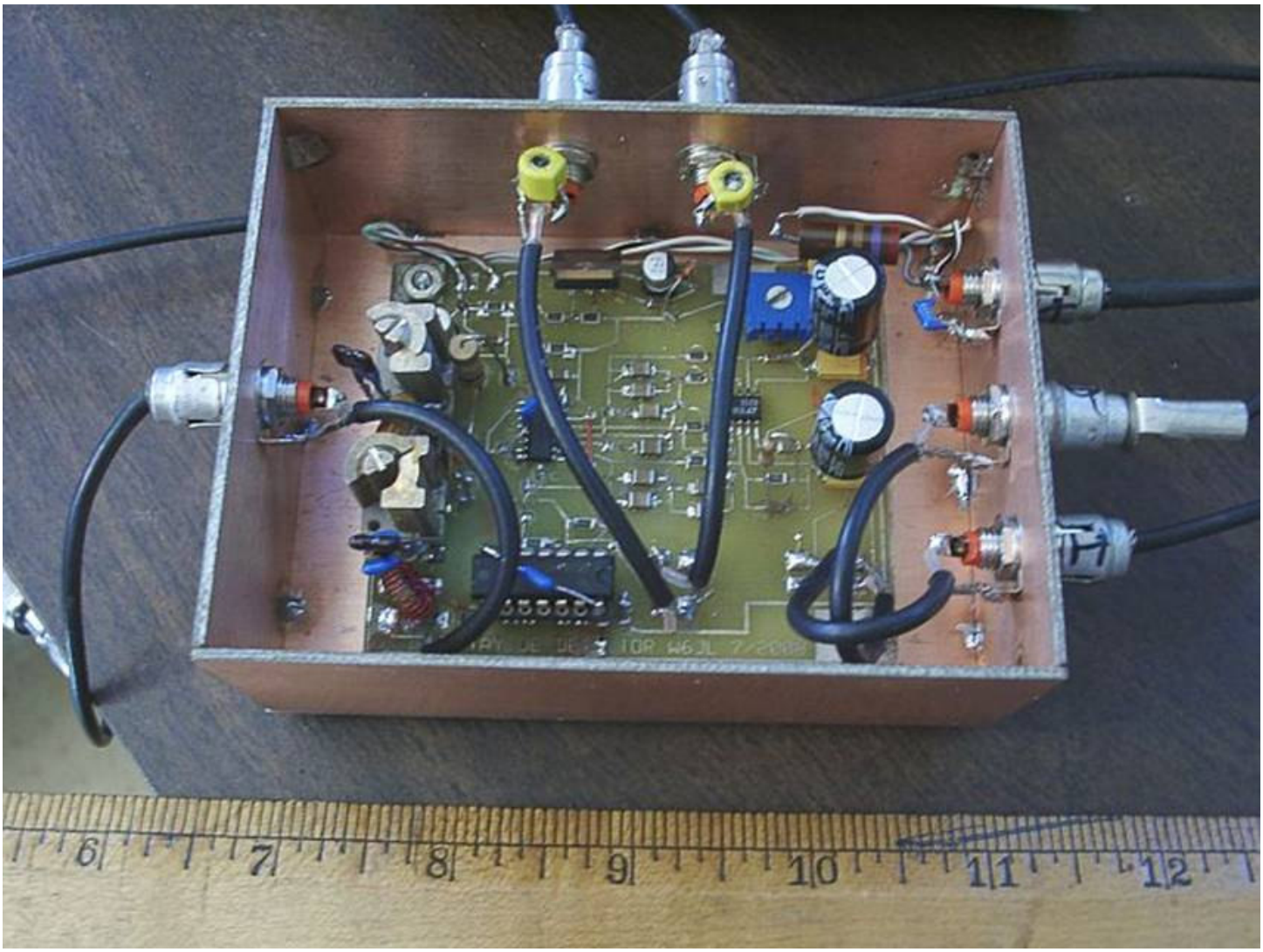


All receiver components - IQ-VFO / R2Pro / Tayloe Mixer / Filter / Audio Amp

IQ-VFO and Tayloe Detector



My Tayloe Detector PC Board



Tayloe Mixer implemented with my PC board

Homebrewing is getting easier and easier all the time! And it has never been easier than it is today (or cheaper). And I should know because I've been at it since early 1955.

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