K7QO's NC40A Beta Build

Version 0.60

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by

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Chapter 1

Introduction

This document is not intended to be printed. This document is to be used by the beta builders of the qrp-tech NC40A PCB. The following is all done with the first set of boards from PCBway and Seeed Studios.

I’m just going to rapidly build the board and make notes for those that get a board, if this build works. Otherwise the boards will be done by another prototype run from China.

This is intended for experts only. If you have a question, then I may not have the time to answer it. I hope the information is obvious.

Chapter 2

Phase 1

Building steps for phase 1.

- ☐ Standoffs. Used to guarantee no shorts on power up.
- ☐ J1 – power connection
- ☐ S1 – power switch
- ☐ C43 – 47nF cap
- ☐ C42 – 10μF electrolytic cap
- ☐ U5 – 78L08 voltage regulator
- ☐ C54 – 47nF cap
- ☐ C8 – 47nF cap
- ☐ C41 – 100μF electrolytic cap
- ☐ D7 – 1N4004 diode as 1N5817 leads will not fit current hole size

Power up and check phase 1 build.

- ☐ Power up.
- ☐ Measure current, if possible. Should be about 2mA.

- ☐ U1–8 voltage measured 7.87V for my regulator.
- ☐ U2–8 voltage measured 7.87V for my regulator.
- ☐ U3–6 voltage measured 7.87V for my regulator.

I forced 0.1” header into S1 and power pads. Used Berg connector in place of a real switch at this time.

Four mounting holes will work up to 6-32 size screws.

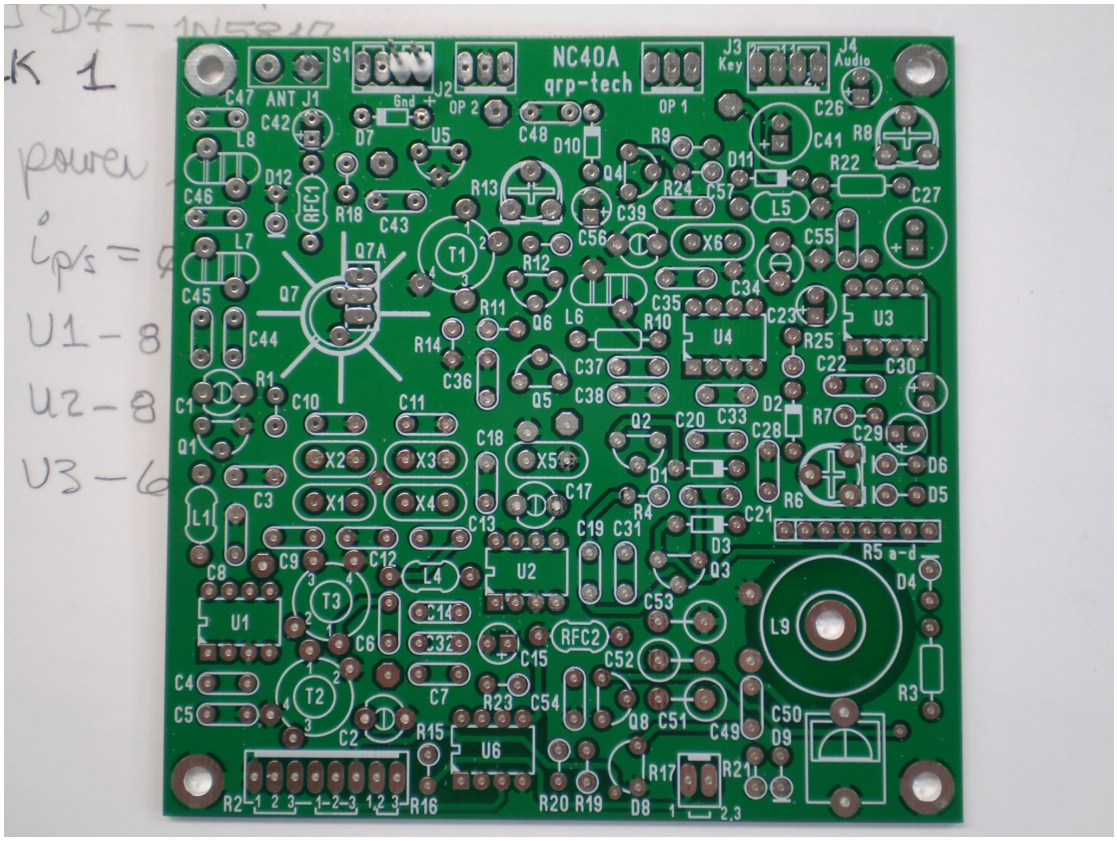

Figure 1: Top of PCB from PCBway.

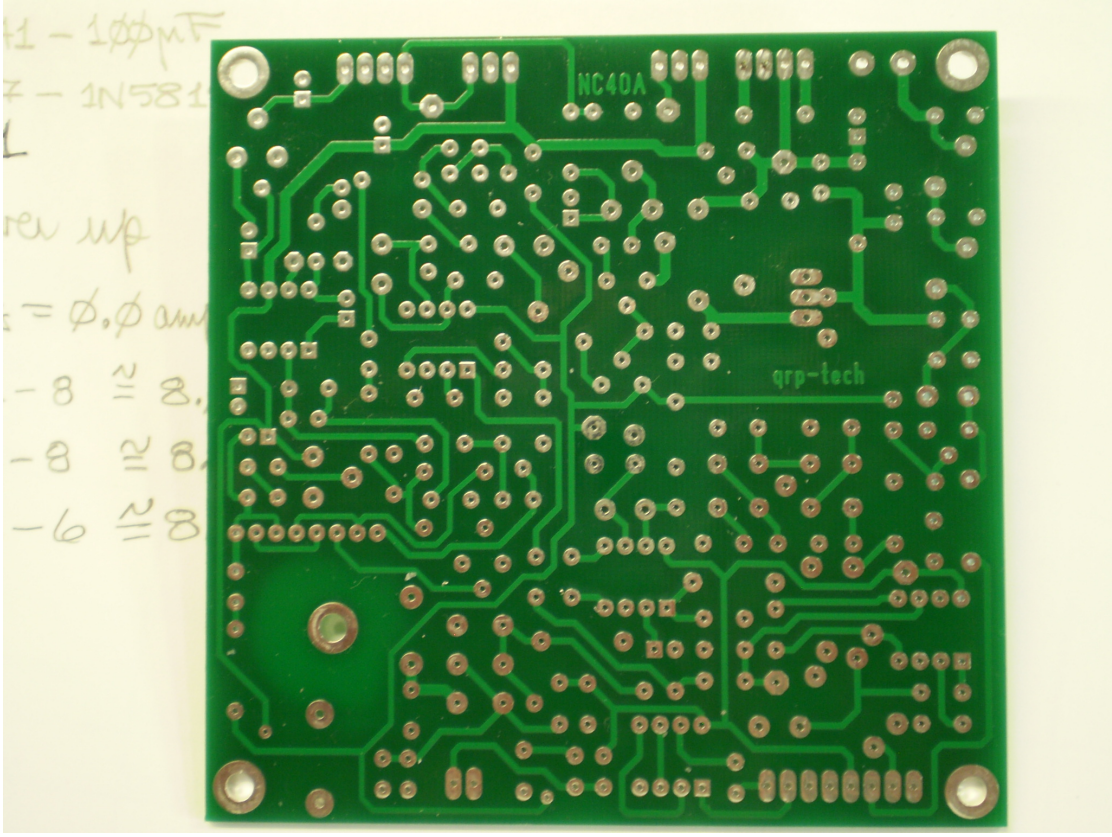

Figure 2: Bottom of PCB from PCBway.

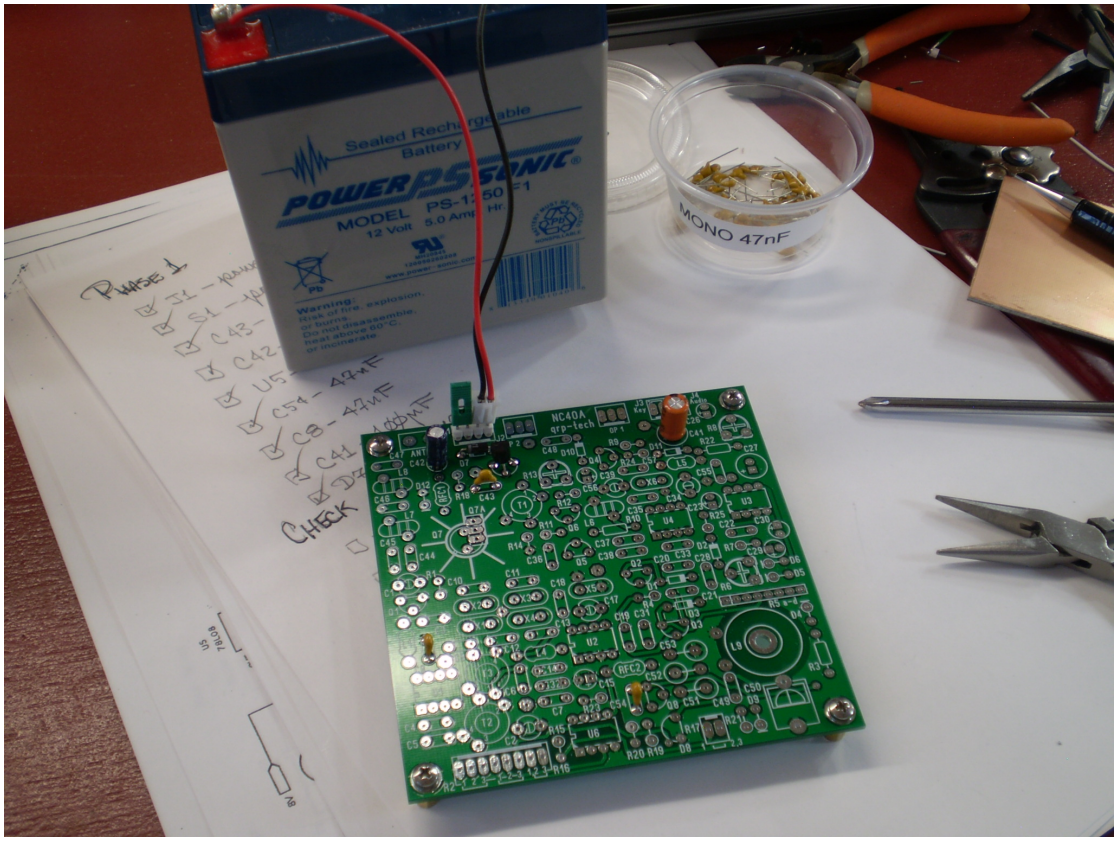

Figure 3: Powered up for testing each phase.

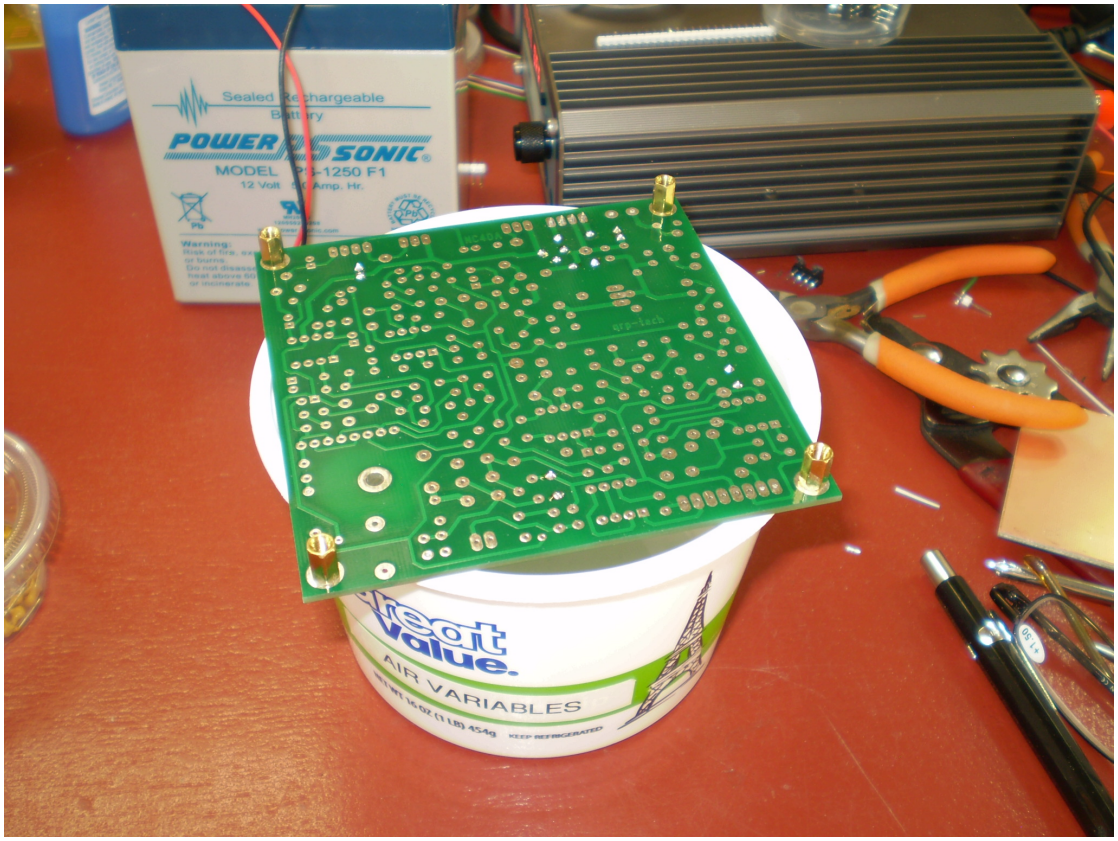

Figure 4: Board on plastic container to solder parts.

This way I don’t bend and mash parts by placing board on bench to solder. Faster than using a PCB holder.

Chapter 3

Phase 2 – AF AMP

- ☐ J4 – Audio jack.
- ☐ C26 – 10μF electrolytic cap
- ☐ R8 – 500 ohm trimmer
- ☐ R22 – 1.8K
- ☐ C27 – 100μF electrolytic cap
- ☐ C55 – 10nF cap
- ☐ U3 – socket
- ☐ C23 – 2.2μF electrolytic cap
- ☐ C22 – 10nF cap
- ☐ R7 – 47K resistor
- ☐ U3 – LM386N into socket

Test

- ☐ R8 – maximum CCW rotation to minimize volume
- ☐ PC Speakers at reduced volume
- ☐ P/S on. Should hear a hiss when volume turned up.

