CWTD

Chat With The Designers

SW30+
30m QRP Transceiver

Kit Assembly, Theory of Operation, Test & Accessories

June 30, 2016

*The **CWTD SW30+ Kit** is provided with permission & assistance from designer Dave Benson K1SWL*

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1) INTRODUCTION

Welcome to the primary document for assembling, testing and using the CWTD SW30+ Transceiver! This will serve as your roadmap of critical information to completing the kit and having a ball with it on the air.

A few remarks are needed at first about this project. Foremost is our gratitude to, and respect for, the original designer **Dave Benson, K1SWL**. Throughout many years Dave has been in the mainstream of defining how quality amateur radio components can be designed and inexpensively produced for kit builders throughout the world. His work has been present in nearly every issue of the ARRL Handbook since he came on the scene, and he's been featured in QST, QEX, SPRAT, QRP Quarterly, Ham Radio, Homebrewer, and more. His designs are legendary and have served to launch the project dreams of hams in every facet of our hobby.

So it is no surprise that Dave continues to help us all to explore and enjoy the hobby by enabling ***Chat With The Designers*** to produce a reprise this elegantly-performing transceiver kit … the Small Wonder 30+. He's provided the pc board gerber files, component recommendations and trade-off guidance, portions of his original documentation, and even some left-over parts he still has since closing down Small Wonder Labs! In a nutshell, Dave has been, and continues to be, a friend and an Elmer to us all!

And speaking of "Elmering", the "Small Wonder" product series has served as the basis for a number of ***Elmer 101 courses*** put together over the years by various hams through the country. We are adding to this pool of useful reference material by conducting an Elmer 101 series within CWTD in a number of back-to-back episodes, so as to further spread an understanding of design principles and basics of electronic assembly! Once again, the SW30+ design surfaces to help a new generations of hams have an appreciation and capability in ham radio electronics.

So … we offer this document as a starting point for assembling and using your Small Wonder 30+, but we also refer you to Dave's original manual, which has some great guidance on basics of kit building, parts inventorying and common sense testing. Further, we recommend that you too stand on the shoulders of those giants before us in the Elmer 101 courses. These extremely informative, creative and well-constructed supporting documents are all listed on the CWTD Elmer 101 page (www.cwtd.org/elmer101), and we urge you to really delve into this material as well.

Lastly, we wanted to acknowledge some team members who have helped put this project together for us (quite literally!) **Mike WA8BXN** served as an advance scout by building up one of the earliest prototypes to ensure that the parts available today would produce the same terrific results that Dave obtained over 20 years ago. Further, Mike chronicled his build-and-test exploits in a series of documents that he wrote along the way, which we are lucky enough to present to you in this document, as well as a spectacular "design walk-thru with a spectrum analyzer" document that will surface in just a little bit. **Larry K3PEG** is another guy working tirelessly behind the scenes to help us manage all the parts acquisition, inventorying and kitting. Without his eagle-eye part in this you really wouldn't have the kit you have in your hand today! Lastly, but equally important are our "partners" in this whole adventure, **Craig AA0ZZ** and the **Four State QRP Group**, who each have graciously contributed design effort and discounts on some really exciting "accessories" that are lined up for use with the SW30+. Thank you all! It is a real honor for us to be working with such a fine team!

So let's get right into it with some good technical background, provided right from the keyboard of the master designer Dave Benson, K1SWL himself!

73 and CU on 30m!
George N2APB
& Joe N2CX

2) THEORY OF OPERATION

(This section is straight from the original SW30+ manual … thanks Dave!)

This transceiver is a single PC-board design measuring 2.8" x 4.0" (7 x 10 cm). It features VFO operation with a 35- kHz tuning range, as well as QSK (full break-in) operation. Let's take the 50-cent tour:

The receiver's RF input is applied to U1 through T1 and C1, which provide a bandpass filter tuned to 10.1 MHz. T1's secondary winding provides roughly unity gain into U1 to minimize overload (IMD). U1 provides about 13dB of gain in this configuration, and converts the RF input to the IF frequency of 7.68 MHz. The L-network (C11 and RFC1) following the mixer serve to step the mixer output impedance down to the crystal filter's design value. Note that C12 and RFC1 appear to be 'transposed'; this reflects the board's physical layout.

The crystal filter itself uses 3 crystals. Loss through the filter is less than 2 dB, and with the component values as shown, the -6 dB bandwidth is about 700 Hz. Despite the filter's low parts count, performance is adequate when combined with the AF section's selectivity. The unwanted sideband image is down about 30 dB at the audio chain's 800 Hz peak response frequency.

The filter output is terminated in a 470-ohm resistor at the input to U3, the product detector stage. U3 converts the 7.68 MHz IF signal to audio and contributes another 13 dB of gain. BFO crystal Y4 has been selected to match the IF filter frequency, so there's no BFO frequency trimming needed. The .033uF capacitor across pins 4 and 5 of U3 provides the first measure of audio low-pass filtering.

The two sections of U4 each provide roughly 30 dB of amplification. The first section is configured as a differential amplifier to make use of U3's differential output and rolls off the audio response above 1.5 KHz. Diodes D3 and D4 serve to limit the audio swing during transmitter key-down to reasonable values. Without these diodes, this stage saturates and upsets the operation of the following FET switch section.

The AF mute function is the familiar series FET switch popularized by W7EL. Despite its relative simplicity, it's hard to beat this circuit for click-free audio switching. In the "key-up" condition the FET is zero-biased and acts like a resistance of several hundred ohms. In the "key-down" condition the FET is in cutoff (because the gate is now 7-8 volts below the source) and acts like an open circuit, preventing audio from getting to U4B, the audio final stage. This stage is configured as a bandpass filter centered at 800 Hz. The high gain of the two AF amplifier stages (64 dB total) allows a design with no IF amp stage. The audio output level is adequate to drive headphones, but it won't do the job for loudspeaker applications. The AF output stage internally overcurrent-limits on loud signals to provide a ready-made ear protection function. If you're interested in saving at least 5 milliamps on receive, U4 may be replaced by an LMC662 (available from Digikey). This suggestion is courtesy of Mitch Lee and Dennis Monticelli, from their excellent article, "Revisiting the 40-40" in the ARRL's 'QRP Power'. Use good quality low-impedance headphones for best results. "Walkman" headphones are fine, but remember – you get what you pay for. The 3-dollar bargains are distinctly inferior!

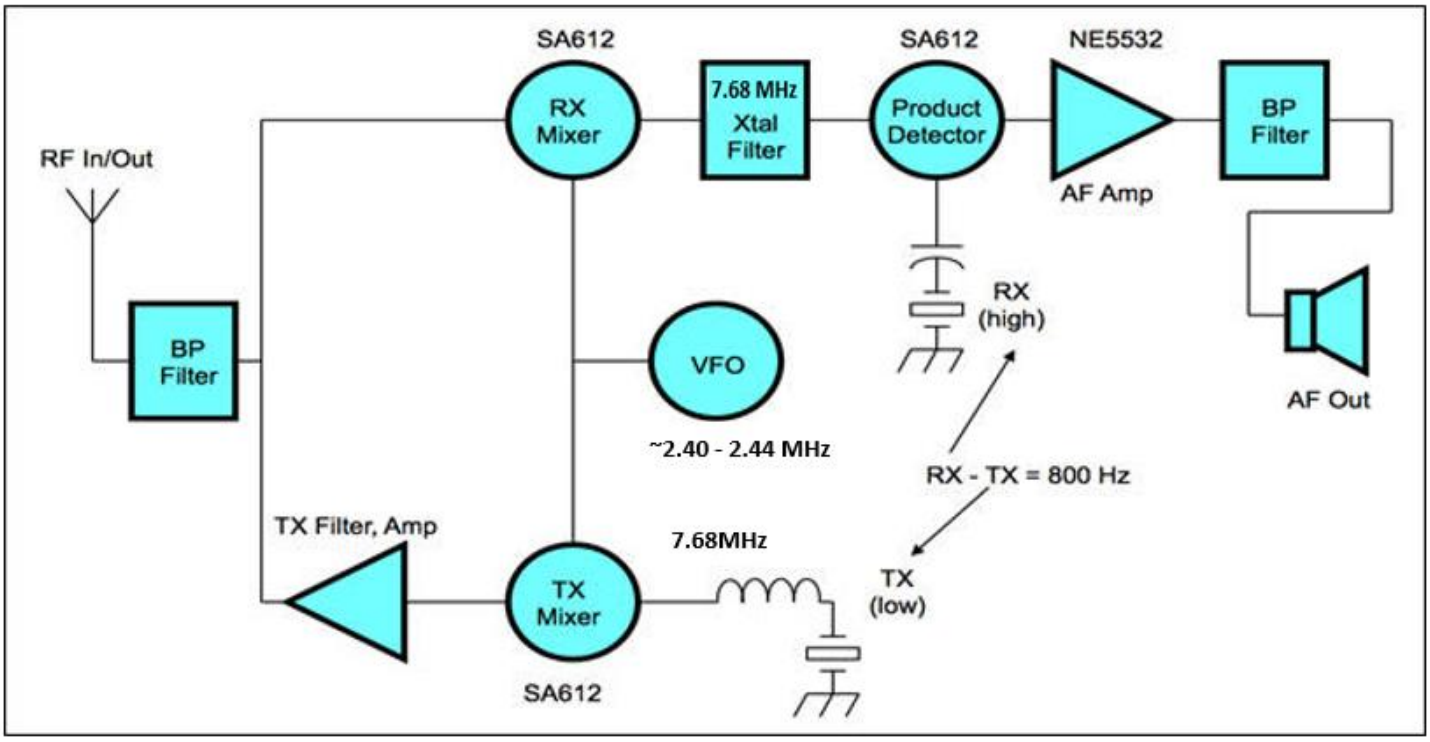
QSK: The T-R switch function is provided by C40 and RFC3, which form a series-resonant circuit. Diodes D7-D10 limit during key-down and thereby restrict the signal levels presented to the receiver front-end during transmit. The double-diode configuration raises the network's intercept point with respect to W7EL's original configuration to improve IMD immunity.

The LO uses the Colpitts configuration. The frequency-determining capacitors are NPO (C0G) monolithic types. These devices are extremely compact and offer good temperature stability. C2 and C3 are a voltage divider providing proper injection to U1. Note: If you want broader frequency coverage, the value of C8 may be increased. The useful upper limit for C8 is about 1000pF, and especially at the larger values, capacitor (and varicap diode D1) thermal stability will become crucial. Use NPO/C0G capacitors if possible, if you tinker with this circuit.

The design also uses a varicap tuning diode for tuning coverage. While a smooth ball-bearing tuning cap and vernier reduction drive are the preferred approach, that choice drives the cost and mechanical complexity of a transceiver up considerably. The varicap approach supports quite a compact package! If you've just got to have RIT, an outboard circuit that injects an adjustable DC offset into the diode bias network on receive does the trick.

The transmitter chain is a pretty standard affair. The maximum output power is about 2-2.5 watts, and there's a drive control at the emitter follower stage (Q4) to adjust the output level. The diode at the base of Q6 serves to 'clamp' the signal to

Q6 above ground and thus improves drive to the PA by several dB. I don't feel that the PA requires a heat sink at the 1.5-2.5W power level and CW duty cycles. If you like, there's room for a 'compact'-style TO-220 heat sink (Digikey #HS-105 or #HS-106).



3) ASSEMBLY & TEST … *Step-by-Step*

The test procedures at the end of each part of the assembly instructions are short and to the point for those whose goal is just to build the radio and do so without problems. In this document I am going to talk about what the tests check and some pointers on what to do if a problem is encountered.

First let me talk a bit about test equipment. It's nice to have lots of test equipment. It's more important to know how to use what you have. For most of the test suggested, a digital volt meter (DVM) is needed. One of the free DVMs offered by Harbor Freight from time to time will do just fine. An RF probe to allow measurement of RF voltages with the DVM which is documented in these various documents is also quite useful.

A frequency reference is required if you are going to put the rig on the air so you will be operating within the 30 meter band limits. A frequency counter will do if you have one. A calibrated receiver (or transmitter into a dummy load) will also work. Just stay away from band edges as needed for the accuracy you have available to you with whatever frequency reference you use.

In most of the assembly parts I reported the values I measured while assembling the radio on the circuit board used in the CWTD kit using parts I obtained myself (not exactly the parts provided in the kit). This should not be an issue. What is an issue is comparing your measurements with mine and knowing if there is a significant difference.