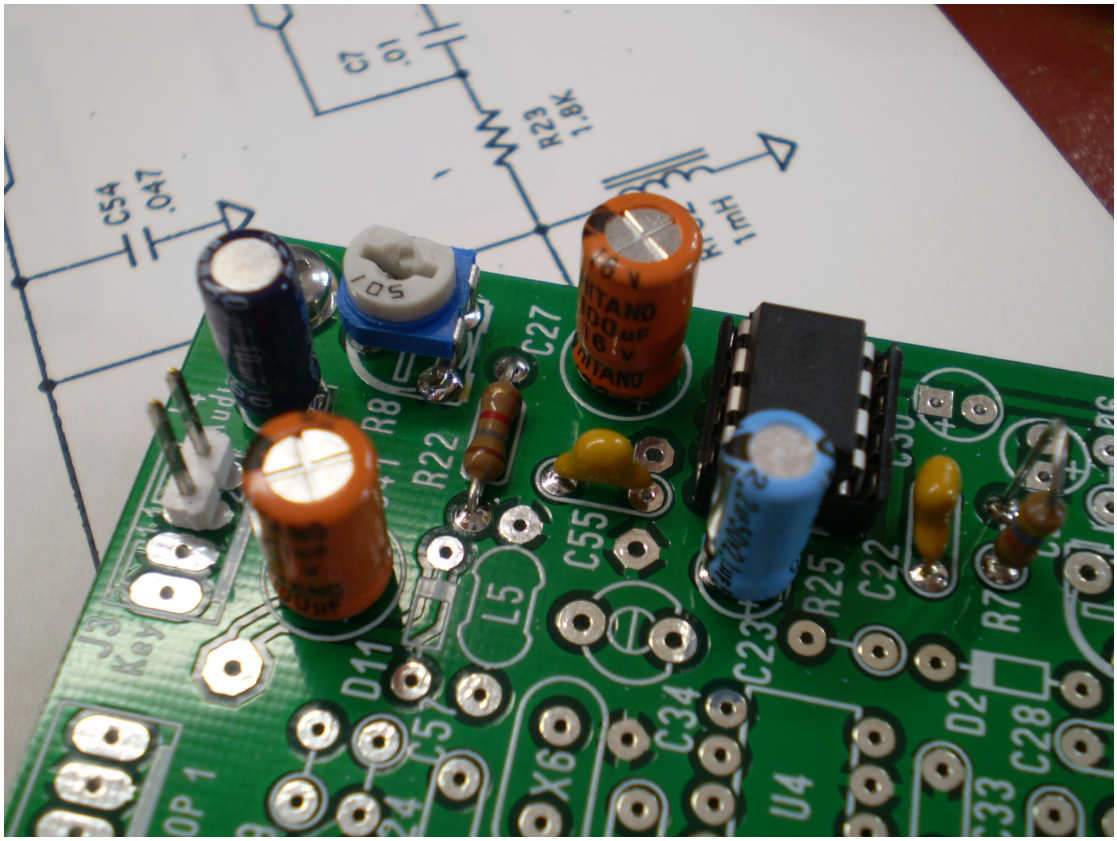

Figure 5: Audio amplifier section.

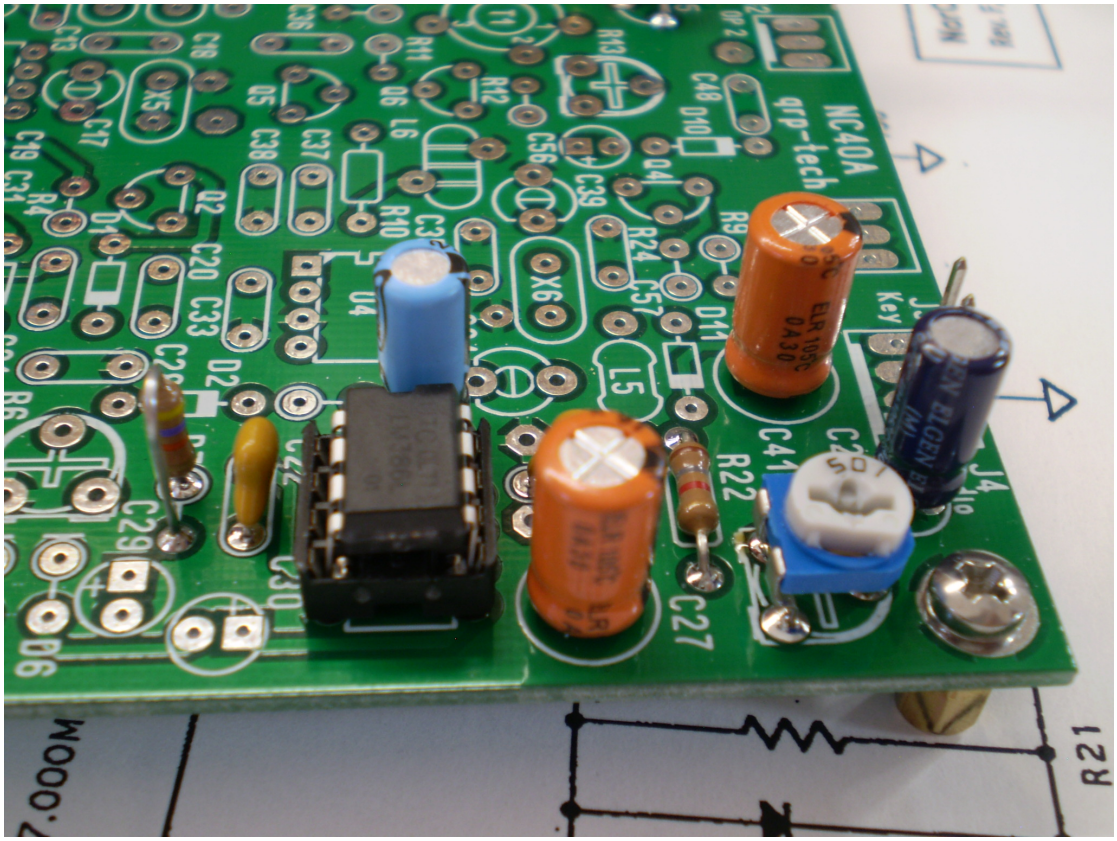

Figure 6: Audio amplifier section from different viewing angle.

Chapter 4

Phase 3 – AGC and Mute Circuits

- ☐ C30 – 2.2μF electrolytic cap
- ☐ D6 – 1N5817 or 1N1711 Schottky diode
- ☐ D5 – 1N5817 or 1N1711 Schottky diode
- ☐ R5a-c – Four matched 2.2M 1/4W resistors
- ☐ D1 – 1N4148 silicon diode
- ☐ D2 – 1N4148 silicon diode
- ☐ D3 – 1N4148 silicon diode
- ☐ D4 – 1N4148 silicon diode
- ☐ C28 – 100nF disc or mono cap
- ☐ C20 – 100nF disc or mono cap
- ☐ C21 – 100nF disc or mono cap
- ☐ C19 – 10nF disc or mono cap
- ☐ Q2 – J309 JFET or equivalent
- ☐ Q3 – J309 JFET or equivalent

- ☐ C29 – 10μF electrolytic cap
- ☐ R3 – 150K resistor
- ☐ R4 – 8.2M resistor
- ☐ R6 – 10K variable resistor

Test.

Set R6 to mid position. Power up transceiver. Touch test probe at pads U-4 and U-5 of U2. A noise should be heard in speaker or headphones. Then the hiss will disappear and then come back after a few seconds or so.

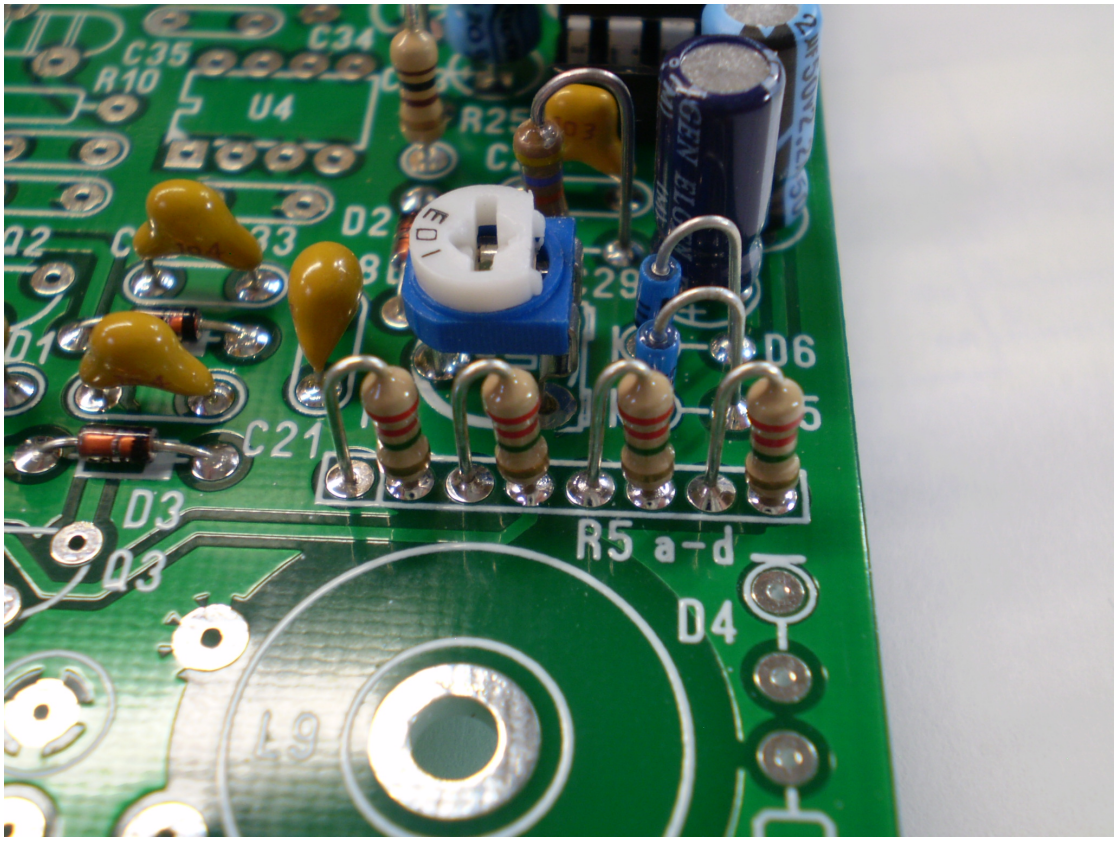

Figure 7: R5a–c with four matched resistors.

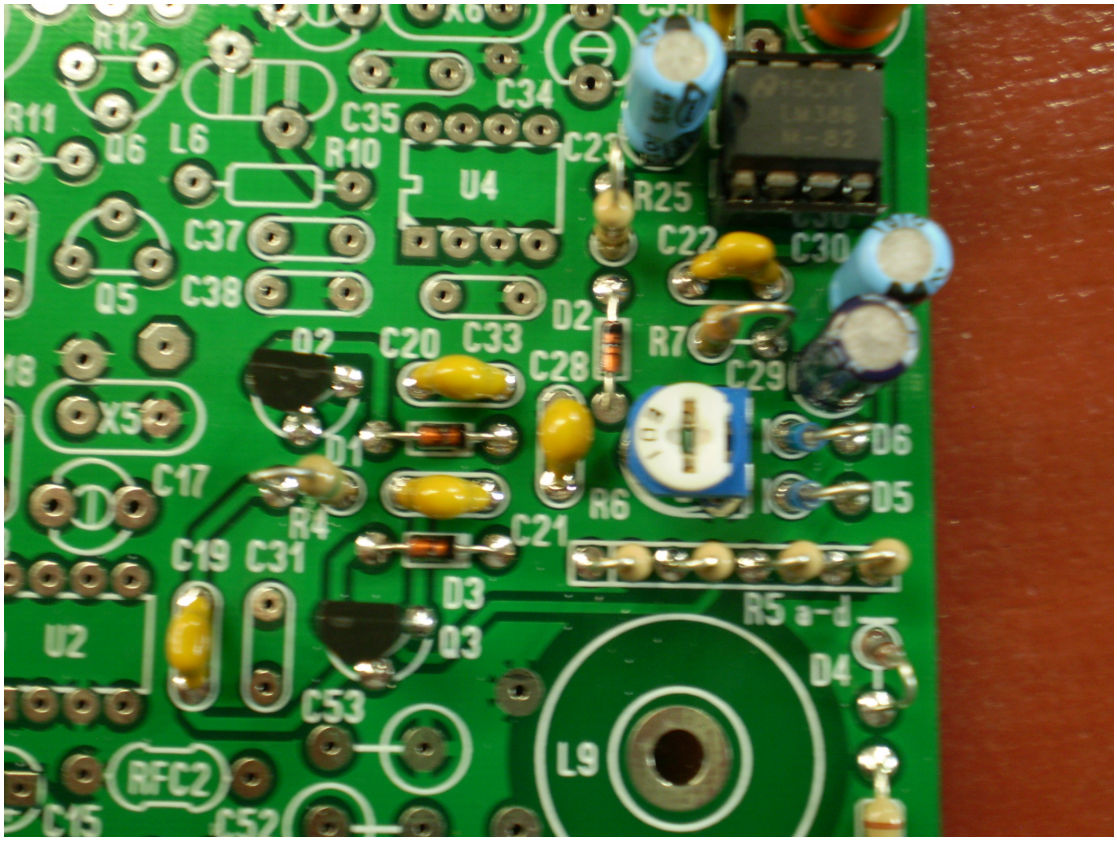

Figure 8: 3756.jpg.

Chapter 5

Phase 4 – Product Detector and BFO

- X5 – 4.915MHz crystal
- C17 – 50pF variable cap
- U2 socket
- C15 – 2.2μF electrolytic cap
- C14 – 47pF disc or mono cap
- C18 – 270pF disc or mono cap
- U2 – NE602A IC

Test.

Power up. Touch pin U2-1 of the NE602 and you should hear an increase in noise in the speaker or headphones.

If you have an AFA or frequency counter, see if you can measure a frequency reading on pin 7 of U2.

If you have a crystal oscillator, take one of the other IF crystals and power up the oscillator with one of the crystals in it. With the oscillator near the NC40A, you should hear a tone in the speaker or headphones.

Adjustment of C17 should vary the tone heard.