In my testing at different stages of the assembly process I used a regulated power supply set for 12.0 volts, using the digital meter in that power supply. That power supply also displays the current in hundredths of an amp, which I reported. Typical receive current shows as 0.01 A. I suspect that could be a current of between 5 and 15 mA. I'm not sure about accuracy, about +/- 10% is a fair guess. The current I document is just a ballpark number.

If you are using a supply voltage of other than 12 volts, some of your readings will be different. I say some because some should not be affected by supply voltage due to voltage regulation found in various parts of the circuit. If your reading is within 10% of mine, that's great. Twenty percent is probably OK too. If we disagree by 50% or more there likely is a problem.

Part 1: IC Sockets

No electrical test instruments are needed here of course. Visual inspection needs to be done at each step but I mention it only here. Obviously, make sure the right parts are installed in the right places with proper orientation. Using an ohm meter to make sure you have the right resistor each time is not a bad idea if there is any doubt about the color bands.

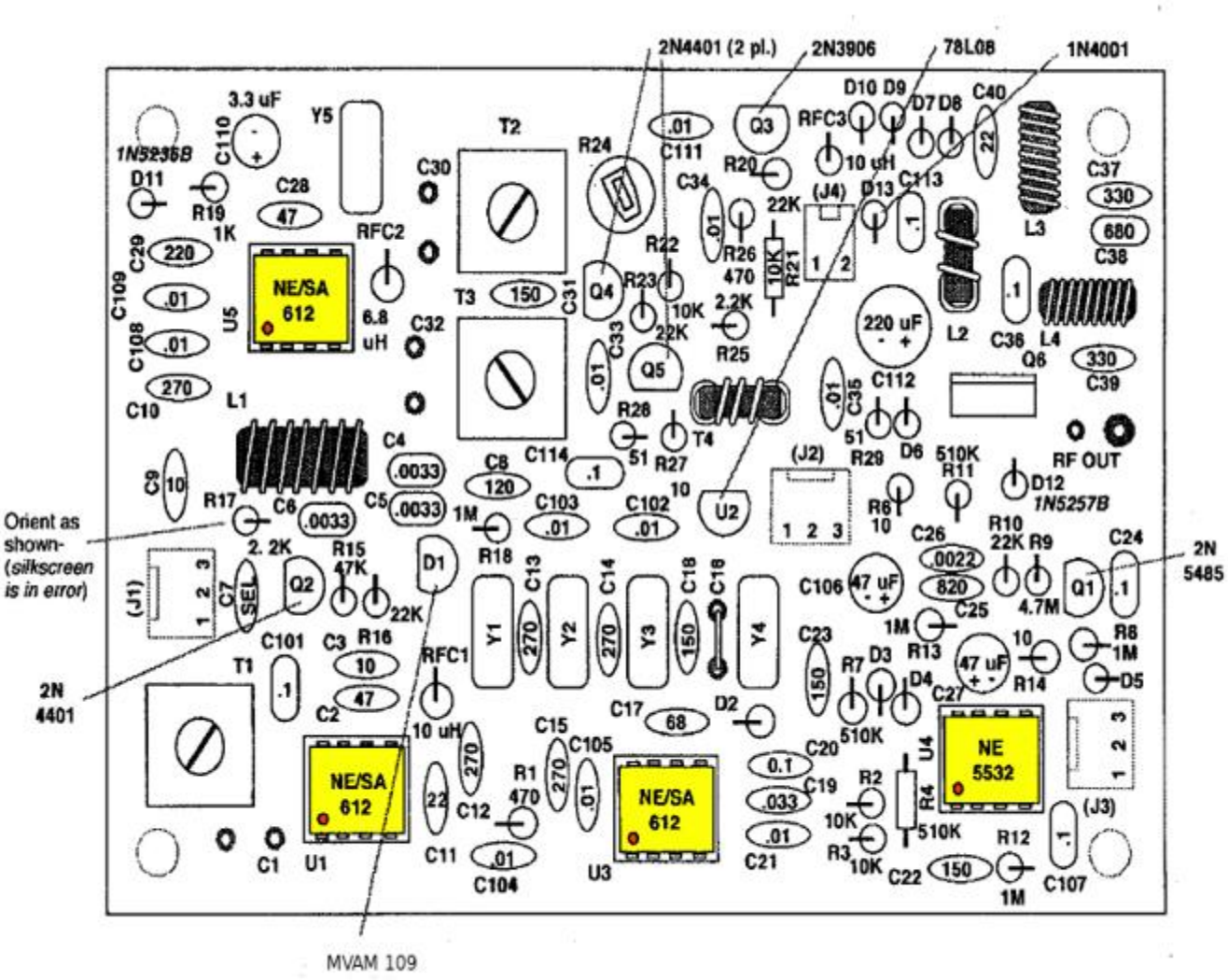
Some visual equipment might be handy. The markings on some of the capacitors is mighty tiny. A magnifying glass of some sort is handy to have. If you have a scanner with a flat glass, it might help some. A digital camera with macro setting is a good way to be able to view an enlarged image of individual parts or either side of the circuit board as you are assembling it on your computer screen.

Check your soldering carefully and frequently. Bad soldering is reported to be a leading reason why kits don't work when completed. Wrong parts is probably the number 2 reason. Very low on the source of problems is bad parts.

I strongly suggest you print on paper the assembly instructions and cross off each part listed there as it is installed. You might also want to print off the schematic and board layout sheet from the original SW30+ manual and cross off parts as installed there too.

Assembly:

Install the 8 pin sockets for U1, U3, U4 and U5. Hold the sockets in place on top with a stiff board as you flip the circuit board over to do the soldering. Orient sockets as shown (red dot is pin 1, notch in socket at this end).



Part 2: Power Supply

The power supply tests are quite basic. They make sure the supply voltage gets connected to the board and the regulator is working. If you don't see near 12 V on the banded end of D13 make sure that you have power connected to the board. Make sure the diode is installed properly and that you have the polarity right from your power supply. Current from the supply to the board should be about 0. A large current draw at this point suggests a solder bridge somewhere (something fairly hard to do on these boards).

WA8BXN Notes:

Very carefully bend leads on C102 as needed

An onboard connector is not supplied for J4 (or for others)

There are various wires supplied in the kit, I picked the red and black ones from the ribbon cable to connect the power connector to the J4 position, red for +12 V and black for ground.

The supplied power connector pair match but are 5.5x2.5 mm which is different from the size used for most other stuff, namely 5.5x2.1

The power connector socket supplied in the kit is weird. A picture is needed on how to wire it. The center connector is pretty obvious but the other two tabs are isolated and connected to each other when the plug is removed. The ground side of the connector is the threaded part that mounts to the chassis.

In wiring power to the J4 labeled board holes, +12 v goes in the hole closest to D13.
Fortunately, because of D13, if you wired it wrong there will be no damage.
It just won't work.

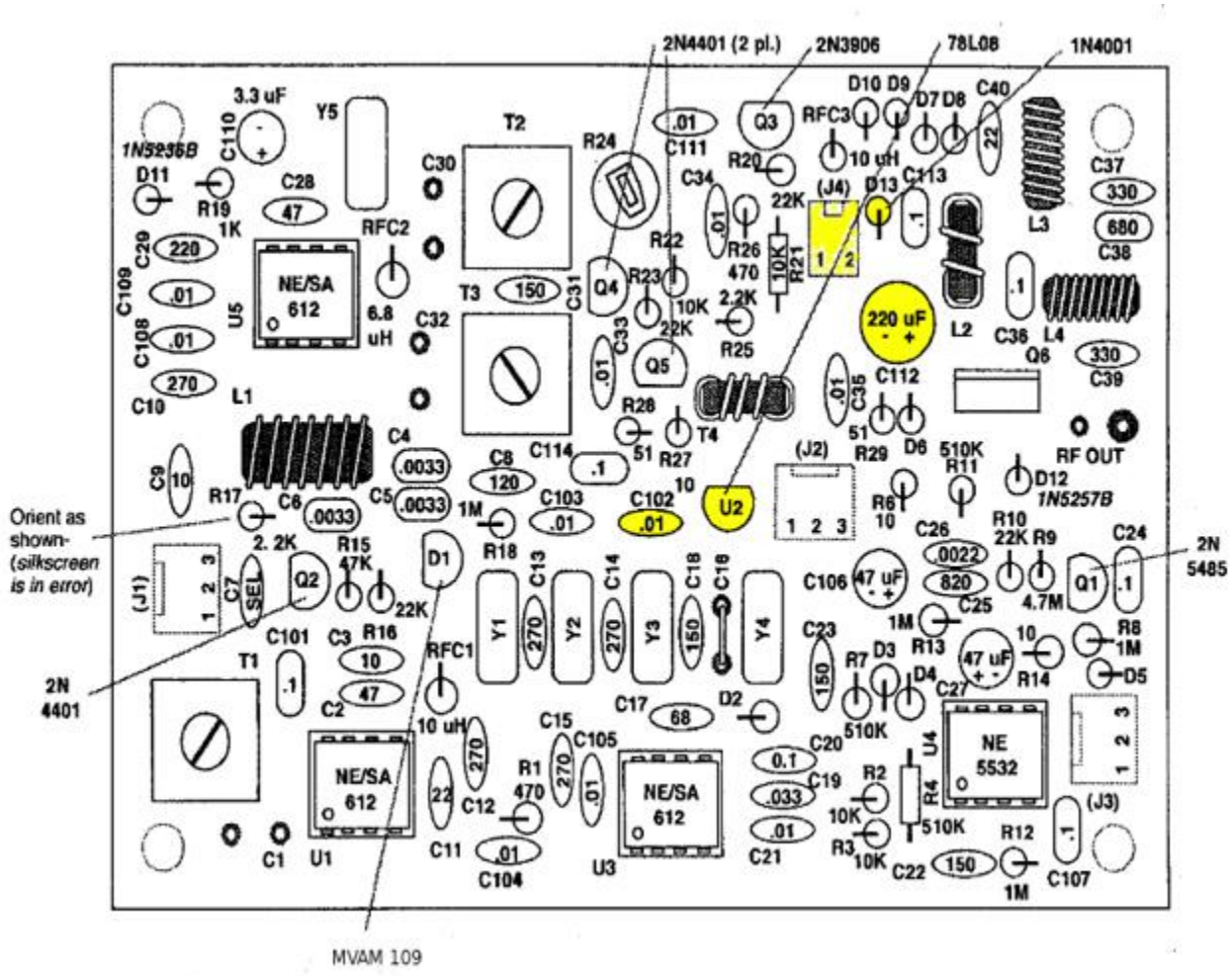
Problems with the +8 V measurement could be bad soldering or installing U2 improperly. You should see very close to 8.0 volts more or less independent of the voltage you supply to the board.

Don't proceed to the next step until you get the right measurements. Of course in each of the steps getting the right values does not guarantee that everything is perfect but is probably good enough to proceed.

Note that in the original SW30+ manual Dave provides a copy of the schematic with various voltages in the circuit. This can be a handy resource beyond my notes here.

Assembly:

D13	1N4001 diode, note banded end should be "up" with body in circled hole
C102	.01 uF capacitor (103)
C112	220 uF electrolytic capacitor --- note polarity
U2	78L08 voltage regulator (looks like a transistor) orient as shown on board
J4	Not supplied. (You can just solder the power lead wires to these pads)



Test procedure:

Connect + 12 V DC to pin 2 of J4, pin 1 of J4 is ground.
Measure voltage at banded end of D13, should be slightly (0.7 V) less than 12 V supply.
The output of regulator U1 should be about 8 volts (measure at pin 1 of J2)
Note: The 4 mounting holes at the corners of the board are ground.

Disconnect power

Measured results (using 12.0 V supply):
D13 …11.41 V
J2 Pin1 … 8.03 V

Part 3: VFO

This is a big step in the assembly. The basic test is to see if it oscillates. Supply current to the board although not noted should be a few mA. The test point is the base of Q2. Find it on the schematic. The top of R15 is where you can access it easily. Anything we connect there to make some kind of measurement is probably going to have some effect on the circuit.

One easy way to see if its working is with a receiver that tunes to around 2.4 MHz, the frequency that the VFO approximately runs on. You don't need to actually connect the receiver to the board in most cases. If you hear it close to that, great. If not, a commonly reported problem is with L1. Make sure the insulation on the wire was properly removed and its properly soldered in place. If the frequency is off by much (say 100 Khz) make sure you have the right number of turns on the toroid and that all the capacitors are the right value. Note that C7 will be installed later in the assembly process.

A frequency counter could also be used to check to see if its oscillating and near the right frequency. Connecting the counter to the test point will probably change the frequency a bit. Its also possible that if the counter loads down the circuit too much it might not oscillate at all. Simply using a receiver to listen for the signal has some advantages over trying to use a counter!

Once we know we have oscillation on about the right frequency we might want to get an idea if its amplitude is in the ballpark. Using a scope, I measured about half a volt peak to peak at the test point. Again, making that connection does have some impact on the circuit. I also tried using my simple RF probe with a DVM and saw about 4.5 volts there. Note that just trying to use the AC volts function of a DVM won't work very well if at all.

Ultimately, a potentiometer will be connected to J2 (check the schematic). This will allow adjustment of the voltage on D1 to allow tuning. A quick check of the tuning range at this point can be done by simply connecting a jumper between pins 1 and 2 and then between pins 2 and 3. My tuning range turned out to be between 2.4 and 2.43 MHz which is quite close to what it needs to be when we are all done.

WA8BXN Notes:

The sheet of capacitors (and a few inductors) is really a great help in finding the components! I still checked each with a magnifying glass. There really are numbers on them. So far I have found no errors. It is not obvious however that these are NP0 caps.

Winding L1: somehow the length of wire to used got dropped, use 18 inches (gives 1" leads, use a bit longer wire if you prefer for winding). Be sure to tin the leads all the way up to the core, it is heat strippable wire in the kit. It is said that soldering the leads can be tricky if not stripped well, carefully check after soldering!

D2: First, it's hiding over there by U3. In the packet of diodes I got in my official kit there were 2 loose diodes and a number of taped ones. The 1N4148 is one of the taped diodes, and it's number is fairly readable. Now might be a good time to identify those two loose diodes and label them yourself with a piece of tape or something. They were not so easy to read the numbers on.

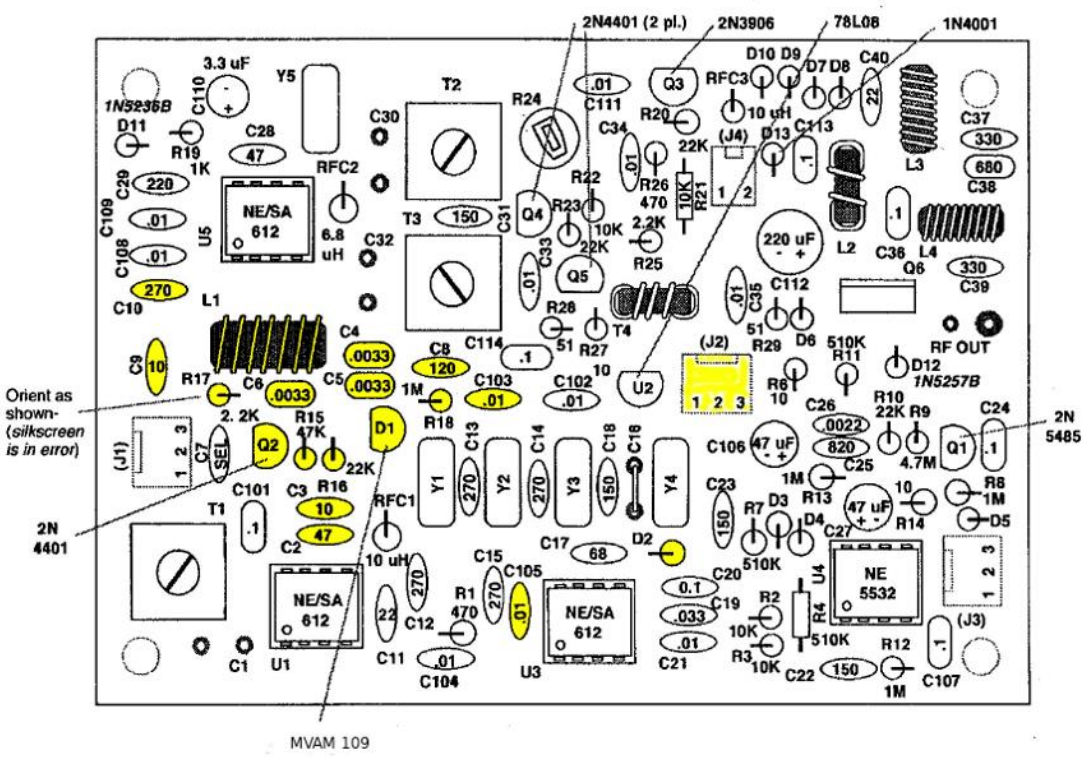
For the fun of it, I checked the 4 resistors used in this step with an ohmmeter to be sure I read the color codes right.

And now after I soldered all the components the big test ... I used a general coverage receiver (actually an old Kenwood TS-440) with a wire laying on Q2

connected to the antenna input of the TS-440, I do find a carrier on 2.46 MHz. Touching L1 causes it to warble, so I found the right frequency. It's quite strong with no direct connection, about 10 dB over S9.

Assembly:

C2	47 pF NP0 capacitor (470)
C3	10 pF capacitor (100)
C4	3300 pF NP0 capacitor (332)
C5	3300 pF NP0 capacitor (332)
C6	3300 pF NP0 capacitor (332)
C8	120 pF NP0 capacitor (121)
C9	10 pF capacitor (100)
C10	270 pF capacitor (271)
C103	.01 uF capacitor (103)
C105	.01 uF capacitor (103)
D1	MVAM109 varactor diode (looks like 2 lead transistor), position as shown
D2	1N4148 diode, note banded end "up", body into circled hole
L1	29 turns #24 on T-50-6 (yellow) core
Q2	2N4401 transistor, orient as shown
R15	47K ohm resistor (yel-vio-org)
R16	22K ohm resistor (red-red-org)
R17	2.2K ohm resistor (red-red-red) … install R17 reverse to what the silkscreen indicates!
R18	1M ohm resistor (brn-blk-grn)



Test procedure:

Apply power. Base of Q2 should have around 2.4 MHz sine wave (probe at top of R15).
Measured: 5V PP, 2.43 MHz J2 1-2 jumper, 2.40 MHz J2 2-3 jumper
1.76 Vrms using RF probe into DVM
Disconnect power.

Part 4 – Keying and transmit mixer

I followed the wisdom of others in using the assembly step ordering of the various Elmer 101 renditions. They mostly dealt

with the 40 meter version of the radio, I've tailored details for our 30 meter radio. If I had not had that previous foundation to follow, I probably would have first done the receiver construction and then work on the transmit side of things.

This ordering makes a lot of sense in terms of testing during construction. The next several parts of the assembly process will work on the transmitter up to but not including the final amplifier (which will of course be completed later). This clever approach will allow us to use the transmitter to provide a test signal for receiver testing.

The “Keying” part of this step in assembly, Q3 and associated components (take a look at the schematic), is part of the rig that handles changing between transmit and receive. Pressing down on the key causes Q3 to conduct, supplying 12 volts to most of the transmitter components (the final amplifier gets power all the time). Pin 8 of U1 is a convenient place to observe the switching.

Key up should give little voltage there (I saw a fraction of a volt) while pressing down the key (a jumper connected between pins 1 and 3 of J3) should give around 7.5 volts there. Its not the full 12 volts because of the dropping resistor R19 and zener diode D11 which form a simple voltage regulator to supply proper voltage to U5. This little regulator circuit is not precise, I got around 7.3 volts when I did my measurement, that' s plenty close. Seeing 12 volts here would be a problem to track down as well as not seeing a voltage change between key up and key down.

The remaining tests for this part of the assembly verify that the mixer (U5 and associated components) appears to be working. We have a couple of things to look for. Part of U5 implements an oscillator for one of the two signals being mixed (the other comes from the VFO). Crystal Y5 determines the frequency with RFC2 slightly shifting the frequency from the marked 7.68 MHz on the crystal.

At pin 6 of U5 we should see the crystal oscillator signal at around 7.68 MHz. Our test equipment will have some impact on circuit operation. Using a scope, I saw about ¾ of a volt peak to peak. Using the RF probe and DVM I got about half a volt DC on the meter. A receiver tuned to around 7.68 MHz should be able to hear the signal as well. It should go on and off as the key is pressed and released.

Finally, we should see a signal coming out of the mixer chip U5 on pin 4. What is useful to us is a signal around 10.1 MHz. Since the mixer produces both the sum (7.68+2.4 MHz) and the difference (7.68-2.4 MHz) of its inputs, there will also be a component around 5.28 MHz that we don't need. Viewed on a scope we won't see a nice sine wave but just seeing a signal there is enough for now. Using the RF probe I found around 1.5 V DC on my meter.

Using a receiver you should hear signals around 10.1 and 5.3 Mhz with the key pressed.

WA8BXN Notes:

Do not use RFC1 & RFC2 from the sheet with the capacitors, rather look for a 1”x1” piece of paper with "IMPORTANT" in red and RFC1 with value 10 uH and RFC2 with value 6.8uH. Use the 6.8 uH choke for RFC 2 in this step.

On the capacitor sheet, the last 0.01 uF capacitor number is C111 and not C110 as printed on the sheet I got in my kit.

Since a connector is not provided in the kit for J3, I would suggest that if you have any .1 inch header pin strips to mount a strip of 3 at J3. The reason for this is that we need to connect and disconnect some of the pins for the tests. Running wires to the holes for J3 now that will go to the key and headphone jacks now will just get in the way as we continue assembly. I did wire the power connector to J4 in step 2 and it’s getting in the way a bit already. If you do mount a header pin strip at J3 you can later solder your wires to the pins or use a mating socket which was done in the original SWL kit. If using the pins when you need to short pins 1 and 3 just put an alligator clip across the pins.

I completed this step and applied power, the voltage readings at pin 8of U5 were as expected for pins 1&3 jumpered or not on J3. But I did not hear a signal around 10.1 MHz as expected. I tuned my receiver to 7.68 MHz to hear the crystal oscillator and nothing.

This is good! I get to troubleshoot the board. I decided to cheat and turned on my oscilloscope. I connected the probe to the top of RFC 2, there should be something around 6.68 MHz there. I did see a signal. I disconnected the jumper from pins 1 to 3 of J3. The signal was still there. Set scope to give rough measure of frequency and it said 2.4 Mhz or thereabouts. That's just the VFO showing up there.

It should be working, my soldering looks ok. Remember I am now looking for the 7.68 MHz signal. The only components needed for it are C28, C29, RFC2, Y5 and U5. I checked RFC2 as soldered in place with an ohm meter, it was good at around 1 ohm. I carefully removed U5 from its socket. I really don't think it's bad, but I do have a couple others in the kit and it's easy to substitute another one there.

Substituting one of the other 602's didn't fix things. I decided to clip the antenna lead of my test receiver to the case of Y5 and tune the dial around 7.68 Mhz and what do you know I hear something! But that something is not a nice single carrier (using the receiver in LSB mode). It's a bunch of carriers slight separated in frequency. Maybe it's from something else. I disconnected the jumper from pins 1& 3 of J3, it should go away. The carriers were still there. Just for the fun of it, I disconnected power from the SW30 board. The carrier frequency started drifting and getting until they were gone. Remember, we have a 220 uF capacitor on the 12 V line that takes a while to discharge.

At this point, things are going downhill a bit. The original test of the voltage on pin 8 of U5 was OK as pins 1&3 of J3 were jumped or not. Now I get the 7.5 volts all the time on pin 8 of U5. Are we having fun yet?

I can solve this. I think I can at least! I'm glad I am doing step by step testing rather than having built up the whole board before doing any tests. First to make my work a bit easier maybe I removed the 602 from U5 socket and put it back in the foam it came in. It's good to simplify things as much as possible. I disconnected the scope leads, all that I have connected to the board now is power. Measure pin 8 of U5 again to make sure that problem is still there. I see 7.29 volts. It should be close to zero.

Time to look at the schematic. My current problem centers on Q3, the 2N3906 that is supposed to be a switch to turn on and off power for U5 (and other stages when we get to them) as the key is pressed. Our jumpering pins 1&3 of J3 simulates pressing the key. I measure the voltage at pin 3 of J3 and see 13 V, so pin 3 didn't get accidentally shorted to ground somewhere.