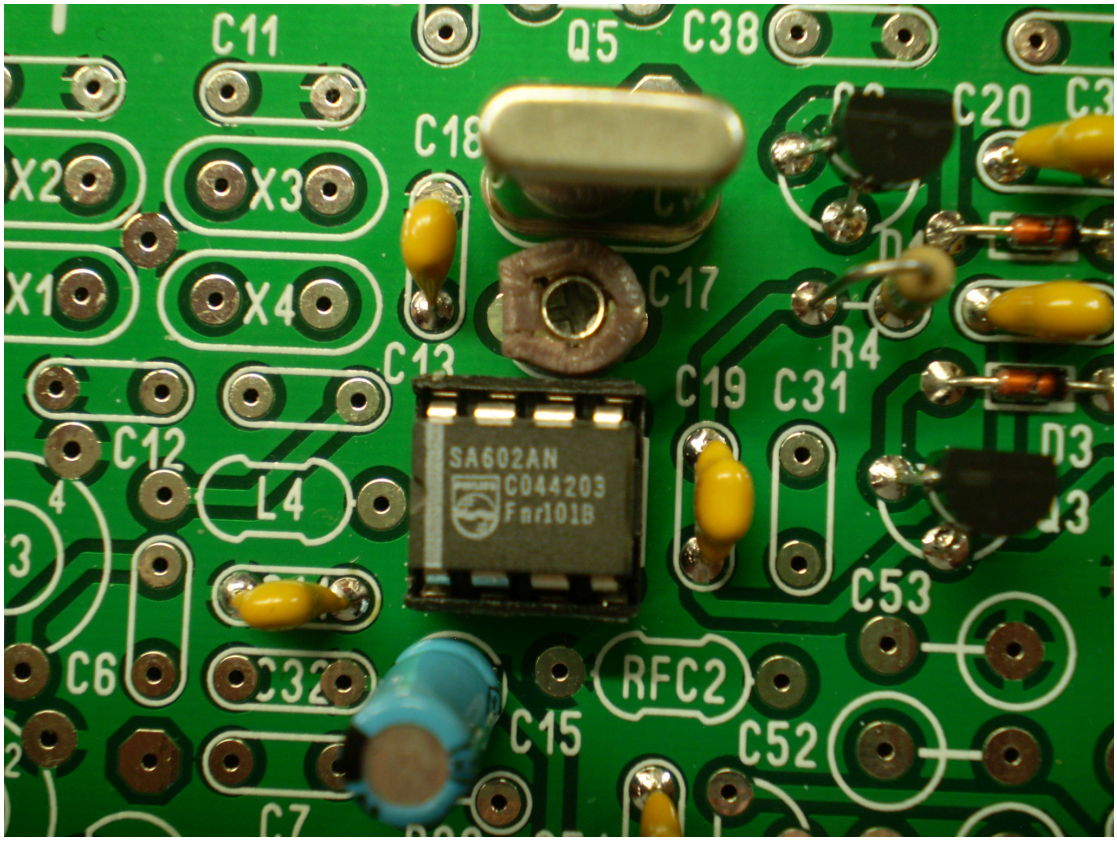

Figure 9: 3761.jpg.

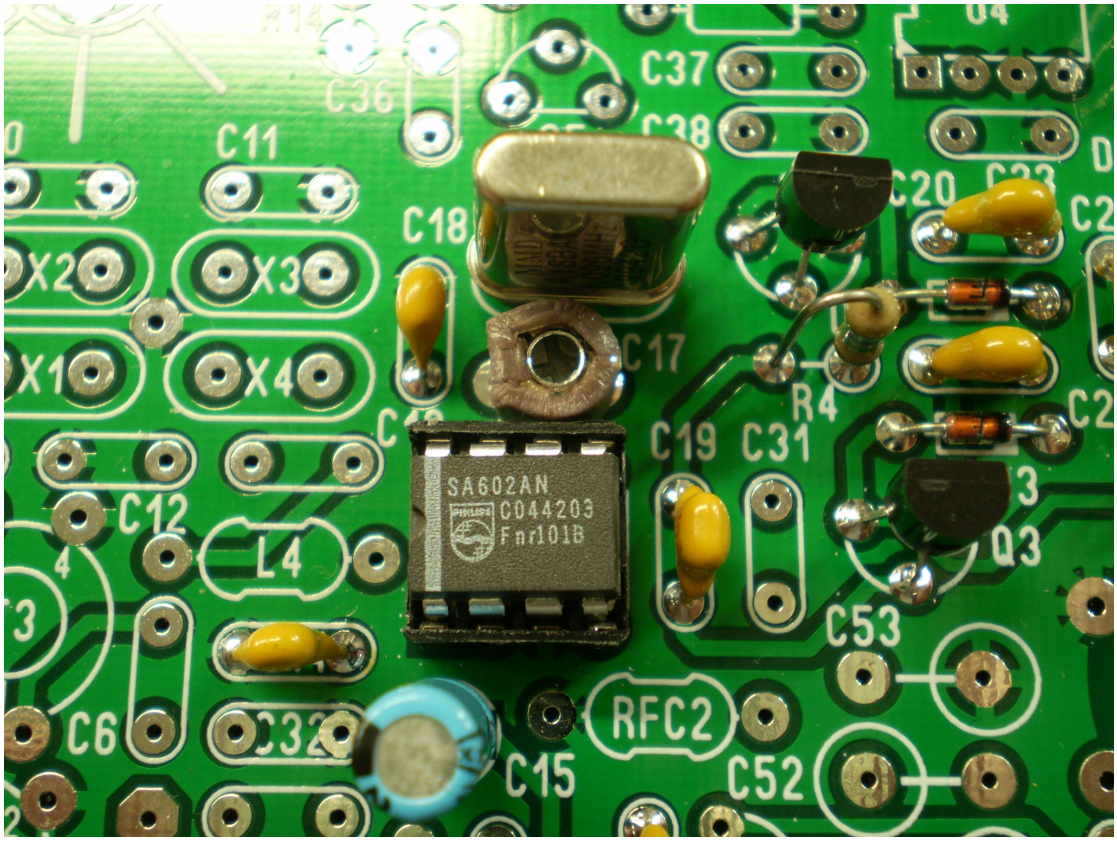

Figure 10: 3762.jpg.

Chapter 6

Phase 5 – IF Crystal Filter

- ☐ L4 – 18μH molded inductor
- ☐ C13 – 270pF disc or mono cap
- ☐ C12 – 270pF disc or mono cap
- ☐ C11 – 270pF disc or mono cap
- ☐ C10 – 270pF disc or mono cap
- ☐ C9 – 270pF disc or mono cap
- ☐ X1 – 4.915MHz crystal
- ☐ X2 – 4.915MHz crystal
- ☐ X3 – 4.915MHz crystal
- ☐ X4 – 4.915MHz crystal

Test.

Power up transceiver as before. Touch test probe to either pad of C9 or pad 3 of T3 and you should hear an increase in noise is the speaker or headphones. Note that the frequency range of the noise is reduced. The tunnel effect, I like to call it because of the band pass frequency range of the IF filter.

Testing receiver by using an Arduino test jumper cable at input of crystal filter and the Colpitts oscillator with a crystal of same frequency as the IF frequency.

I think this is a nice easy way to check your progress without too much expense involved with expensive signal generators.

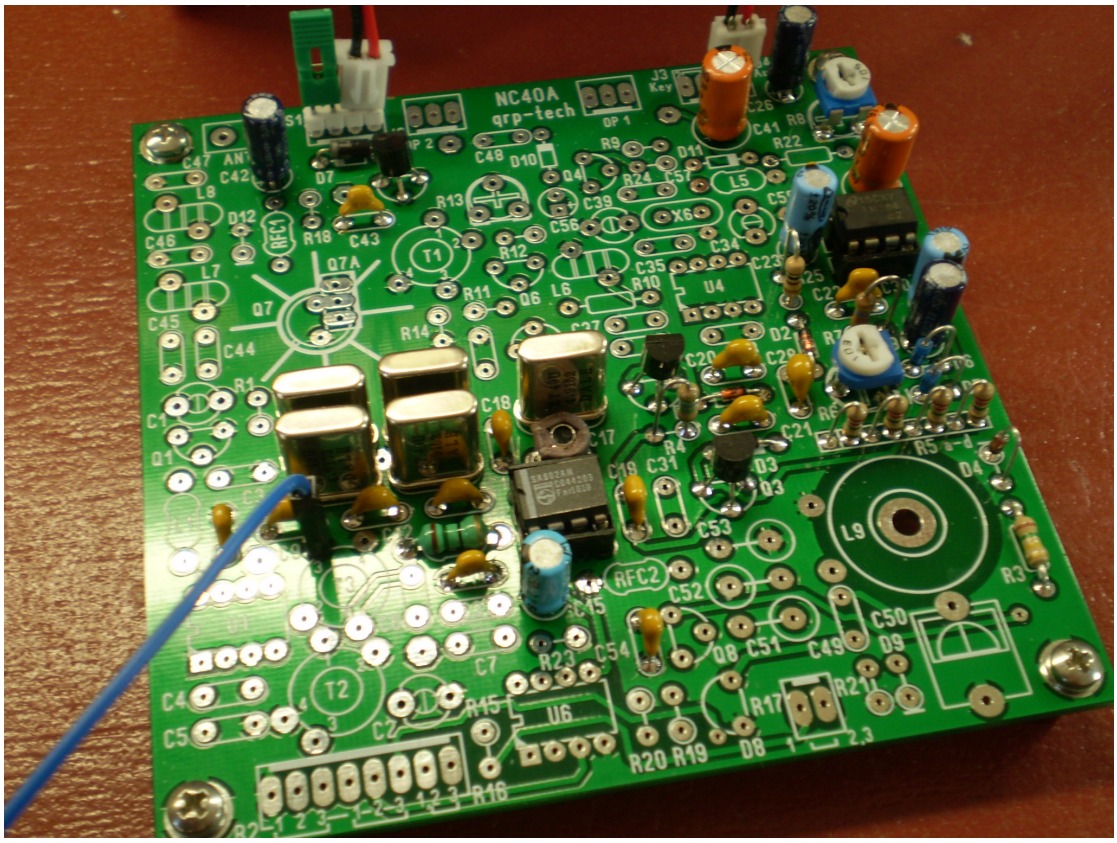

Figure 11: Testing receiver.

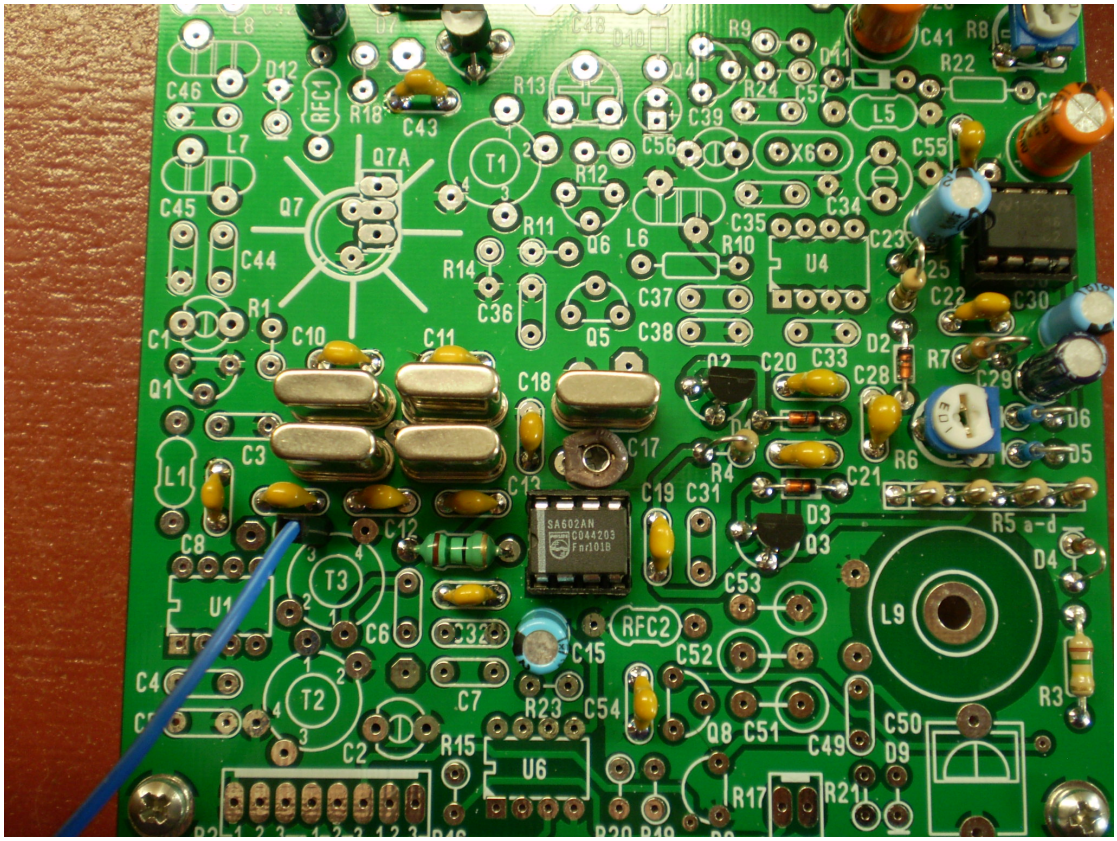

Figure 12: 3764.jpg.

This is something I was doing on the qrp-tech list to see the effect of the Zobel filter, which is not in the NC40A design.

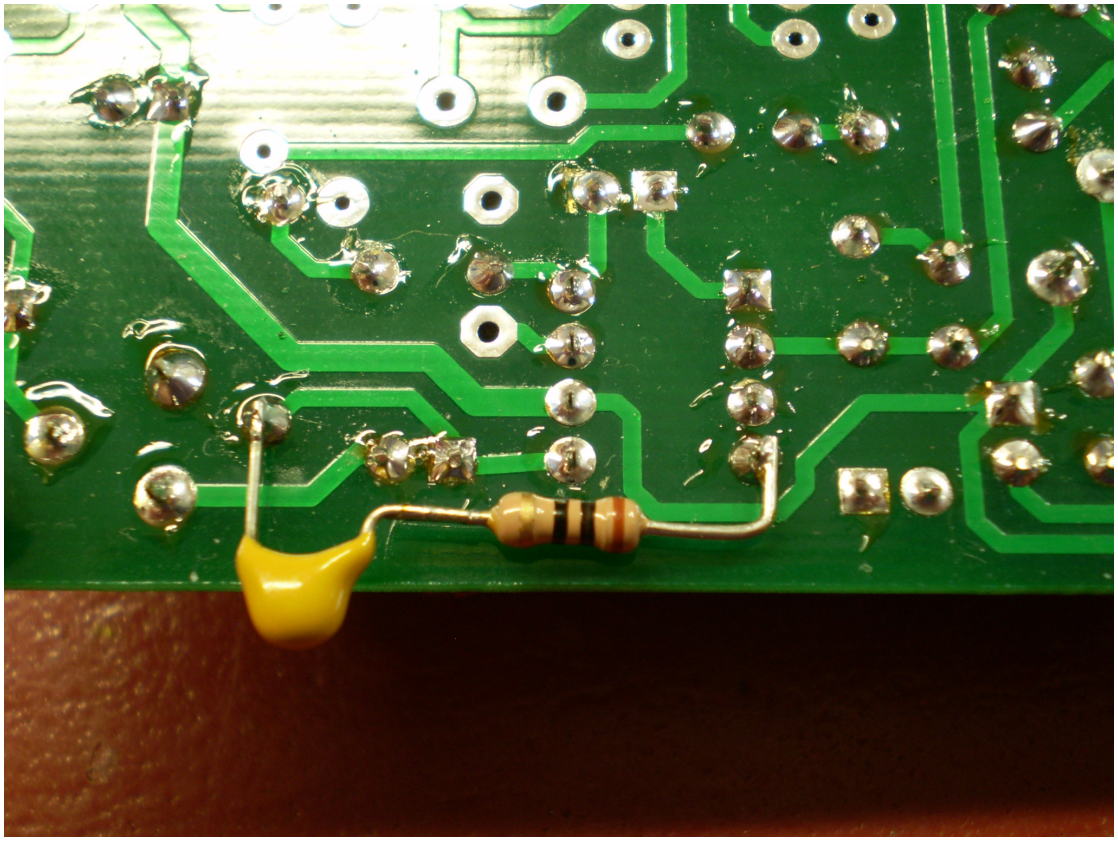

Figure 13: Test of Zobel filter.