Now Q3 is sort of upside down in the schematic. It's a PNP transistor and the emitter and base voltages are the same, so it should not be conducting. Either the transistor is now shorted, or I may have done some bad soldering. Disconnect power and inspect the board under the magnifier (again). It's the right transistor there, 2N3906, flat side where it should be. R20 and R21 are the right values. I don't see any soldering problems.

Check from E to C with an ohm meter. I get 9.8 ohms in both directions. Sure looks shorted. Center lead on the transistor is the base. What to do next. I could get out the solder wick and remove the transistor. I don't think it's a bad transistor though. What else could be causing that short? Let me look some more. I just don't see anything on the board.

Let me carefully remove Q3. That wasn't too bad. Checking the transistor with my ohm meter, it does look shorted. I am surprised! From my junk box I found a new 2N3906 and it does not appeared shorted. I solder in the Q3 location.

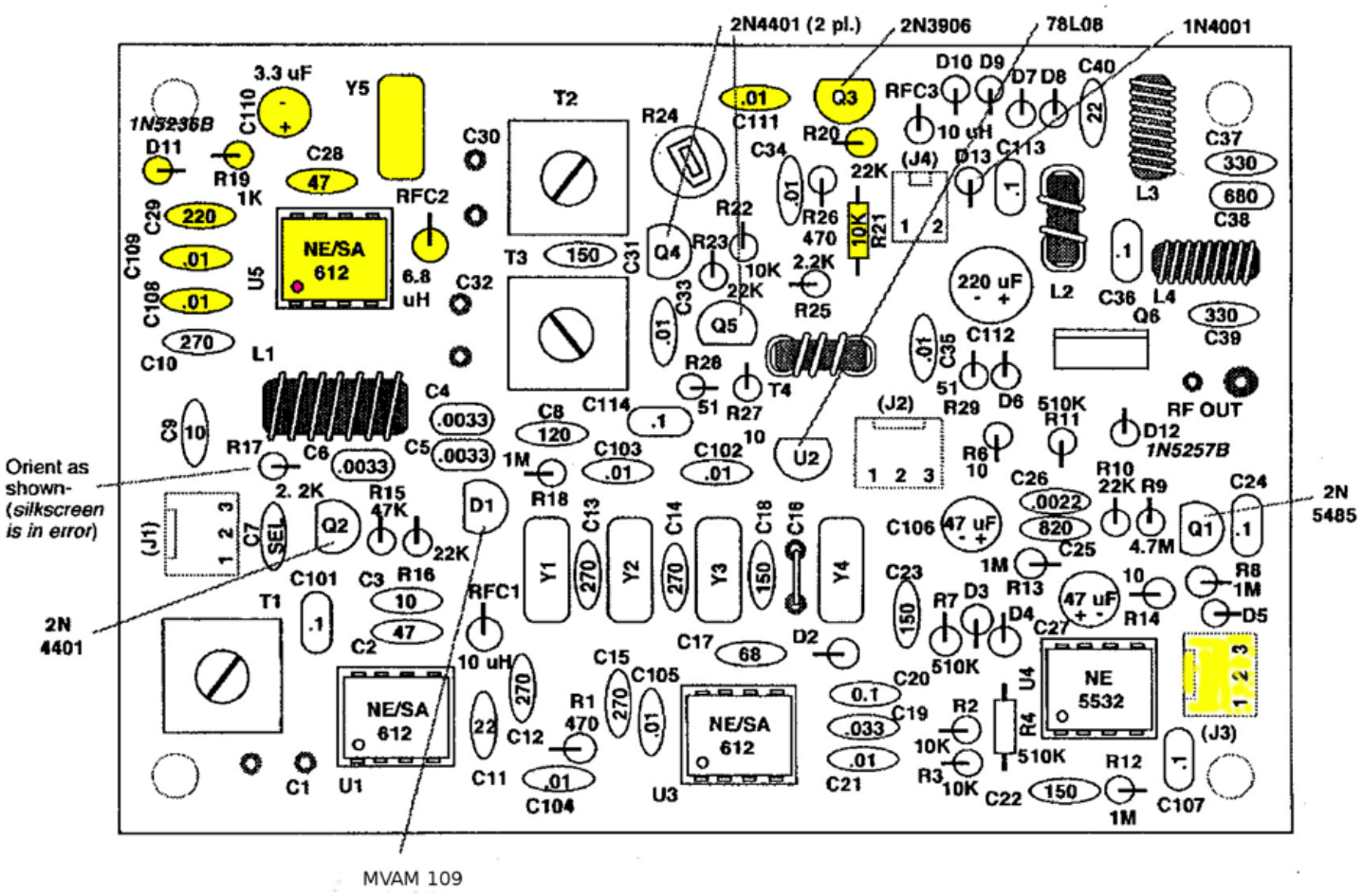
With U5 still removed from the socket, I apply power. Pin 8 of U5 without the J3 jumper is .395 volts, not quite zero. My replacement transistor has some leakage. With pins 1&3 of J3 jumpered, I see 7.29 volts on pin 8 of U5, as it should be. With the jumper removed, its 5 volts???? Wait, that may be OK. C110 got charged up and with no IC in U5 socket there isn't much to discharge it. The voltage is slowly dropping.

I put a 602 in U5 and now hear the 7.68 MHz signal (and nearby birdies, that could possibly be my receiver not liking the out of ham band frequency). I will worry about that later. The signal keys on and off properly with the jumpering of J3 pins 1&3. I then tried using the other two 602 ICs, and it looks like one is actually bad.

Next I looked for a signal around 10.1 MHz on pin 4 of U5 using my receiver. Yay, I found it at 10.146 MHz, close enough at this point. And it sounds clean and does key on and off with the jumpering of pins 1&3 of J3. So at this point my board seems to pass the tests. I have no idea why I had problems. Maybe I should have taken static discharge precautions and turned off the Van de Graaff generator while doing my building. But I do enjoy those sparks jumping around the workbench!

Assembly:

Q3	2N3906 PNP plastic transistor, orient as shown
D11	1N5236 7.5 V ½ W zener diode, note banded end “up”, mount vertically. (“236B”)
C28	47 pF NPO ceramic disk capacitor (470)
C29	220 pF ceramic disk capacitor (221)
C108	.01 uF capacitor (103)
C109	.01 uF capacitor (103)
C110	3.3 uF electrolytic (note polarity)
C111	.01 uF capacittor (103)
R19	1 K ohm resistor, mount vertically (brn-blk-red)
R20	22 K ohm resistor, mount vertically (red-red-org)
R21	10 K ohm resistor (brn-blk-org)
RFC2	6.8 uH RF choke, mount vertically (blu-gry-gold)
Y5	7.68 MHz crystal
J3	3 pin plug, orient as shown on board
U5	NE602 8 pin IC, orient as shown



Test procedure:

Apply power, check for 0 volts pin 8 of U5. (Measured: < 0.5 V)
Connect jumper between pins 1 and 3 of J3.
Measure about 7.5 volts on pin 8 of U5. (Measured: 7.29 V)
U5 Pin 6: Measured: 750 mV PP 7.68 MHz using scope, 0.5 VDC using RF probe
Pin 4 of U5 should have around 10.1 MHz signal. (Measured: 1.5 V DC using RF probe)
Disconnect power.

Part 5 – Transmit Bandpass Filter

There are few parts installed in this step of assembly. What they accomplish is to get rid of that unwanted 5.3 MHz frequency coming out of the mixer U5. If we look at the output of the bandpass filter with a scope (at the base of yet to be installed Q4) we should see a nice sine wave at around 10.1 MHz. There will be some loss of amplitude compared to what was coming out of the mixer (due to loss in the filter and loading on the output of U5). I got 2.5 volts peak to peak on a scope, 2.9 volts using the RF probe with key down.

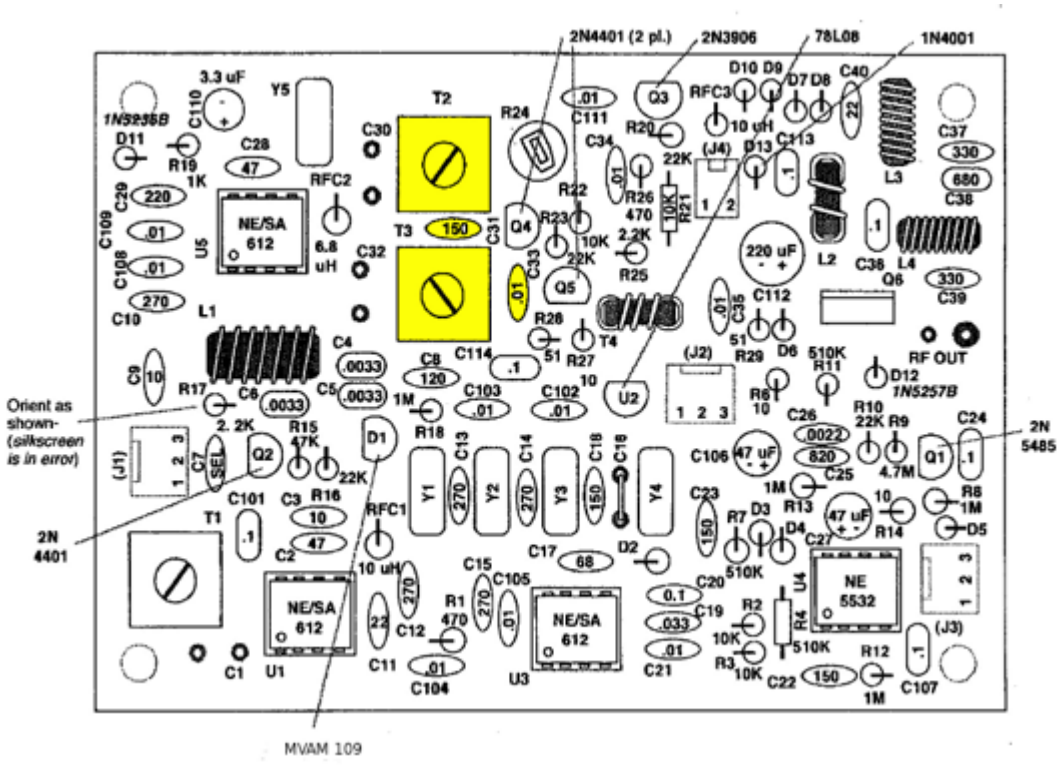
We can attempt to tune T2 and T3 to the right frequency at this point. Further touch up will be done later. First adjust T3 a bit for maximum signal and then T2.

WA8BXN Notes:

Well I survived this step. The peaks are neither sharp nor extremely large but they are there. We will come back to peaking them again later.

Assembly:

C31	150 pF capacitor (151)
C33	.01 uF capacitor (103)
T2	10.7 MHz IF transformer (42IF123)
T3	10.7 MHz IF transformer (42IF123)



Test procedure:
Apply power, connect jumper between pins 1 and 3 of J3 if not present from previous step.
Observe signal at base of Q4 (middle hole for Q4 which is not yet installed) using oscilloscope, RF probe or possibly a receiver tuned to signal around 10.1 MHz. Try to peak signal adjusting T3 and then T2.

Measured value: 2.5 V PP on a scope, 2.9 V DC using RF probe, 10.114 MHz using counter
Note: 1X scope probe significantly loaded output, RF probe had different peak adjustment
Disconnect power and J3 jumper.

Part 6 – TX Preamp and Driver

Two more stages of the transmitter are assembled in the part of the assembly process. One could do all of the assembly and then just look for output from the buffer. If it's not there then backtracking would be needed to identify if the Preamp or Buffer has the problem. Testing the preamp before going on to the driver makes some sense.

The Preamp (Buffer stage - Q4) doesn't provide gain but provides isolation, allowing us to now adjust T2 and T3 without our test equipment having any practical effect. R24 is set to provide maximum output, which ultimately will be too high for proper operation overall.

The test for the Driver stage (Q5) again looks for output, this time at what will be the base of the final amplifier when we put in those parts. Besides testing to see if we got the parts in right we have the opportunity to lower the output by turning R24 counterclockwise some. Its handy to have a scope to observe the waveform, but not required.

If you run into problems testing these stages, check for proper parts and orientation along with good soldering. The collector of both transistors should be around 12 volts. If neither has that voltage, make sure you have the jumper or key between pins 1 and 3 of J3 which turns on Q3 to pass voltage to the transmitter stages. If only Q5 is not getting +12 volts at its collector, check the leads of T4 very carefully to make sure they are properly soldered to the board!

WA8BXN Notes:

When hunting for the 2.2K resistor I found it's a tiny one, looks like there is a black band before the red band but that's just the end.

Make sure you don't try to use the brn-blk-grn resistors (1 M ohm) in place of the grn-brn-blk (51 ohms) for R28 & R29

T4 --- something is not quite right. It should be a FT37-43 as called out in the instructions but on the labeled sheet with the capacitors it is mislabeled as T37-6. A real T37-6 would be yellow and not black. And if you are looking for the diagram mentioned in the assembly instructions, it's on page 11 of Dave's original manual in the top right of the page. Don't have that manual? Well fortunately it's on the CWTD website. I think you can find it there! Use a 6-inch piece of magnet wire to wind the 8 turns on the core. For the one turn secondary two inches of insulated wire will do fine, cut as needed to go between holes S1 and S2 on the board. Be sure to get the leads well stripped and tinned.

I ran the test procedure and had no problems!

Preamp (buffer):

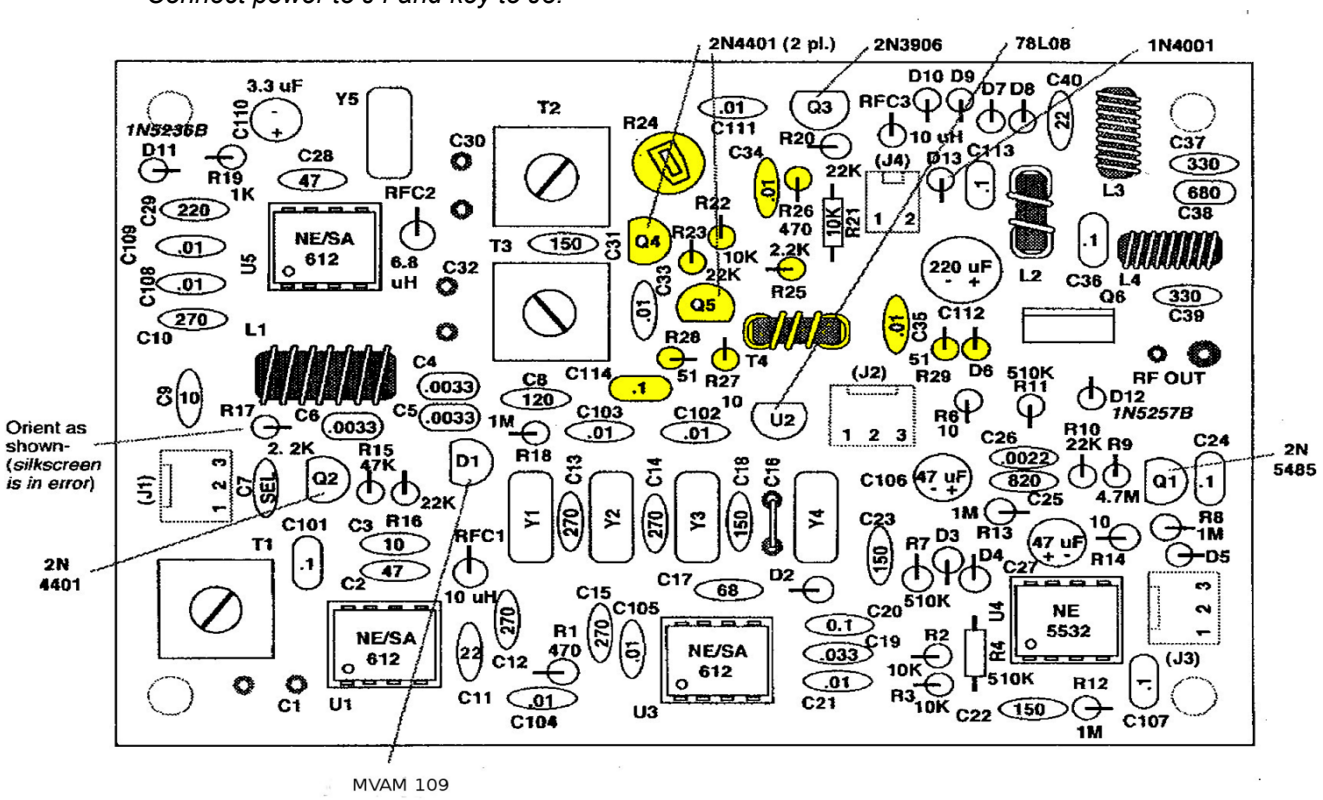
R22	10 K ohm resistor, mount vertically (brn-blk-org)
R23	22 K ohm resistor, mount vertically (red-red-org)
R24	500 ohm trimpot
C34	.01 uF capacitor (103)
Q4	2N4401 plastic transistor, orient as shown

Test procedure:
Connect key between pins 1 and 3 of J3. Apply power. Adjust R24 maximum clockwise. Observe keyed RF at base of Q5 (middle lead, not yet installed). Re-peak T3 and T2. Measured: Supply current .01 A @ 12 V 2.2 V PP (2.2 V using RF probe) at Q5 base Disconnect power and key.

Driver:

R25	2.2K ohm resistor, mount vertically (red-red-red)
R26	470 ohm resistor, mount vertically (yel-vio-brn)
R27	10 ohm resistor, mount vertically (brn-blk-blk)
R28	51 ohm resistor, mount vertically (grn-brn-blk)
R29	51 ohm resistor, mount vertically (grn-brn-blk)
C114	.1 uF capacitor (104)
C35	.01 pF capacitor (103)
D6	1N4148 diode, note banded end "up" with body of diode in circled hole
Q5	2N4401 plastic transistor, position as shown
T4	FT37-43 (black core), PRI: 8 turns #24 mag wire, SEC: 1 turn tinned stranded wire.

Test procedure:
Connect power to J4 and key to J3.



Test procedure:

Connect power to J4 and key to J3. Observe RF signal at base of Q6 (left lead, not yet installed) while pressing key. It should be stronger than previous level. If you have a scope, reduce R24 to get clean sine wave.
Measured: after adjusting R24 CCW a bit to get good waveform, supply 12 V @ .03 A.
At Q6 base 2.4 V PP using scope, 1.7 V DC using RF probe Disconnect power and key.

Part 7 – Receive Mixer (1st Mixer)

There is one more stage in the transmitter to complete but it will be saved for the last board assembly step. Once that is done we will have to have a dummy load or antenna connected or risk damaging the final. Enough of the transmitter has been completed for the reason it was assembled before the receiver, namely for use as a test signal for checking the receiver stages as we complete them. Clever!

The various jumpers specified in the test procedure route the low level transmit signal to the receiver. Another mixer chip (U1) now combines a 30 meter signal around 10.1 MHz with the VFO (2.4 MHz), again producing the sum (12.5 MHz that is not of use to us) and the difference around 7.68 MHz that we want. You can hear both frequencies on a receiver if you care to listen. The presence of some signal as indicated by the RF Probe indicates success, assuming its anywhere near the expected value. A scope could also be used, but we won't be seeing a nice sine wave because of the two frequencies present.

T1 is adjusted for maximum signal thus tuning it to around 10.1 MHz. Its not a sharp peak but that's OK, its mostly there to get rid of the possible image frequency.

If this stage isn't working as expected, make sure U1 is properly in its socket. That means properly oriented and all the pins really are seated in the socket. Verify that pin 8 of U1 is around 7 volts. That voltage comes from D2 Located near U3. It was installed in Part 3 of the assembly steps but not tested at that point. If D2 is reversed that will be a problem.

WA8BXN Notes:

Nothing special to note about the parts, just make sure you have the right ones!

Test jumpers: For the J1 jumper I took a cut off component lead and bent into a U shape and inserted that from the bottom of the board and then tightly twisted the ends on the top of the board together. This will be cut out later.

For the second test jumper, the base of Q6 is hole closest to R29 and D6. From my junk box I found some wire that just fit in the holes to use for the jumper to the top hole for C36. Alternately you could trace where the lines go and tack a wire on the bottom side of the board at already soldered components.

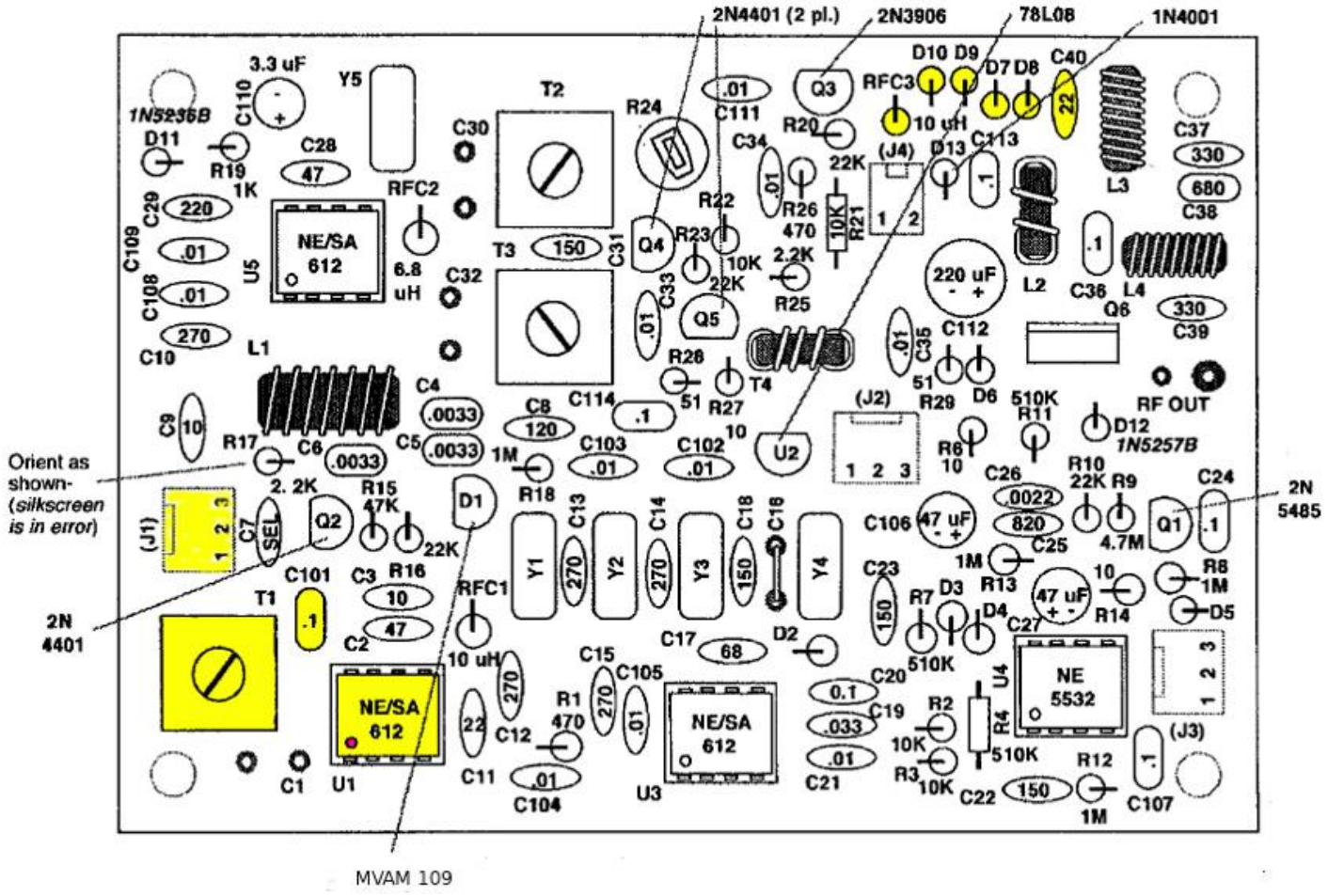
On J3 jump pins 1&3 as you have in earlier steps.

Things seemed to work for me in this step.

Leave the jumpers in place, but do disconnect power.

Assembly:

T1	10.7 MHz IF transformer (47IF123)
C40	22 pF NPO disk capacitor (22)
C101	.1 uF capacitor (104)
D7	1N4148 diode, note banded end up, body of diode in circled hole.
D8	1N4148 diode, note banded end up, body of diode in circled hole.
D9	1N4148 diode, note banded end up, body of diode in circled hole.
D10	1N4148 diode, note banded end up, body of diode in circled hole.
RFC3	10 uH RF choke (brn-blk-blk)
U1	SA612 8 pin IC, orient as shown



Test procedure:

Temporarily connect a jumper between pins 2 and 3 of J1, another a jumper between base of Q6 and top hole for C36 (neither yet installed), and a third jumper between pins 1 and 3 of J3. Apply power. Look for RF signal at pin 5 of U1 using RF volt meter, scope or receiver tuned around 7.68 MHz. Try to adjust T1 for peak reading (very broad peak). Disconnect power but leave jumpers in place.