The NorCal40A kits never had the 10 ohm resistor and 100nF cap in series to ground from the output pin, pin 5. Will be added in final revision of the qrp-tech board.

Chapter 7

Phase 6 – Receive Mixer

- ☐ T3 – FT37–61 toroid with 23T, #28 primary; 6T #26 secondary.
- ☐ C6 – 47pF disc or mono cap
- ☐ C5 – 10nF disc or mono cap
- ☐ U1 socket
- ☐ U1 – NE602A IC
- ☐ C4 – 5pF disc or mono cap

I bought a lifetime supply of magnet wire from techfixx.com. I like to wind toroids and they are used a lot in BPF and LPF filters.

Figure 14: Magnet wire and toroid.

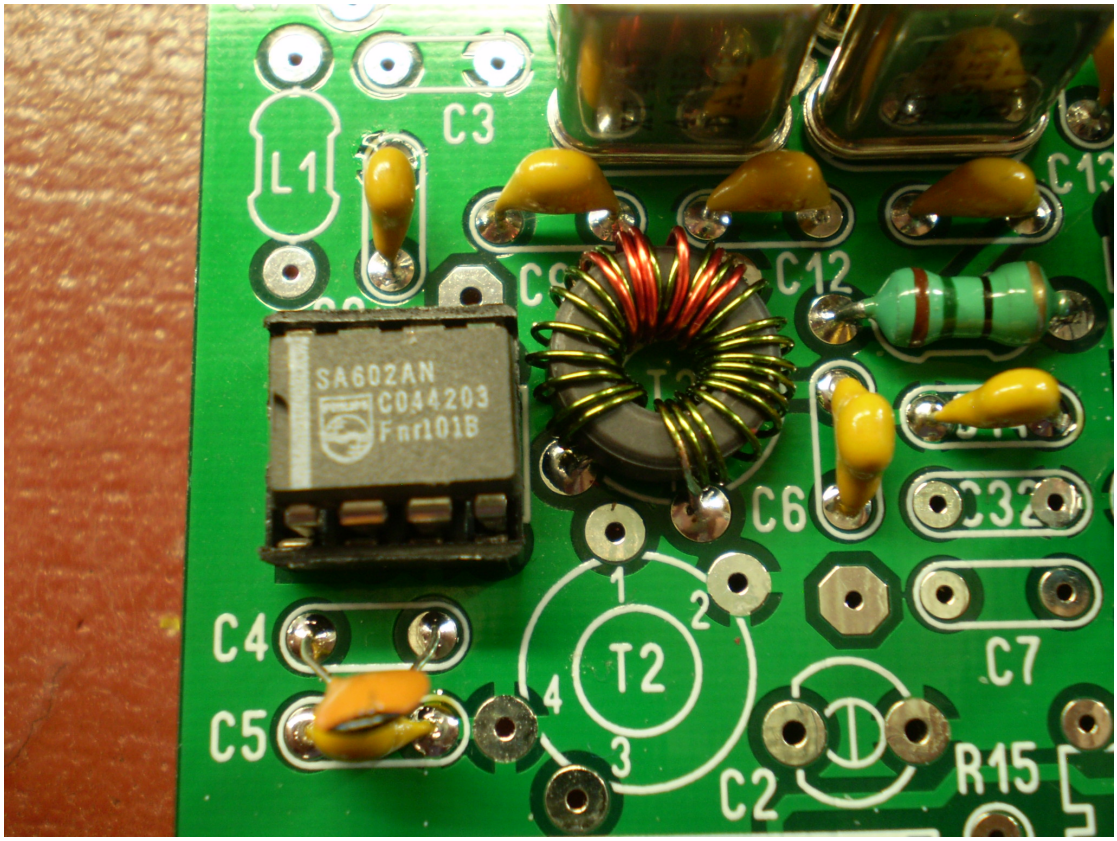

Figure 15: T3 in place after winding.

Chapter 8

Phase 7 – Receiver Band Pass Filter (BPF)

- T2 – FT37-61 20T #26 secondary; 1T #26 primary
- C2 – 50pF variable capacitor
- R2 – front panel 1K RF gain control
- L1 – 15μH molded inductor
- C1 – 50pF trimmer cap
- Q1 – 2N4124 NPN transistor
- C3 – 47nF disc or mono cap
- R1 – 1.8K 1/4W resistor

Chapter 9

Phase 8 – VFO Section and RIT

- ☐ C7 – 10nF disc or mono cap
- ☐ C32 – 150pF disc or mono cap
- ☐ R23 – 1.8K resistor
- ☐ RFC2 – 1mH molded inductor
- ☐ Q8 – J309 or equivalent JFET
- ☐ C52 – 1200 polystyrene cap
- ☐ C53 – 1200 polystyrene cap
- ☐ D9 – 1N4148 silicon diode
- ☐ R21 – 47K resistor
- ☐ C51 – 390pF polystyrene cap
- ☐ L9 – 21uH toroid inductor, 60T #28 wire on T68-7 toroid
- ☐ C50 – 2-25pF air trimmer cap. May be omitted and replaced with C0G or NP0 cap during VFO alignment
- ☐ C49 – 47pF NPO or C0G cap
- ☐ D8 – MVAM108 varactor diode or equivalent
- ☐ R19 – 47K resistor

- R20 – 4.7K resistor
- R15 – 510 ohm resistor
- U6 socket
- U6 – LM393 IC
- R17 – 10K front panel tuning pot
- R16 – 1K front panel tuning pot
- S2 – single pole double throw RIT switch

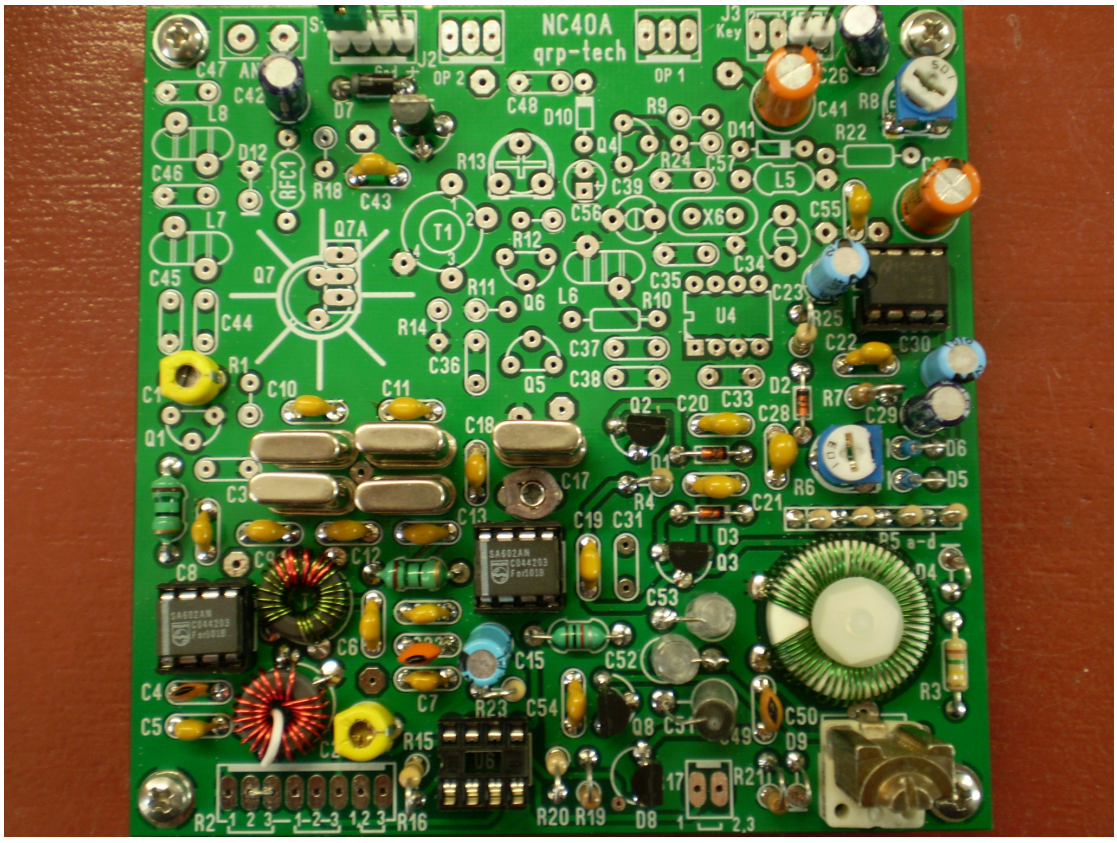

Figure 16: 3772.jpg.

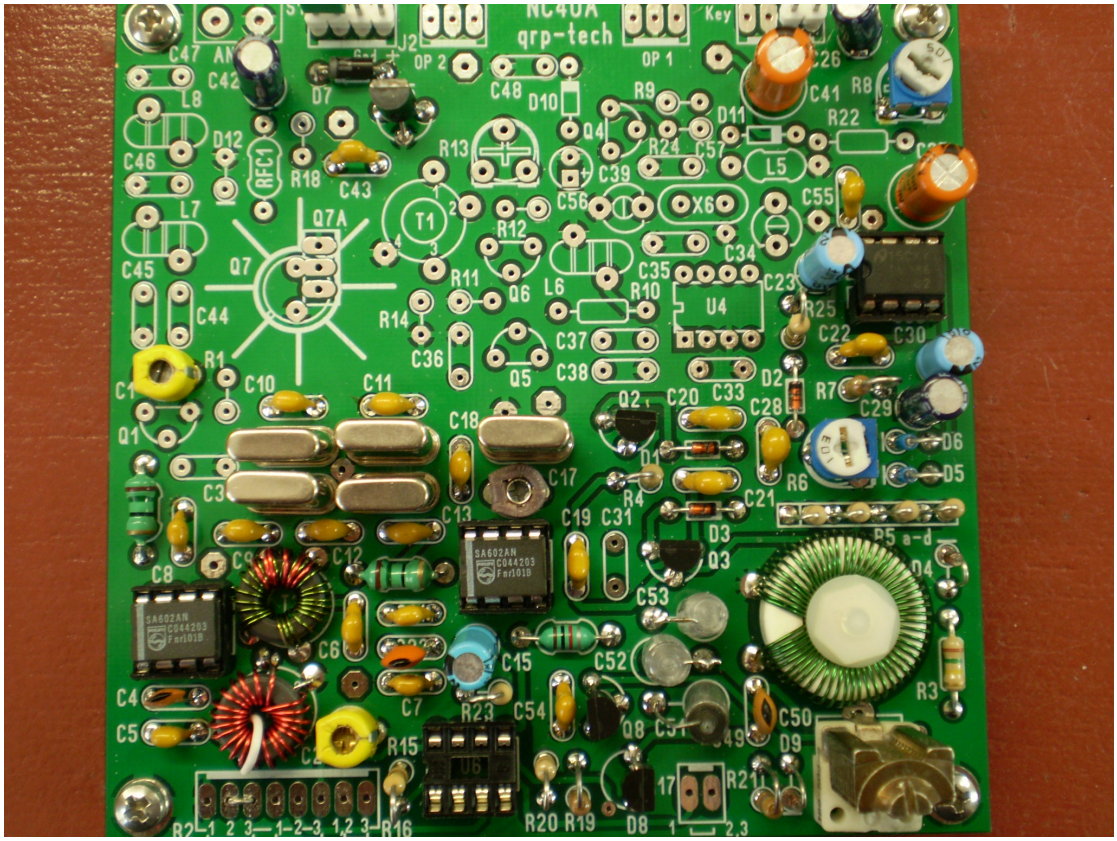

Figure 17: 3773.jpg.

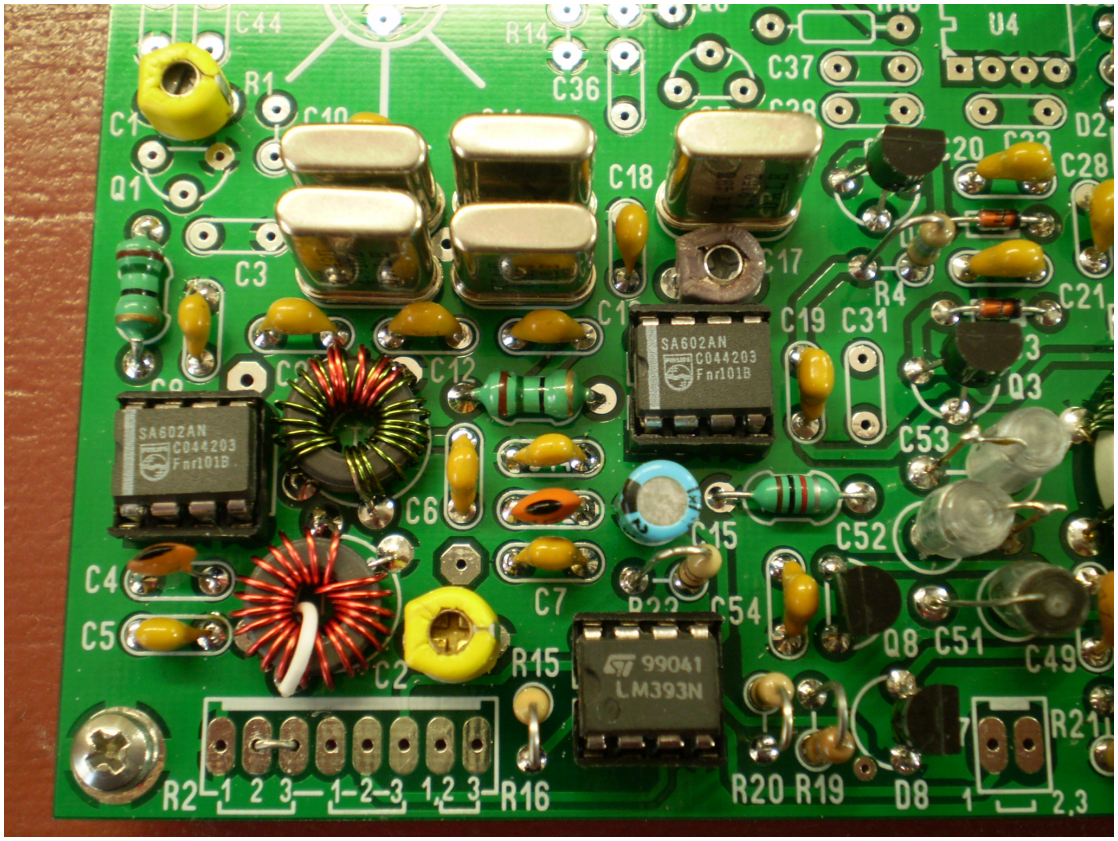

Figure 18: 3776.jpg.