Measured values: Supply 12 V @ .04 A
U1 Pin 5: 1.25 V PP using scope (waveform not sine wave), 1.8 V DC using RF probe

Part 8 – Receive Crystal Filter

Y1- Y3 form a quite selective passband filter that gets rid not only of the 12.5 MHz frequency coming out of the mixer but also gets rid of signals not close to the signal we want to receive. If you have a scope you should now see a clean looking sine wave around 7.68 MHz. An RF probe is quite sufficient to see the stage is working. That ground wire connected to the crystal cases is there to reduce stray pickup of external 7.68 MHz signals.

If you aren't getting the signal through the crystal filter, use an ohm meter to check each lead from crystals Y1-Y3 to ground. None should be shorted to ground. If any show shorts to ground, gently pull on the crystal from the top of the board while heating the pins on the bottom to raise the crystal a slight bit.

WA8BXN Notes:

Not much to go wrong here I hope.

C11 is labeled 220.

RFC1 - don't use the one on the capacitor sheet, find the other one (brn-blk-blk)

Somehow I managed to misplace one of the 270 pF caps, put another piece of tape on the cap sheet if needed when you remove caps.

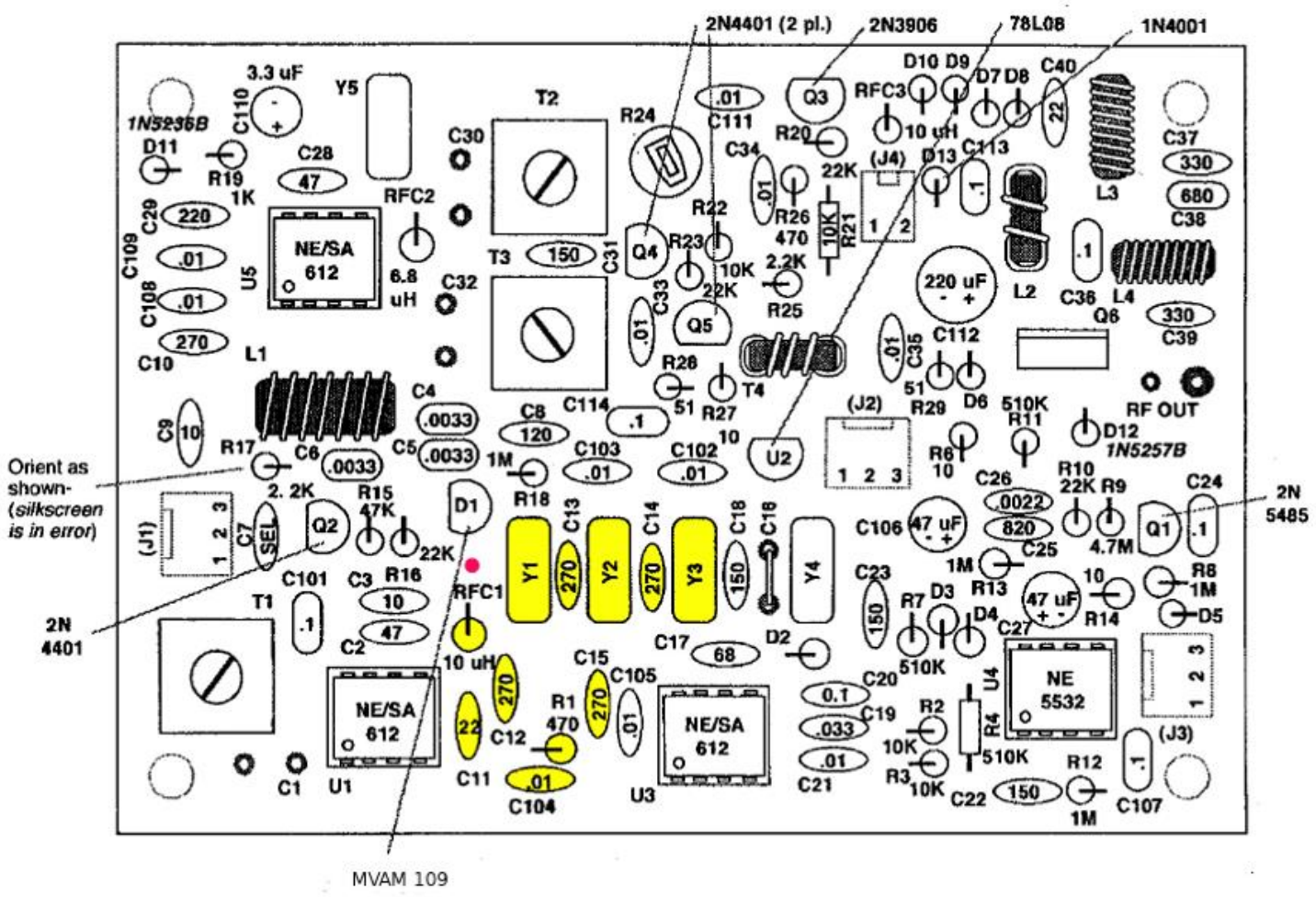
I completed assembly less one of the 270 pF caps. I did not install C14, hoping it will turn up. I'm sure I have a suitable replacement in the junk box but not having that capacitor in the circuit will not be a big deal, the bandpass characteristics of the crystal filter will just not be optimal.

One of the power leads I soldered to the board finally broke. Looking at the other power lead on the board its about ready to break as well. I resoldered them into place.

I have to remember to keep looking for C14 that is hiding somewhere, and to put the ground wire across the crystal cases to the red dot place when I do install it. As expected at this point not having C14 installed is not a major problem.

Assembly:

C11	22 pf NPO disk capacitor (22)	
C12	270 pF capacitor (271)	
C13	270 pF capacitor (271)	
C14	270 pF capacitor (271)	
C15	270 pF capacitor (217)	
C104	.01 uF capacitor (103)	
R1	470 ohm resistor, mount vertically (yel-vio-brn)	
RFC1	10 uH RF choke (brn-blk-blk)	
Y1	7.68 MHz crystal	Note - mount all 3 crystals slightly above the board
Y2	7.68 MHz crystal	- ground all 3 cases using hole at red dot shown below
Y3	7.68 MHz crystal	(don't use holes for RFC1)



Test procedure:

Apply power (with jumpers from previous step still in place).

Look for signal at pin 2 of U3 (not yet installed).

Disconnect power but leave jumpers connected.

Measured: 12.0 V @ .04 A supply. U3 Pin 2 180 mV using scope, nice sine wave, 45 mV using RF probe

Part 9 – Receive Product Detector

The output of U3, another mixer, has a signal in the audio range that we can see on a scope or simply hear with sensitive headphones or an amplified speaker (use a DC blocking capacitor).

If previous stages are working but you aren't getting audio here as expected first check to be sure U3 is properly oriented and all the pins properly seated into the socket. Next get out your frequency selective RF signal tracer. A general coverage receiver that tunes to the IF frequency (7.68 MHz) will do nicely.
Temporarily unkey the transmitter that we have been using as a test signal so that signal source is turned off. Look for the BFO oscillator running around pins 6 and 7 of U3. If you can't find it, check Y4, C17 and C18 for proper soldering and values. Make sure W1 is in place next to Y4 where the board is labeled C18.

If you have the BFO running but still no audio out, start looking around pin 2 of U3. Key the transmitter on and off, you should hear the test signal in your general coverage receiver going on and off very near the BFO frequency. When done testing be sure to leave the transmitter keyed (jumper on J3 pins 1 to 3).

WA8BXN Notes:

C17 is labeled 680

C18 comes from the tape square separate from the sheet of capacitors

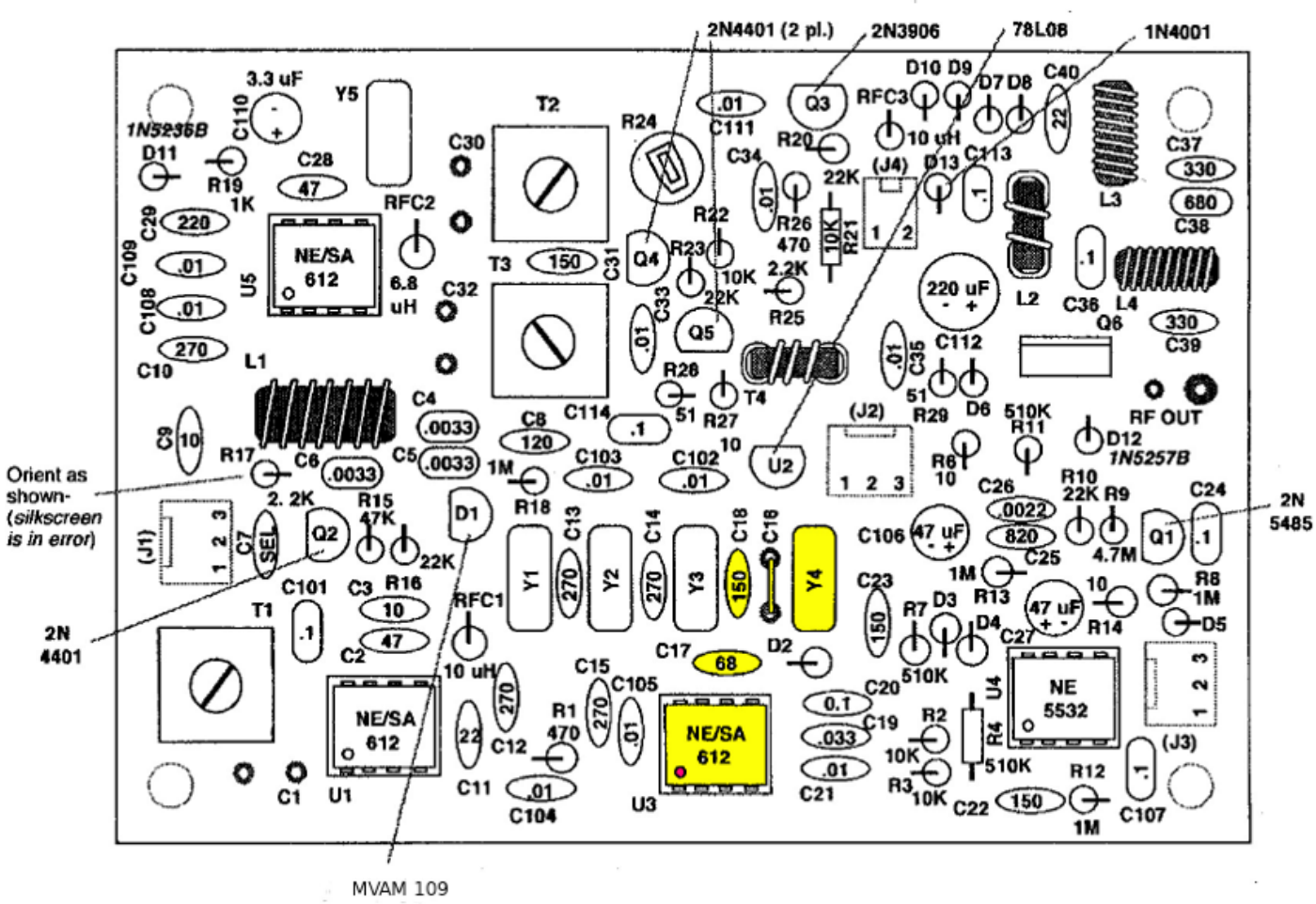
To test our assembly, jumpers are needed Pins 2-3 of J1, Q6 base to C36 top hole, and pins 1&3 of J3. These are the same jumpers used in parts 7 and 8.

When I started testing, I did see a signal at pin 5 of U3, but it was in the MHz range, not audio. Fortunately before troubleshooting I changed my scope sensitivity and sweep frequency. Now I see an audio sine wave maybe around 800 Hz and a volt or two peak to peak.

Before it occurred to me it might just be a scope setting problem I thought a bit how I would troubleshoot this stage. First thought that came to mind was that I should hear the 7.68 MHz oscillator from U3 in my receiver. Fortunately I didn't have to look for it as I got the expected audio output.