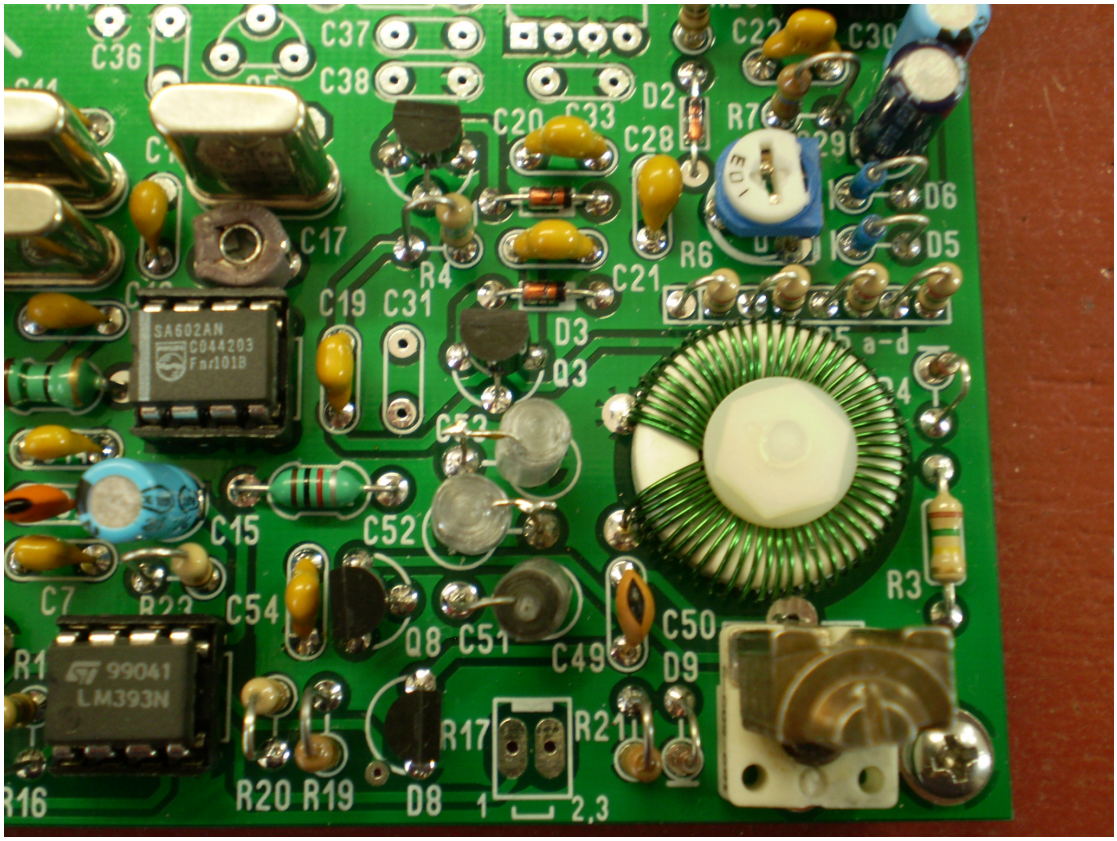

Figure 19: 3777.jpg.

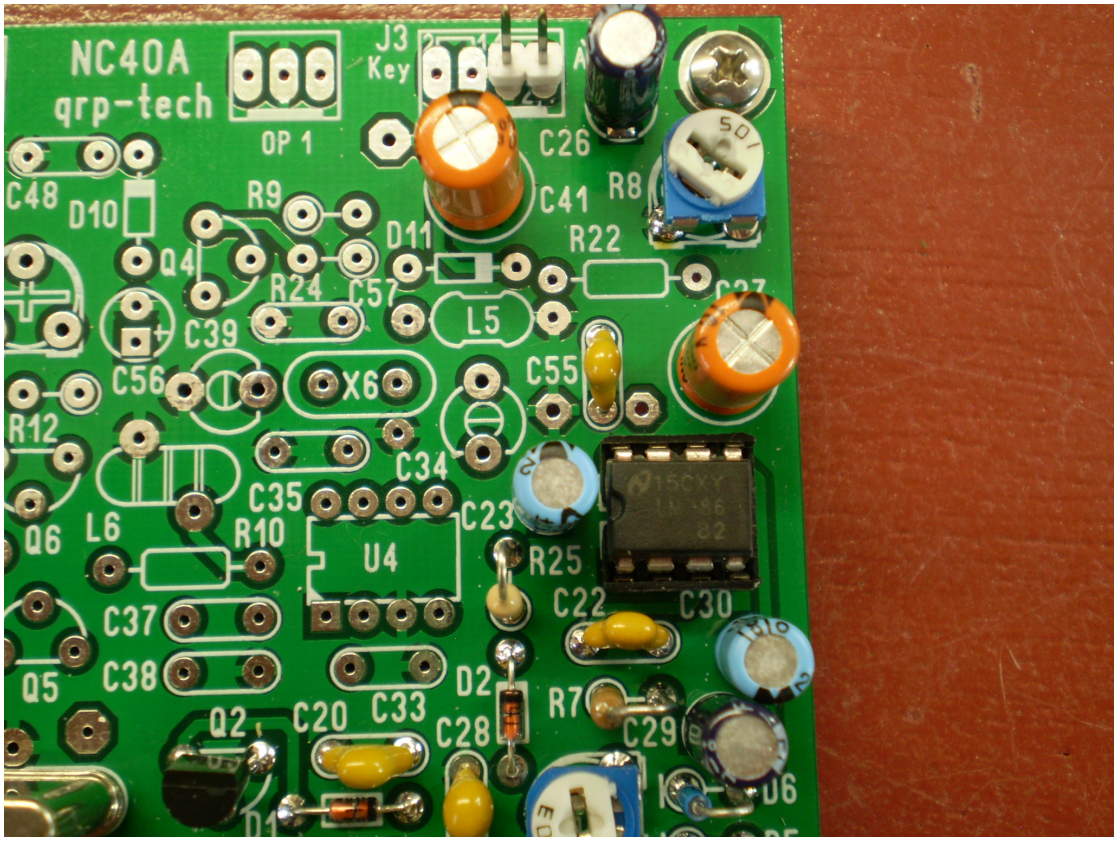

Figure 20: Showing where R22 was removed earlier.

Do you notice how cleanly I was able to remove the resistor after it had been soldered in?

Chapter 10

Phase 9 – Key Switch

- ☐ Q4 – 2N3906 PNP transistor
- ☐ R29 – 150K resistor
- ☐ R9 – 47K resistor
- ☐ D11 – 1N4148 silicon diode
- ☐ C57 – 47nF disc or mono cap
- ☐ C36 – 47nF disc or mono cap
- ☐ R25 – 100 ohm resistor
- ☐ C48 – 10nF disc or mono cap

Testing. Power up transceiver. See if receiver can hear any 40m signals with short wire CAREFULLY touching any pad common to C44, L7 and C45. At least you should near an increase in noise level in speaker/headphone due to atmospheric noise.

Short keyline to ground. Carefully. Receiver should mute. Measure voltage at U4-8 and it should be near 8V. Remove of short to keyline should cause receiver to recover and go back to receiving.

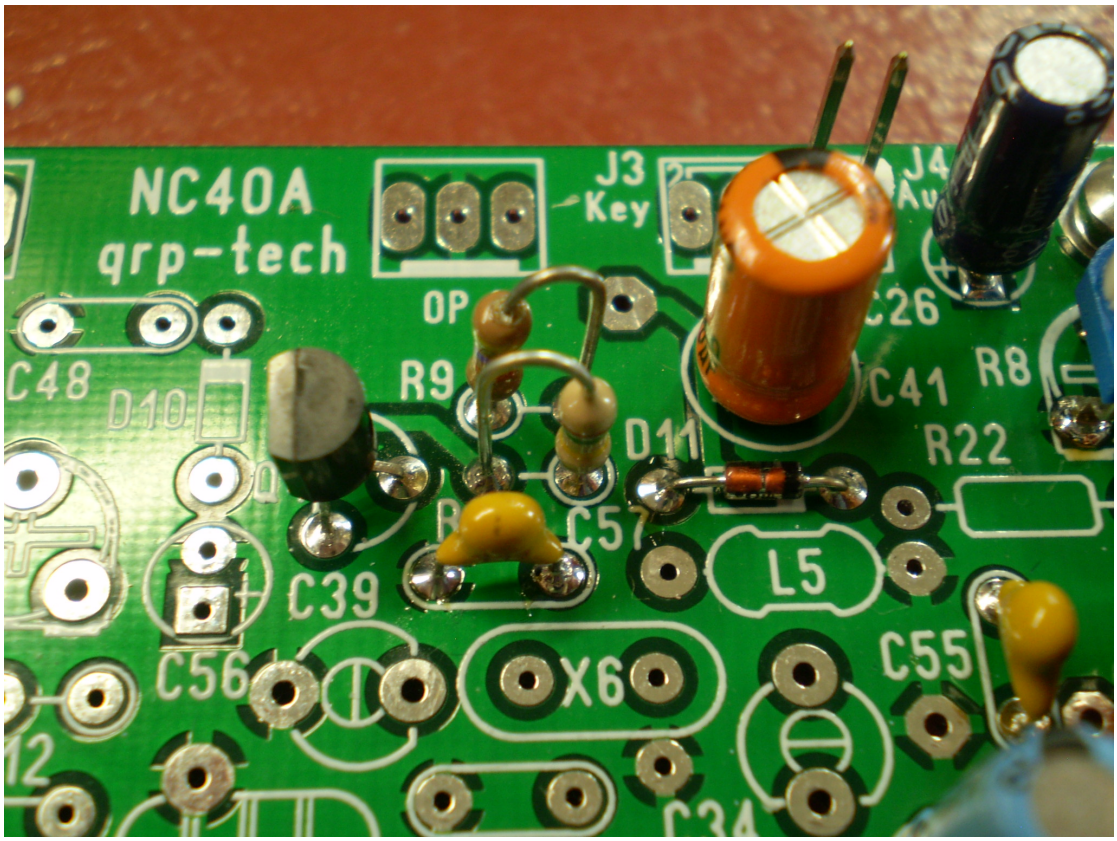

Figure 21: 3779.jpg.

Chapter 11

Phase 10 – Transmit Mixer, Bandpass Filter and Buffer

- ☐ C31 – 5pF disc or mono cap
- ☐ C38 – 100pF disc or mono cap
- ☐ C34 – 50pF variable trimmer cap
- ☐ C35 – 270pF disc or mono cap
- ☐ R10 – 510 ohm resistor
- ☐ L6 – T37-2 red toroid 28T of #28 magnet wire
- ☐ L5 – 18μH molded inductor
- ☐ X6 – 4.915MHz crystal
- ☐ Q5 – J309 or equivalent JFET transistor
- ☐ R11 – 510 ohm resistor

Testing.

Power up transceiver and key the transmitter. You should hear a weak signal in the receiver. Adjust C34 to determine if tone changes in pitch and adjust to tone you normally want to use when transmitting.

Chapter 12

Phase 10 – Transmit Driver Circuit

Assembly steps.

- ☐ Q6 – 2N2222A plastic TO-92 transistor
- ☐ R12 – 20 ohm resistor
- ☐ R13 – 500 ohm variable resistor set full CCW
- ☐ C56 – 10μF electrolytic cap
- ☐ D10 – 1N5817 Schottky diode
- ☐ C48 – 10nF disc or mono cap
- ☐ T1 – FT37-43 toroid 14T #26 (primar), 4T #26 (secondary)
- ☐ R14 – 100 ohms (for beta place reversed from silkscreen)

Testing.

Power up transceiver and key transmitter. Tone should be louder than previously heard. Adjustment of R13 should change the volume.

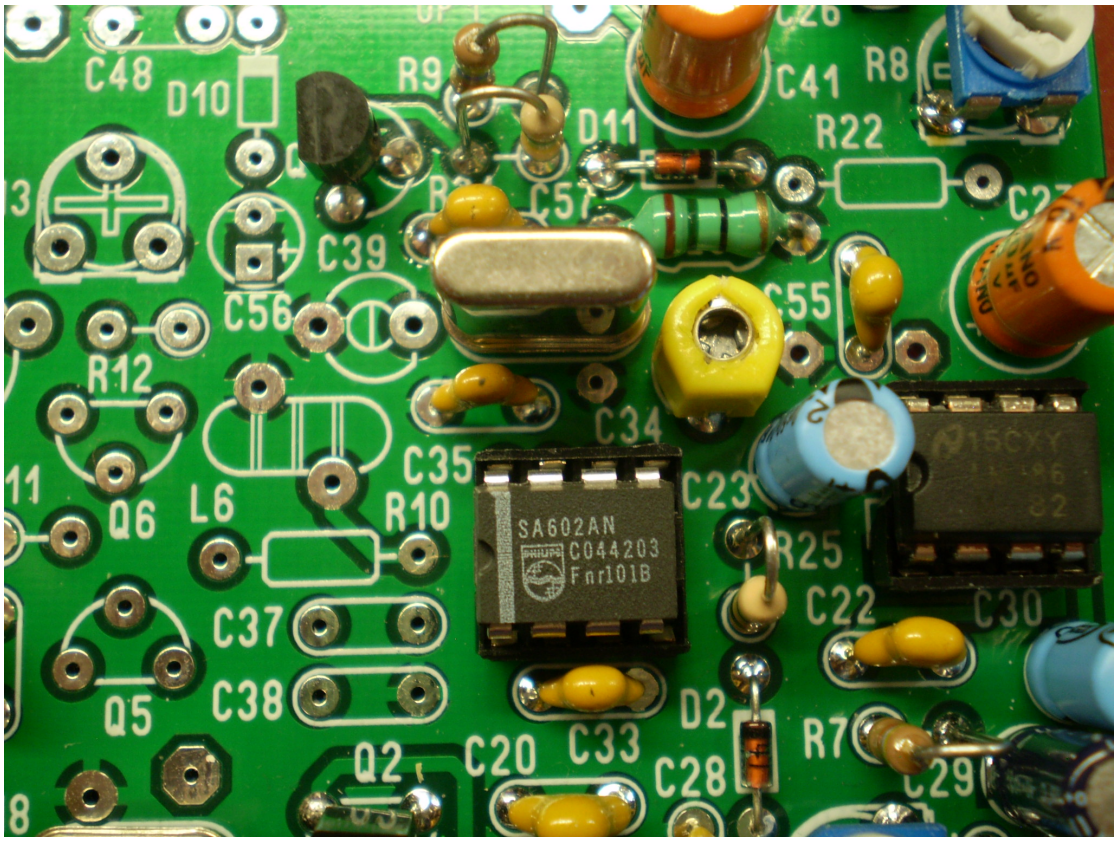

Figure 22: 3780.jpg.

Chapter 13

Phase 12 – Transmitter PA and LPF

Assembly steps.

- ☐ R18 – 1K resistor
- ☐ RFC1 – 18μH molded inductor
- ☐ C44 – 47nF disc or mono cap
- ☐ C45 – 330pF disc or mono cap
- ☐ C46 – 820pF disc or mono cap
- ☐ C47 – 330pF disc or mono cap
- ☐ D12 – 1N4755A 43V 1W zener diode
- ☐ Q7 – 2SC799 or equivalent PA transistor

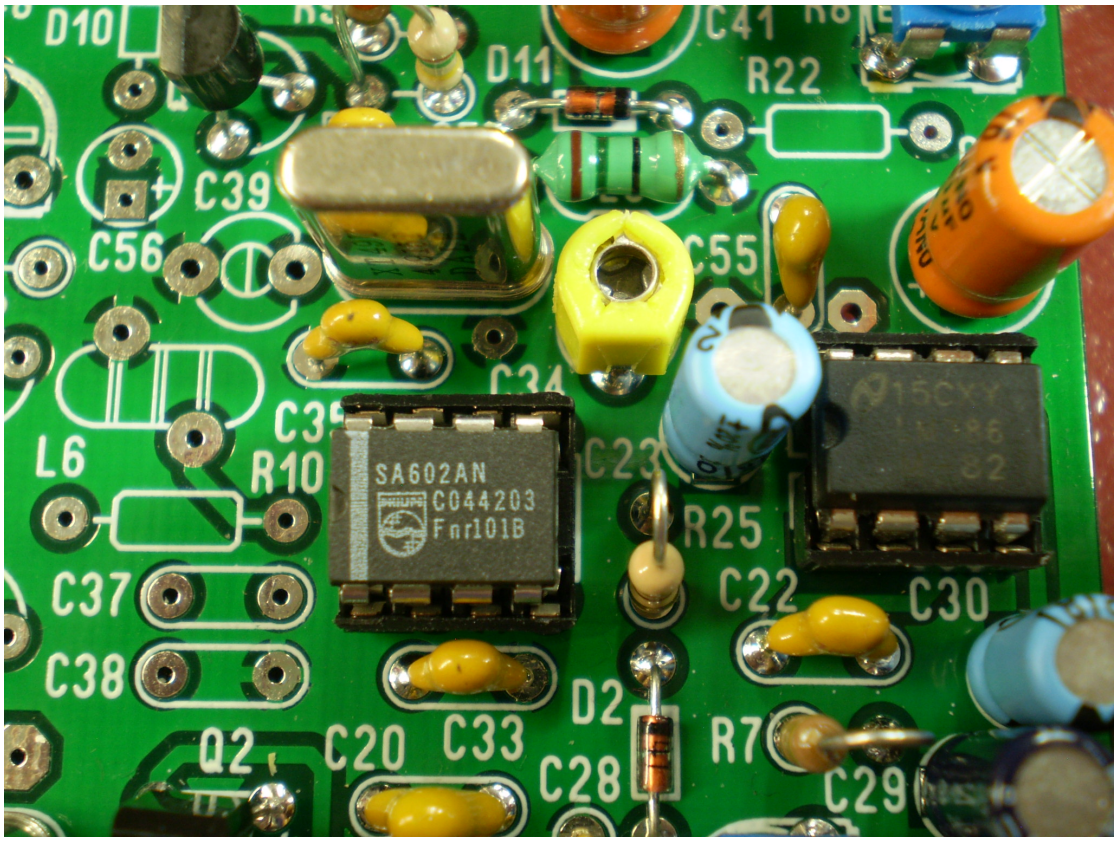

Figure 23: 3781.jpg.

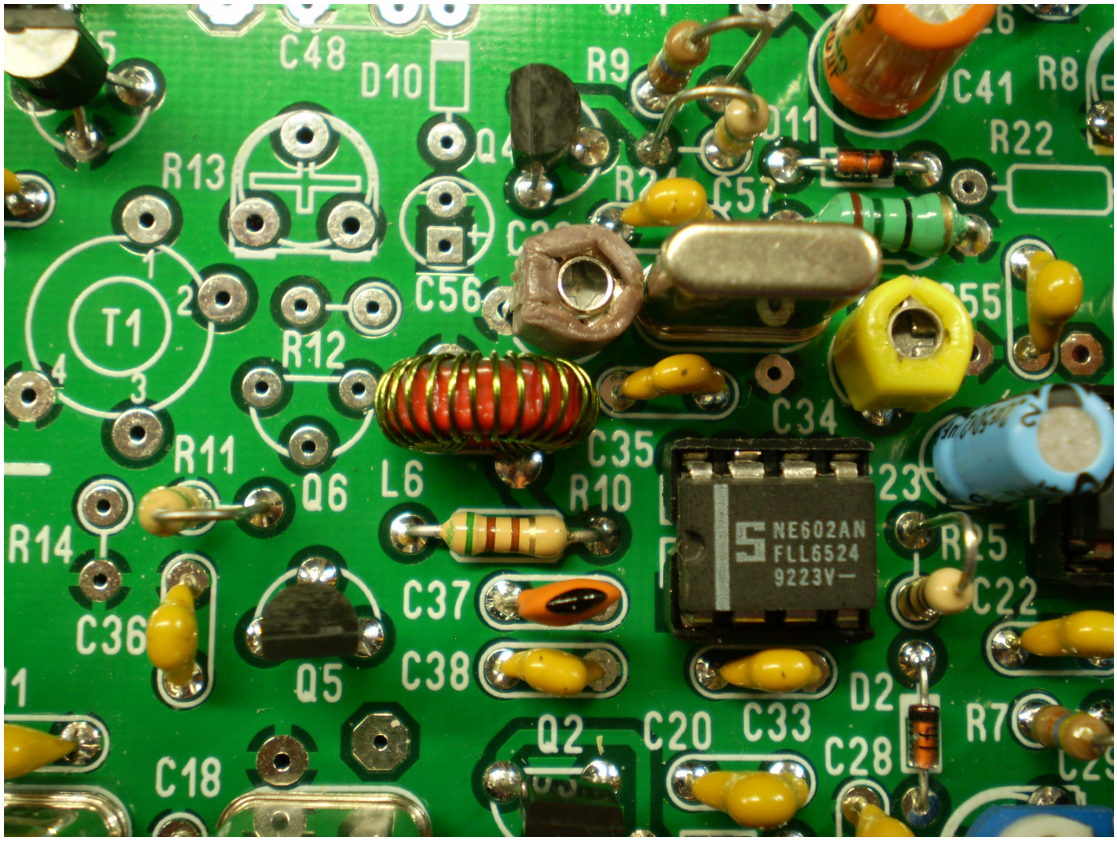

Figure 24: 3782.jpg.

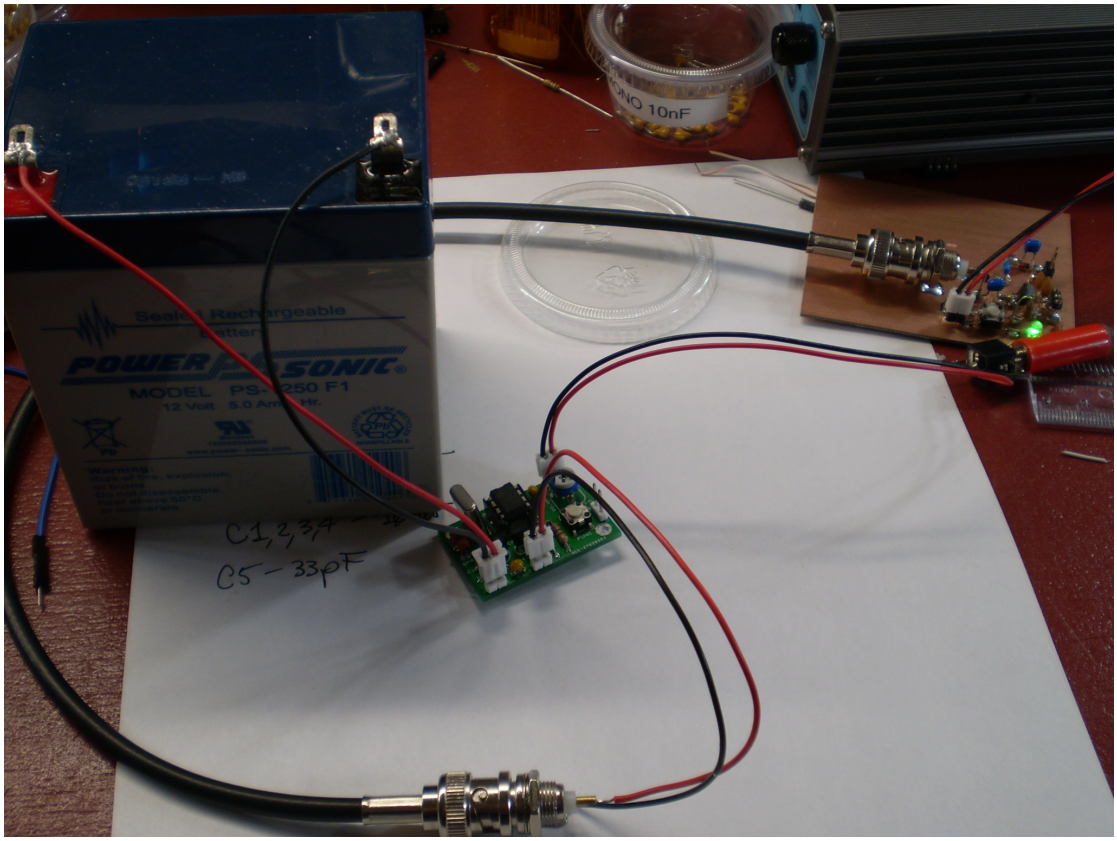

Figure 25: 3783.jpg.

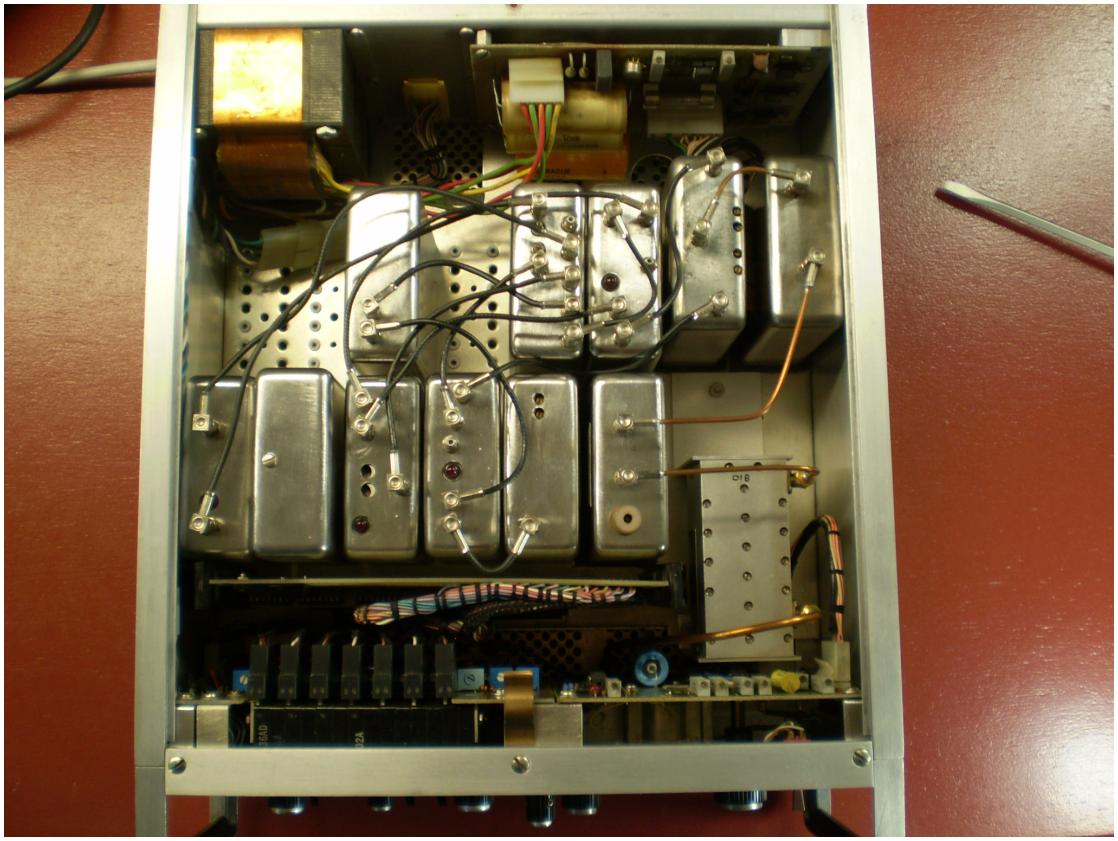

Figure 26: 3784.jpg.