Assembly:

C16	Wire jumper, see “W1” below
C17	68 pF NP0 disk capacitor (68)
C18	150 pF NP0 disk capacitor (151)
Y4	7.68 MHz crystal (don’t push tight against the board)
U3	SA612 8 pin IC, orient as shown



Test procedure:

Apply power. Look at the signal from pin 5 of U3 with a scope if you have one. Otherwise use your audio signal tracer (amplified computer speakers) to listen for an audio tone.
Disconnect power.

Measured: 12.0 V @ 0.04 supply
U3 Pin 5: 0.6 v audio sine wave using scope, 0.19 VAC using DVM

Part 10 – Audio Preamp

This half of U4 amplifies the audio signal. It should be louder with an audio tracer. If this is not the case check to be sure U4 is plugged into the socket properly. Verify 7 volts or so on pin 8. Using your audio signal tracer listen for a tone at pins 2 and 3 of U4. There should be a little something on each, a bit louder on pin 2. Pin 1 should be noticeably louder than 2 or 3, if not check all the component values and proper soldering. Also refer to voltage checks on page 17 of the original SW30+ manual.

WA8BXN Notes:

R4 - mount horizontally

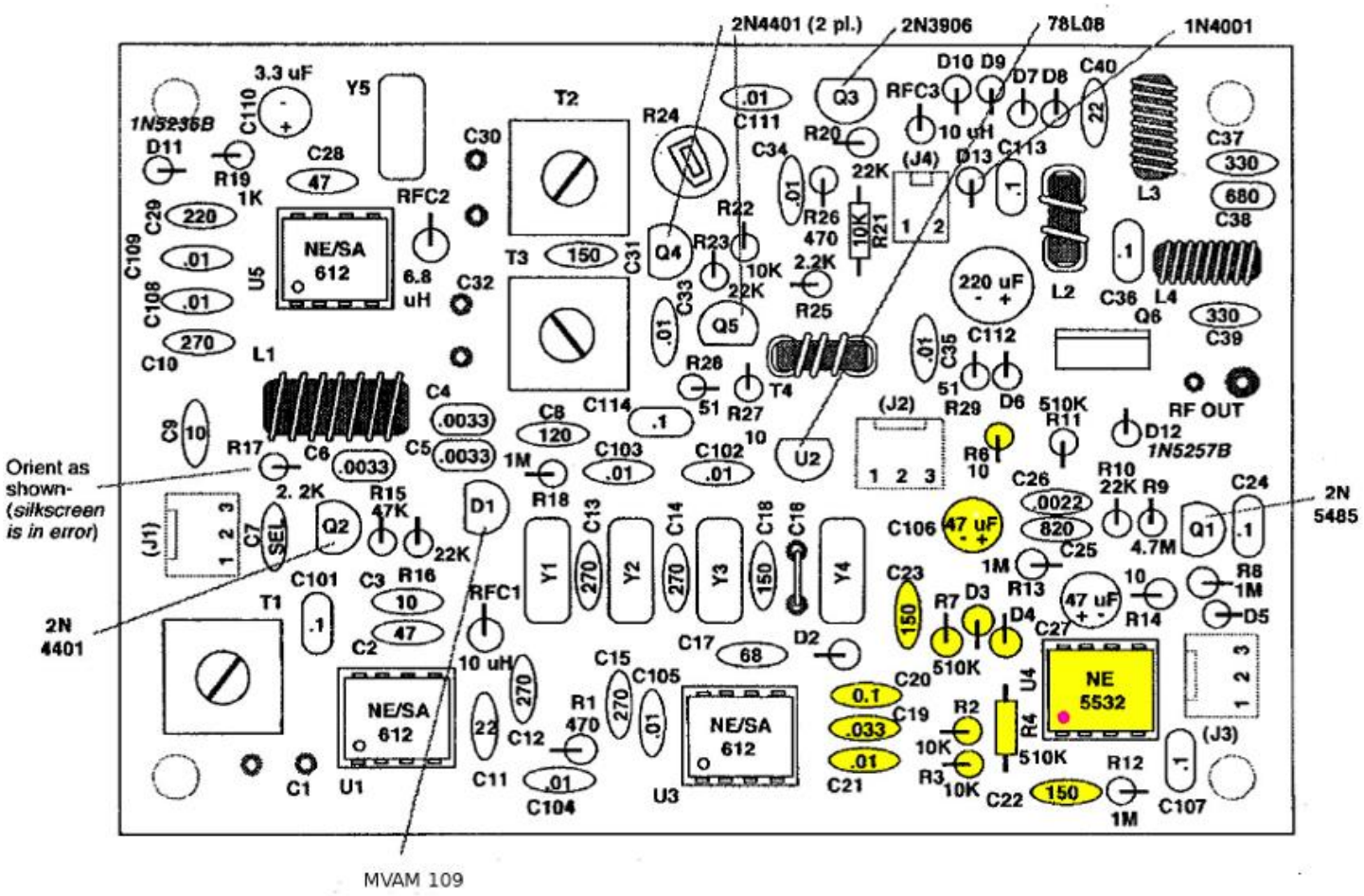
R6 - mount vertically

R7 - mount vertically

On the scope I used to check for audio, the waveform was not quite a sine wave. There was a sort of clipping, not at the peaks but rather an oddity at the zero crossing.

Assembly:

C19	.033 uF capacitor (333)
C20	.1 uF capacitor (104)
C21	.01 uF capacitor (103)
C22	150 pF capacitor (151)
C23	150 pF capacitor (151)
C106	47uF
R2	10 K ohm resistor, mount vertically (brn-blk-org)
R3	10 K ohm resistor, mount vertically (brn-blk-org)
R4	510 K ohm resistor (grn-brn-yel)
R6	10 ohm resistor (brn-blk-blk)
R7	510 K ohm resistor (grn-brn-yel) … mount horizontally
D3	1N4148 diode, note banded end up, body of diode in circled hole.
D4	1N4148 diode, note banded end up, body of diode in circled hole.
U4	NE5532 8 pin IC, orient as shown



Test procedure:

With the previous jumpers still in place apply power. Look for an audio signal on pin 1 of U4 using a scope or audio signal tracer. (There should be jumpers on J1, J3 and Q6-C36)
Disconnect power.

Measured: 12 V DC @ 0.04 A, U4 Pin 1: 1.3 Volts PP sort of sine wave using scope, 0.825 V using DVM

Part 11 – VFO Frequency Range Adjust

C7 Pick particular value NPO capacitor giving proper frequency range.
C7 is located middle left part of board between J1 and Q2

Check tuning range without C7. If you have a counter, connect to jumper wire between base of Q6 and top hole for C36, with jumpers still installed from previous steps. Install a jumper between pins 1 and 2 of J2, record frequency. Move this jumper to pins 2 and 3 of J2, record that frequency. These are your lower and upper bounds of tuning range without C7.

Now follow these excellent instructions from the original SW30+ manual. If you don't have a tuning range near these, change turns on L1 by first moving existing turn spacing or adding/removing turns as needed.

WA8BXN Notes:

This looks complicated, but it is not!

ith no C7, my frequency range was 10.149 to 10.184 which would put me pretty much out of the band. That range is roughly 10.150 to 10.180 which is not in the table. Looks like somewhere between 47 pF and 68 pF would be needed for C7. I tried 47 pF. That gave me a tuning range of 10.101 to 10.135. Prefect for my needs. If I wanted to make a finer adjustment I would just adjust the spacing of the turns on L1.

Don't forget to actually solder the capacitor you pick for C7 to the board!

For 10.100 – 10.135 MHz operation: If the frequency was between	Install the following value for C7
10.100 – 10.120	(none)
10.120 – 10.140	22pF
10.140 – 10.160	47pF
10.160 – 10.180	68pF
10.180 – 10.200	82pF
10.200 – 10.220	100pF
10.220 – 10.240	120pF
10.240 – 10.260	150pF

The table above does not show that more capacitance moves the frequency higher. It means that more capacitance compensates for higher frequency. Are we clear on that?

(The approximate formula for the value of C7 is as follows:)

$$\Delta f\,(\text{KHz}) = 1.0 \times [\text{C7}]\ (\text{in pF})$$

where Δf is the desired frequency shift

It's possible to adjust the operating frequency as much as 15-20KHz downward by squeezing L1's turns more closely together.

Thanks Dave!

Measured values: Without C7, my tuning range was 10.112 to 10.147 Mhz. I tried a 10 pF NPO capacitor I had (I know, it's not a supplied value) and that gave me a range of 10.1015 MHz to 10.1358 MHz. I could have adjusted the spacing of turns on L1 to get right down to 10.100 on the low end but decided I was close enough to always be in the band.

Part 12 – Audio output

The second half of U4 further amplifies the audio signal after it passes through Q1. We have been using the transmitter (less the final amplifier) as a signal source. When we key the transmitter stages at this point to produce the sidetone Q1 is biased as an open circuit but R9 still passes some audio that we hear.

If you don't have a fair amount of audio coming out of the receiver at J3 at this point, first check for audio at pin 7 of U4. If nothing there you can go back to listening for output at J3. You do still have the transmitter keyed for testing, right? With the transmitter keyed, Q1 is turned off. Try jumpering R9 to pass more audio from the preamp to audio output stage. R7 sets the sidetone level should you want to change it.

If you have some audio going into pin 6 of U4 you ought to get more audio out on pin 7. If not, do the usual verification of proper components and soldering in this stage.

WA8BXN Notes:

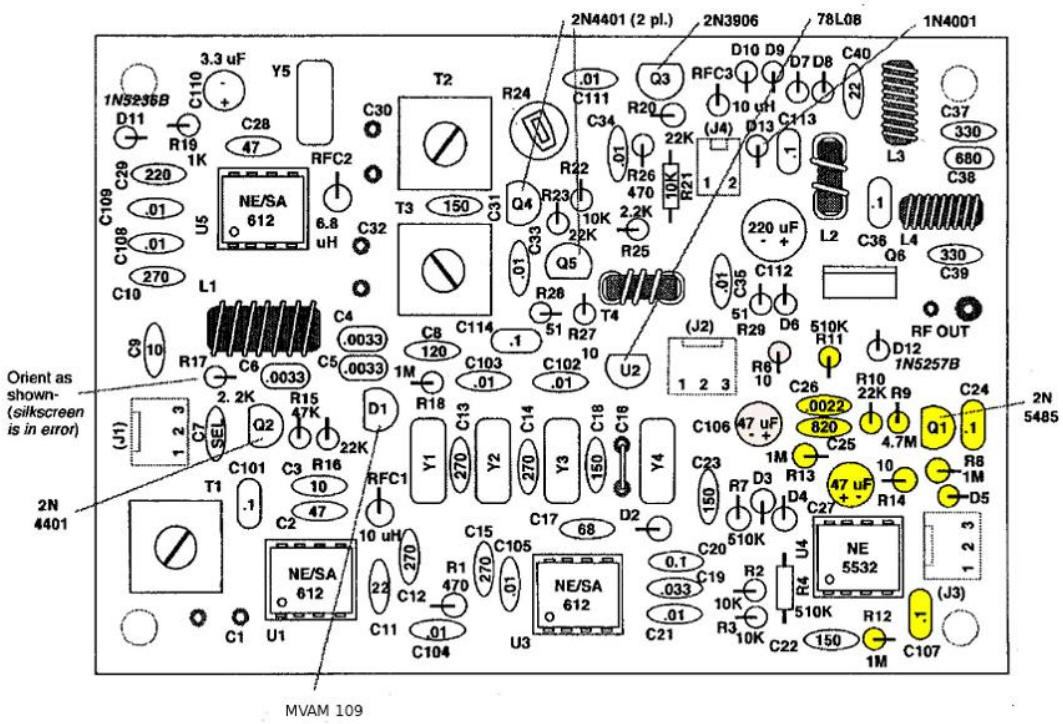
Resistors - This step finishes off the resistor supply, if you have any left over , well something is wrong!

The silkscreen label for R12 is a bit confusing, refer to illustration in assembly instructions.

Audio level in headphones should be moderate, no doubt it's there.