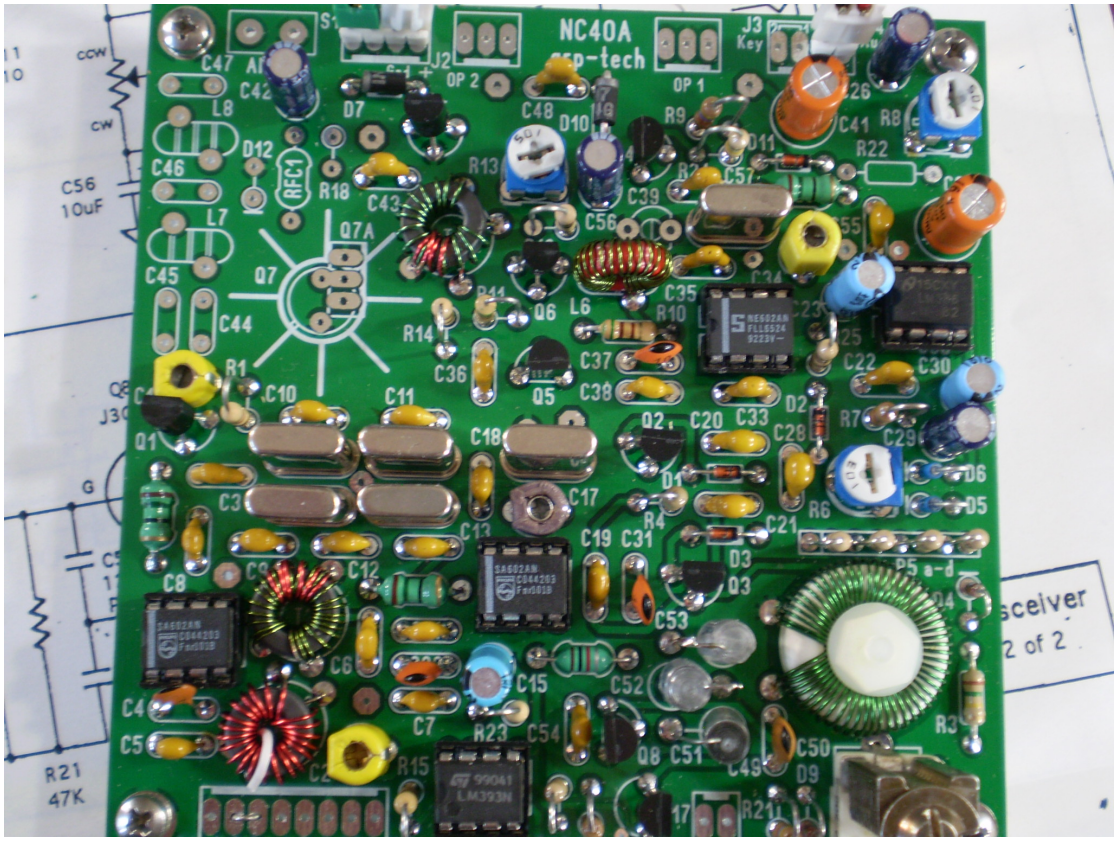

Figure 27: 3785.jpg.

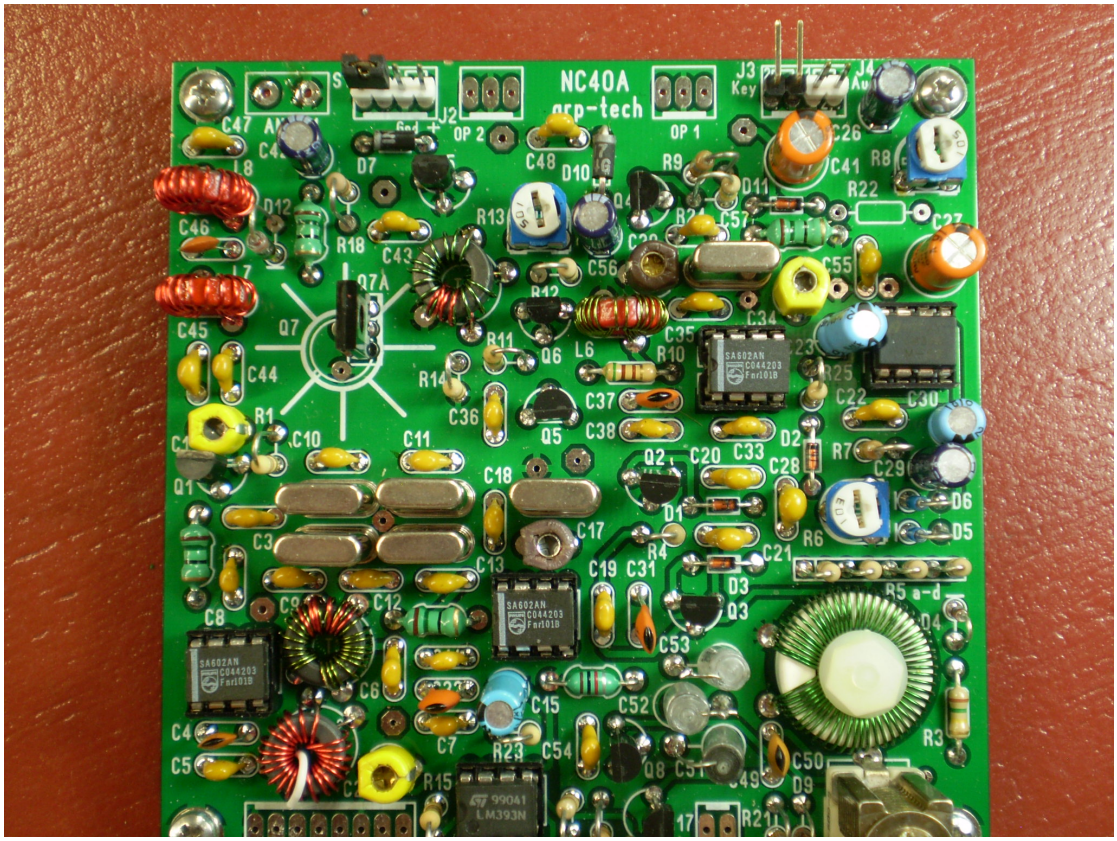

Figure 28: 3786.jpg.

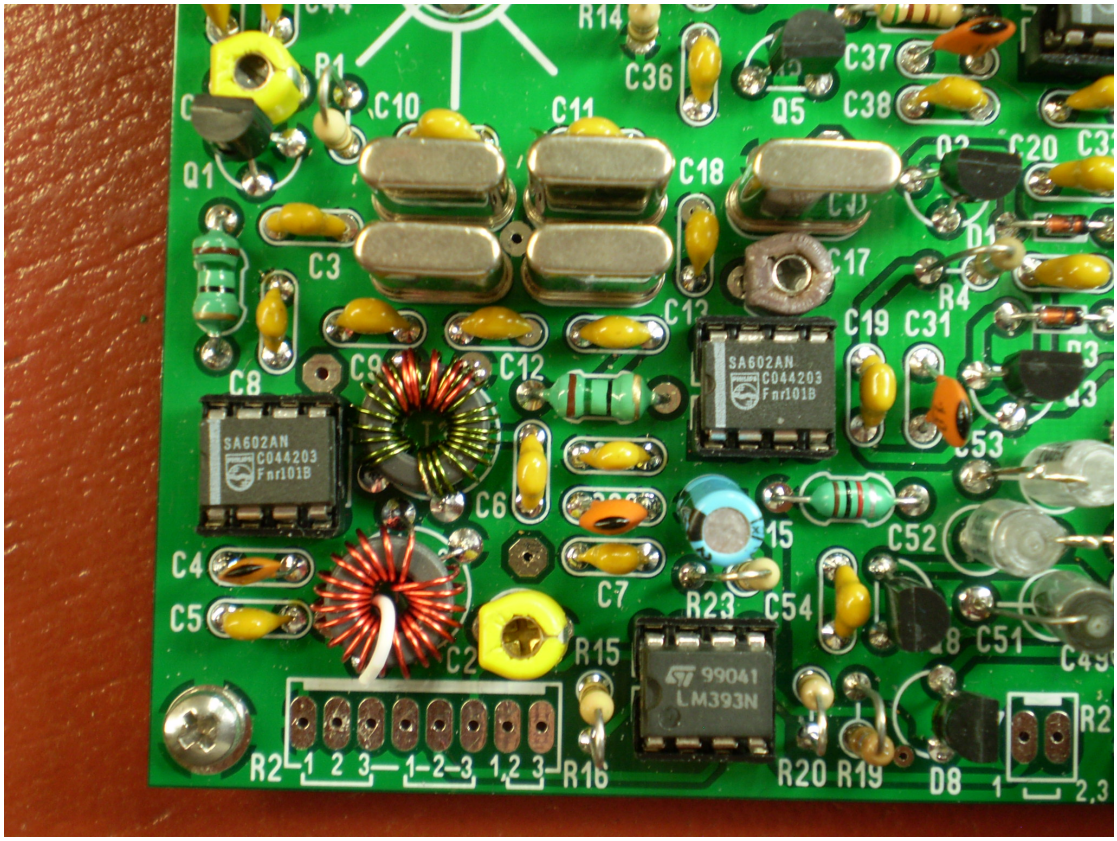

Figure 29: 3787.jpg.

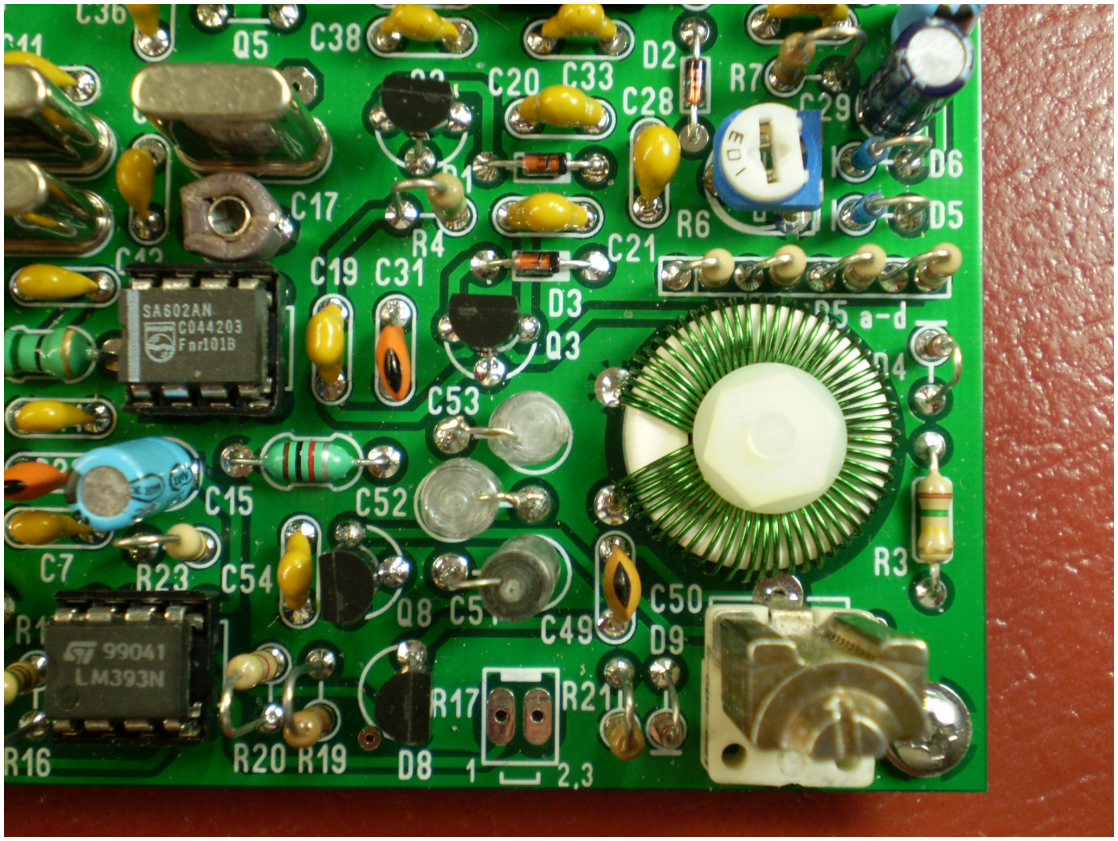

Figure 30: 3788.jpg.

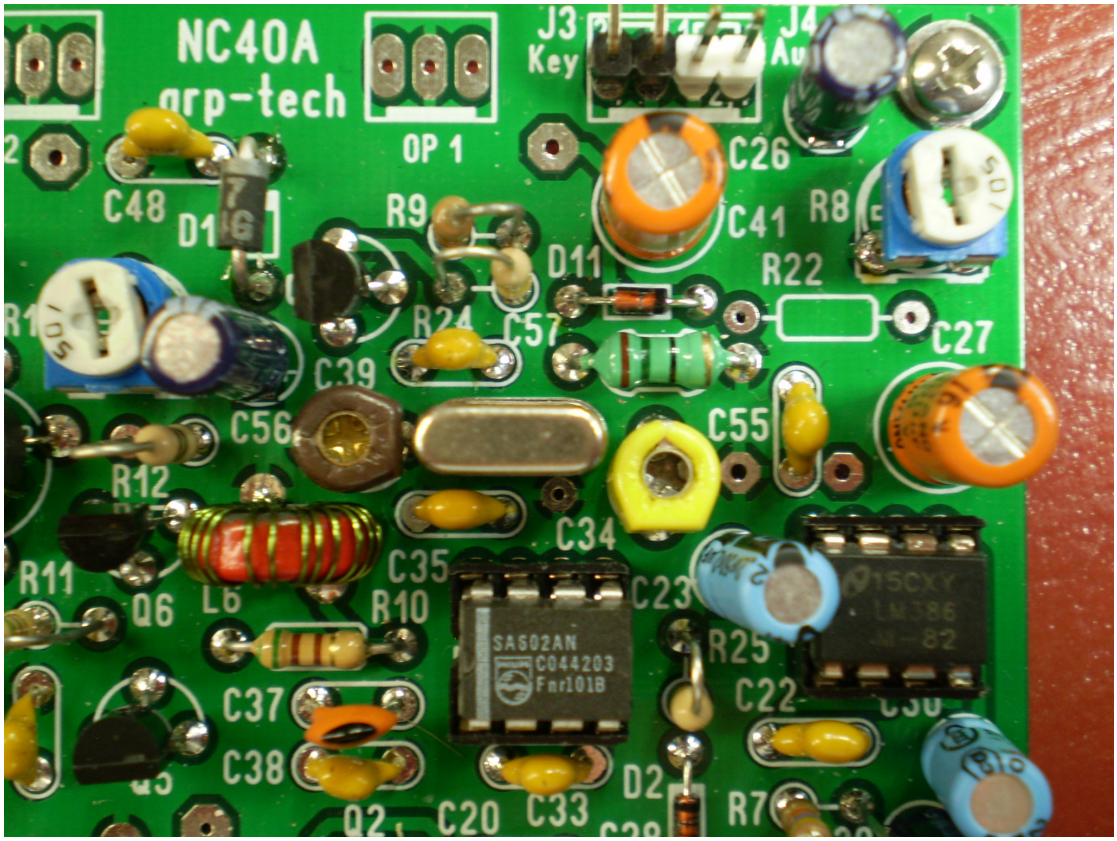

Figure 31: 3789.jpg.

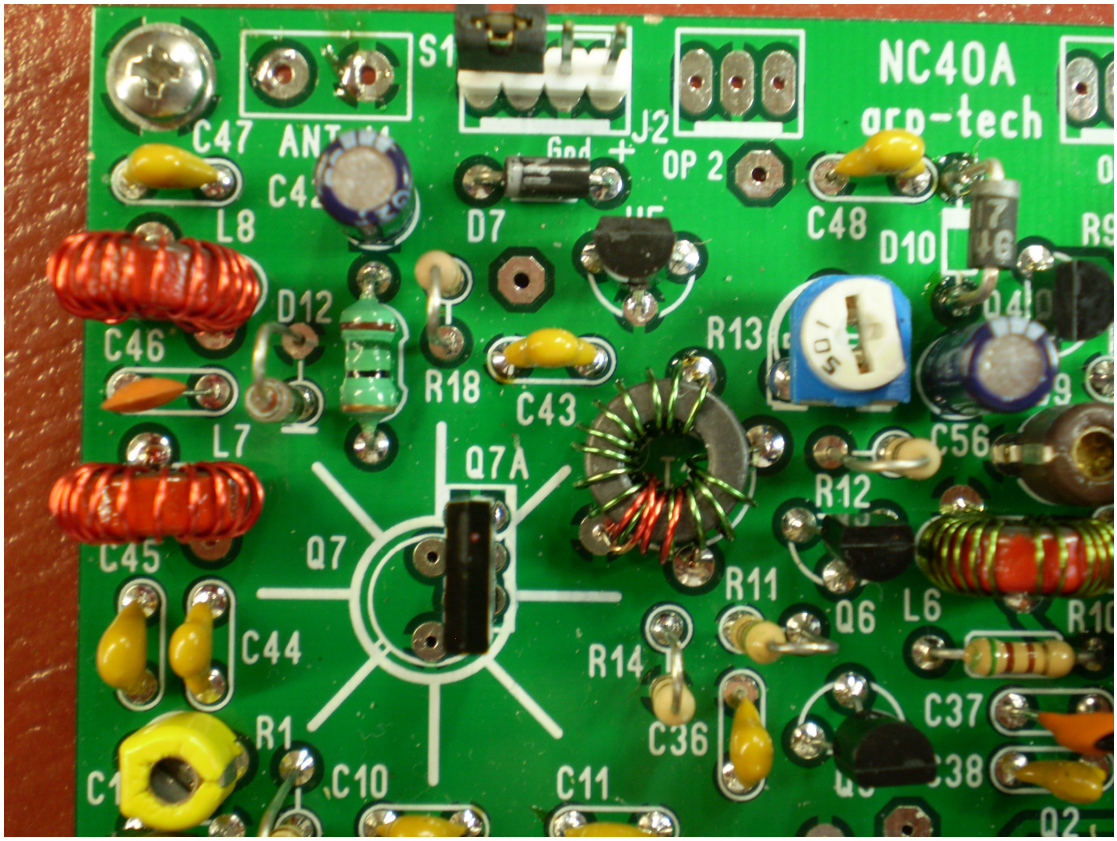

Figure 32: 3790.jpg.

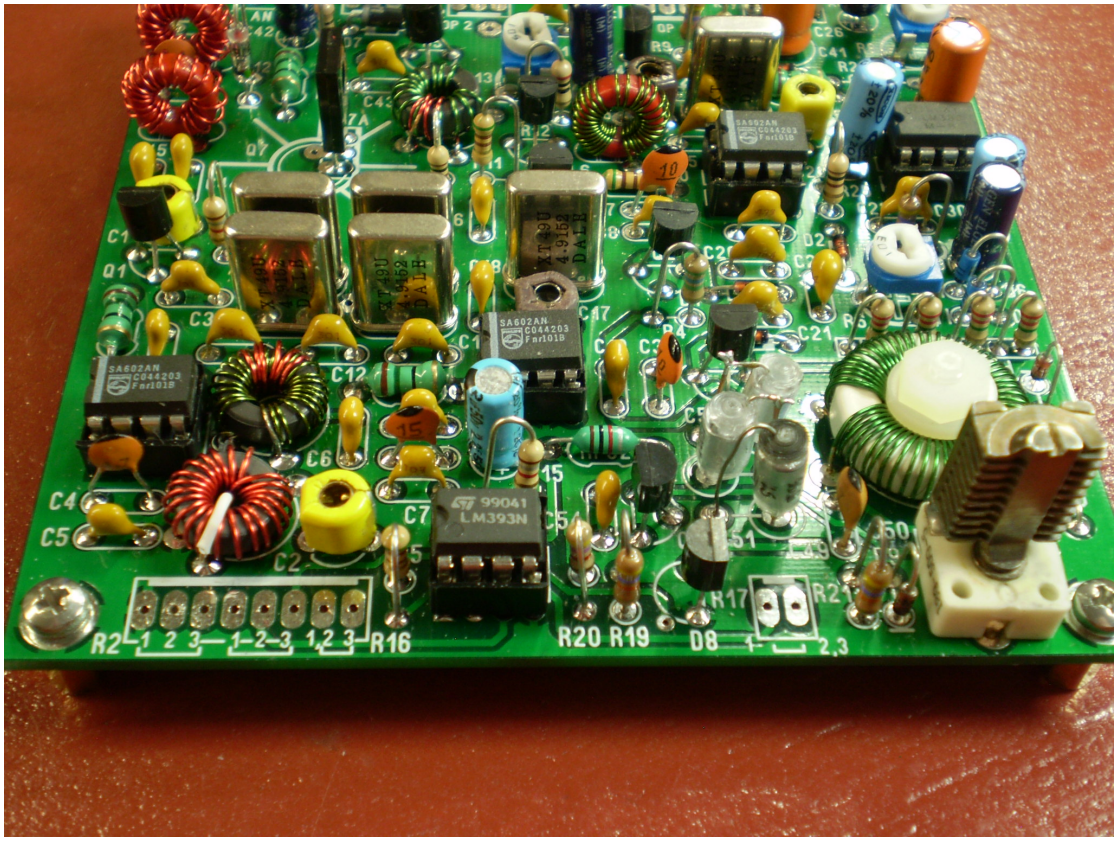

Figure 33: 3791.jpg.

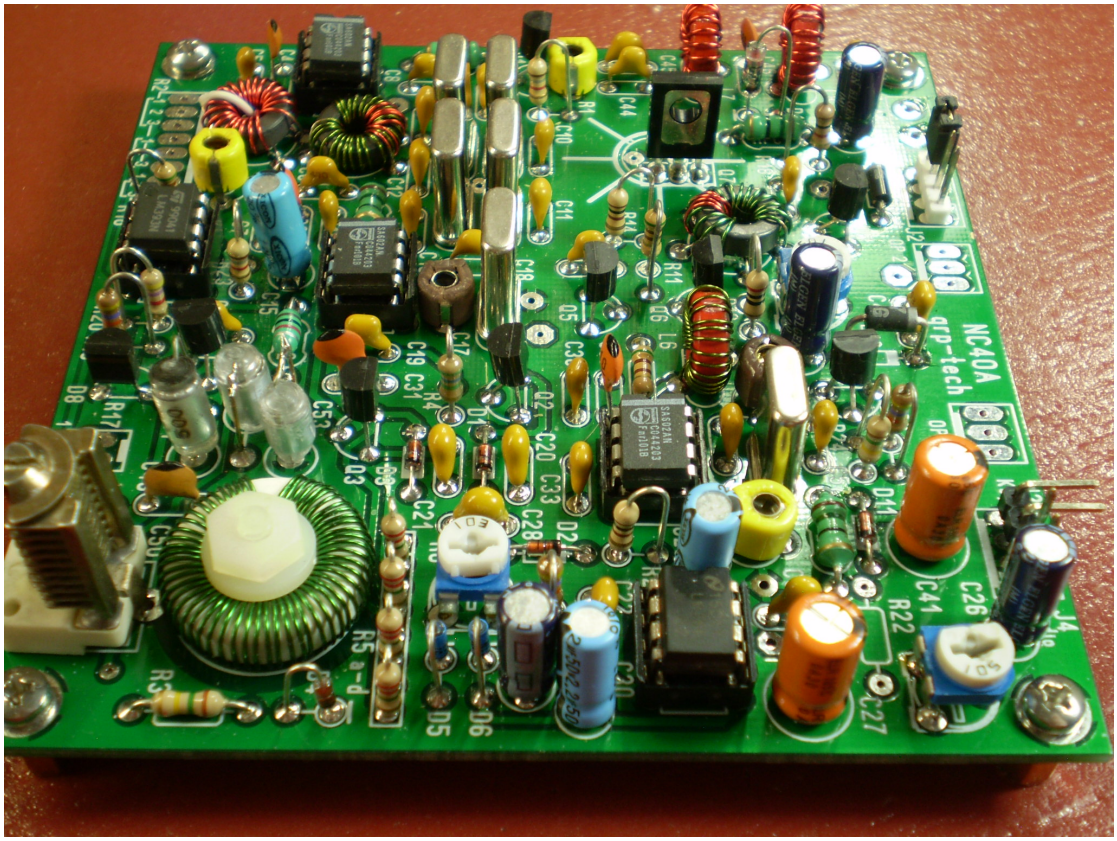

Figure 34: 3792.jpg.

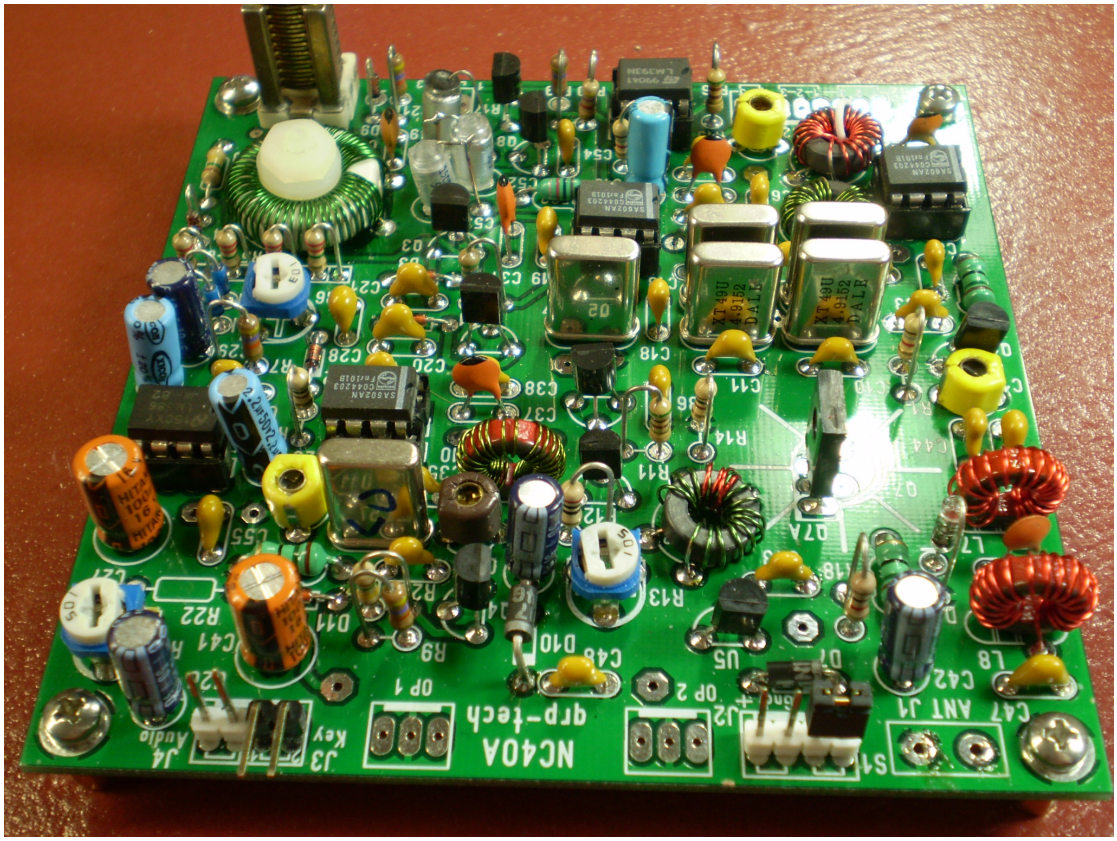

Figure 35: 3793.jpg.

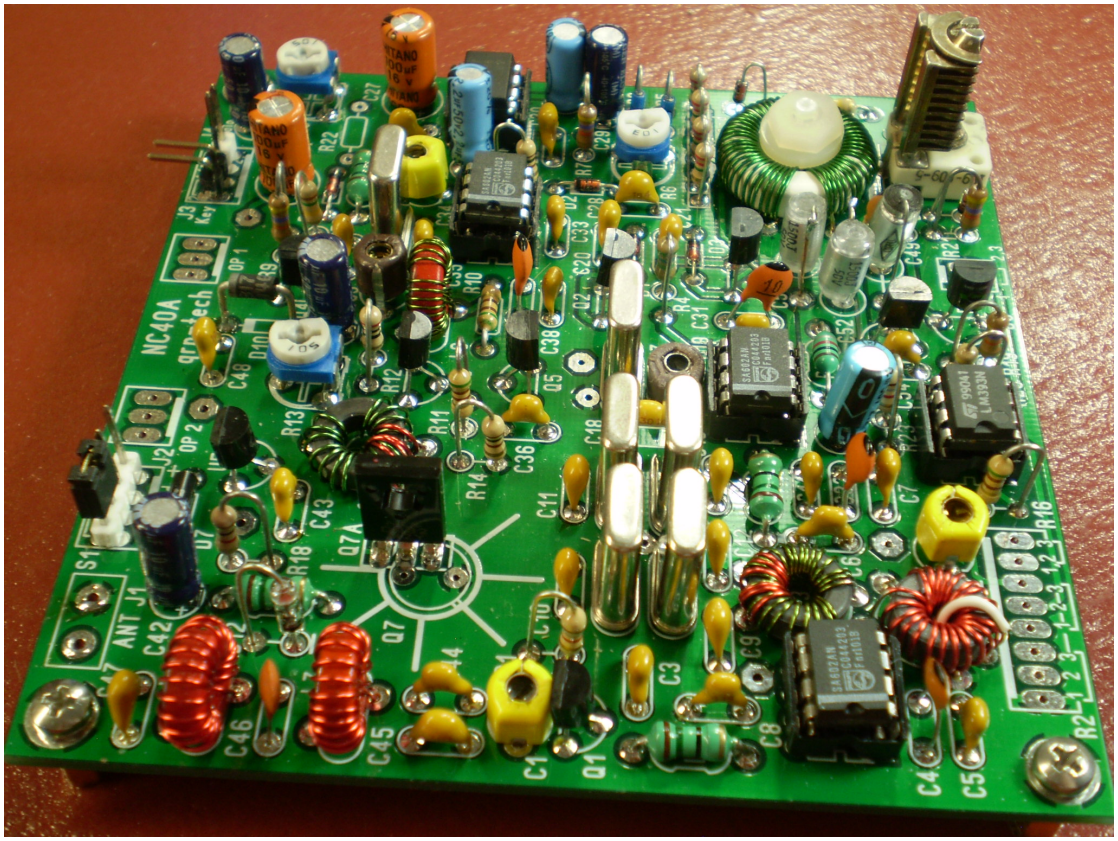

Figure 36: 3794.jpg.