Assembly:

R8	1 M ohm resistor, mount vertically (brn-blk-grn)
R9	4.7 M ohm resistor, mount vertically (yel-vio-grn)
R10	22 K ohm resistor, mount vertically (red-red-org)
R11	510 K ohm resistor, mount vertically (grn-brn-yel)
R12	1 M ohm resistor, mount vertically (brn-blk-grn)
R13	1 M ohm resistor, mount vertically (brn-blk-grn)
R14	10 ohm resistor, mount vertically (brn-blk-blk)
D5	1N4148 diode, note banded end up, body of diode in circled hole.
Q1	2N5485 or 2N5486 plastic transistor, orient as shown
C24	.1 uF capacitor (104)
C25	820 pF capacitor (821)
C26	.0022 uF capacitor (222)
C27	47 uF electrolytic capacitor, note + sign
C107	.1 uF capacitor (104)



Test procedure:

Apply power. Connect headphones between pins 1 & 2 of J3 and hear noise. Ground pin 3 of J3 and hear sidetone.
Disconnect power and jumpers.
Measured: 12.0 V DC @ .04 A (keydown) 0.01 A unkeyed power supply

Part 13 – Transmit final amplifier

Now we are looking for real power output from the transmitter. R24 is also adjusted to provide the proper drive level for the final amplifier. I found 1 watt output to give a clean signal and 2 watts to be a dirty signal. Err on the side of caution!

With the final amplifier components in place its probably not a good idea to continuously key the transmitter. Also, be very sure you have a good dummy load connected to the rig.

With the rig unkeyed, you should see 12 volts on the collector/banded end of D12. If not, check soldering of L2. With the key closed there should be output at the antenna connector as you carefully advance R24 to increase drive level. If that doesn't happen suspect soldering of L3 and/or L4.

WA8BXN Notes:

Wire lengths for the coils:

L2 6 turns #24 (4 inches) on FT37-43 core (dark grey)

L3 15 turns #24 (8 inches) on T-37-6 core (yellow)

L4 15 turns #24 (8 inches) on T-37-6 core (yellow)

BE SURE to tin the leads very well!

D12 1N5256 30 V ½ W Zener diode, note banded end up, body of diode in circled hole.

Note: Drawing below shows 1N5257B (33V instead of 30V).

When I wrote the assembly instructions I used connectors on the board for the various J connections. Now I am trying to not be doing that as they are not included in the CWTD kit. I have the beautiful red PCB case to put together but I first want to test this last stage assembly before putting the board in the case and cutting all the various wires going off board to final length.

Adequate testing can be done with only power, antenna and J3 pins 1&3.

Actually we just need to be able to ground J3 pin 3 to key the transmitter.

So using the provided RG-174 I temporarily wired up the antenna connector for testing. I don't have to connect a pot to J1 for example, because I know the extremes of the tuning range are within the band. I will also be using a dummy load.

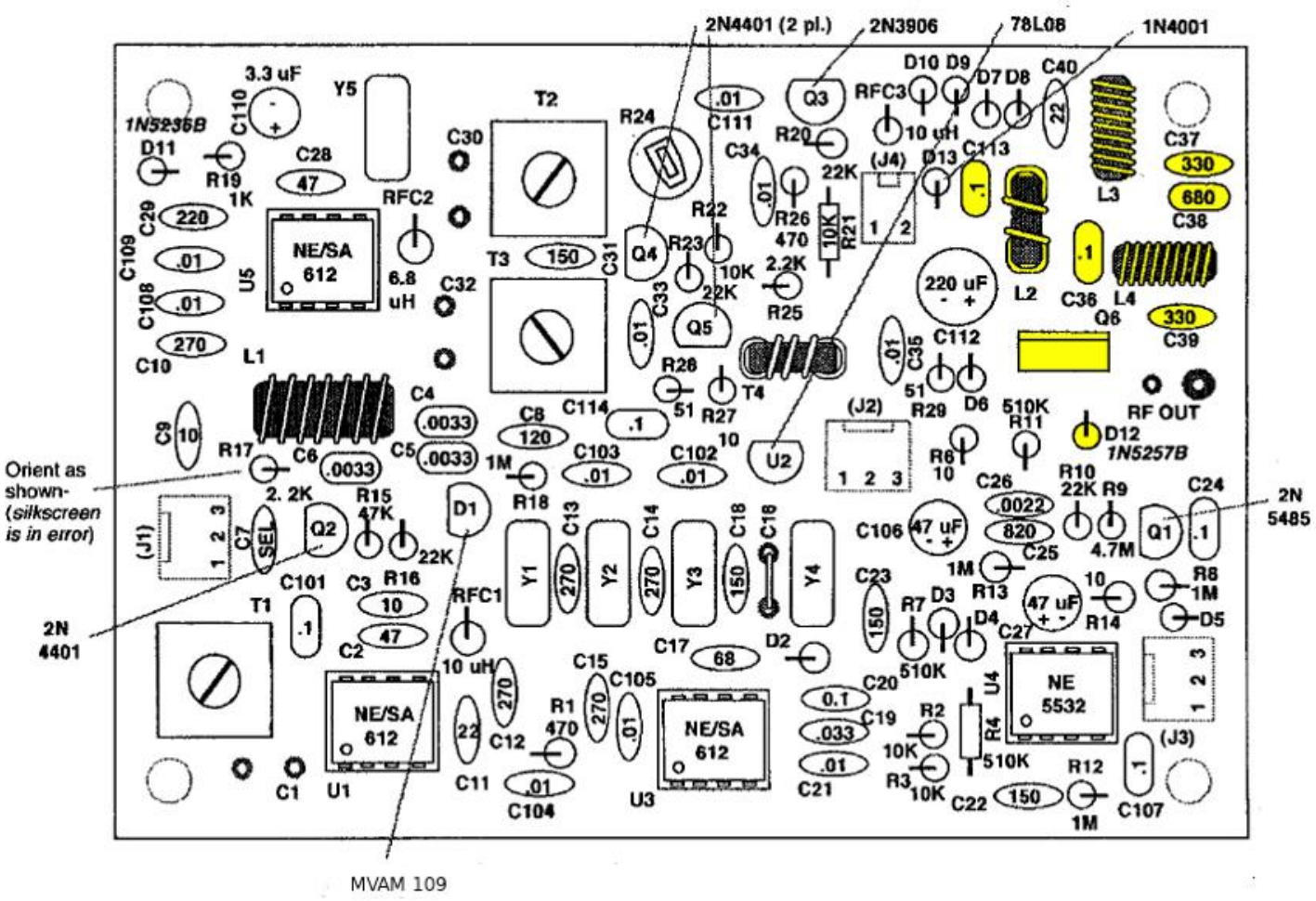
Drum roll .... I connected power, grounded pin 3 of J3 and got 2.1 watts output. I think it works! Next I need to build up the case and wire up everything.

Good luck!

You should have 2 RFCs each 22 uH still taped to the capacitor sheet and various alternate values of capacitors that could have been used for C7 left over to add to your junk box.

Assembly:

L2	6 turns #24 on FT37-43 core (dark grey)
L3	15 turns #24 on T-37-6 core (yellow)
L4	15 turns #24 on T-37-6 core (yellow)
C36	.1 uF capacitor (104)
C37	330 pF capacitor (331)
C38	680 pF NP0 capacitor (681)
C39	330 pF capacitor (331)
C113	.1 uF capacitor (104)
D12	1N5256 33 V ½ W zener diode, note banded end up, body of diode in circled hole. (“256B”)
Q6	2SC2166 RF power transistor, orient as shown on board



Test procedure:

Connect 50 ohm load to "RF OUT" (coax center goes to RF, braid goes to OUT).
Connect key J3 pins 1&3, headphones J3 pins 1&2. Connect 100K pot to J2.
Apply power. Key rig and adjust R24 for no more than 2 watts out (higher power makes an ugly output signal). Peak T3 and T2 for max power output, reduce R24 as needed. Replace dummy load with antenna. Peak T1 for max noise or signals. Tune VFO, hear many signals.
Measured: 12.0 V supply, 0.01 A keyup, 0.19 A keydown
R24 adjusted for 1.2 W output using watt meter, 22 V DC using RF probe. At higher drive adjustment on R24, signal started looking bad on scope.
Tuning range: 10.102 to 10.136 MHz
A fair number of signals were heard when connected to antenna.

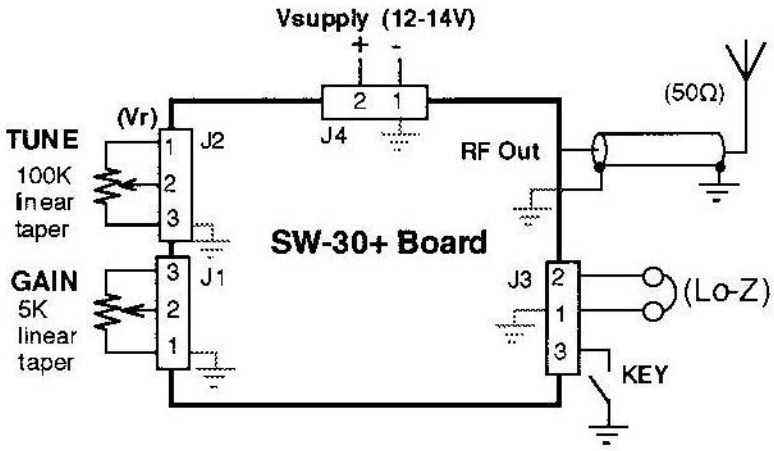
Note: C1, C30 and C32 locations on the board are not used for 30 meters.

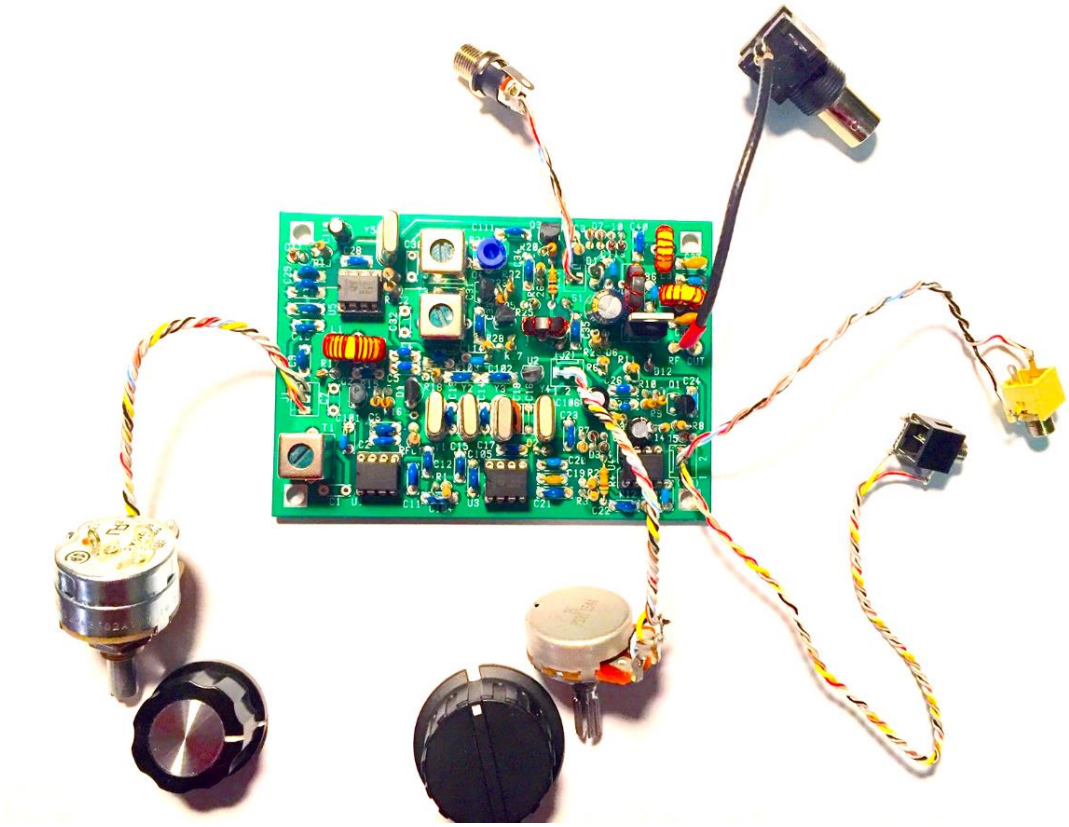
Go build case, install off board controls and connectors, get on the air!

Comments on my assembly/testing: At one or two steps, I did not get the expected result. The problem was always I had omitted installing a part because I did not print off these instructions and check off each part as installed, instead just looking at them on the computer screen. I do strongly suggest printing them and checking off each part as it is installed.

After assembly you should have some parts left over, in particular 5 capacitors that might have been used for C7.

4) Wiring Diagram

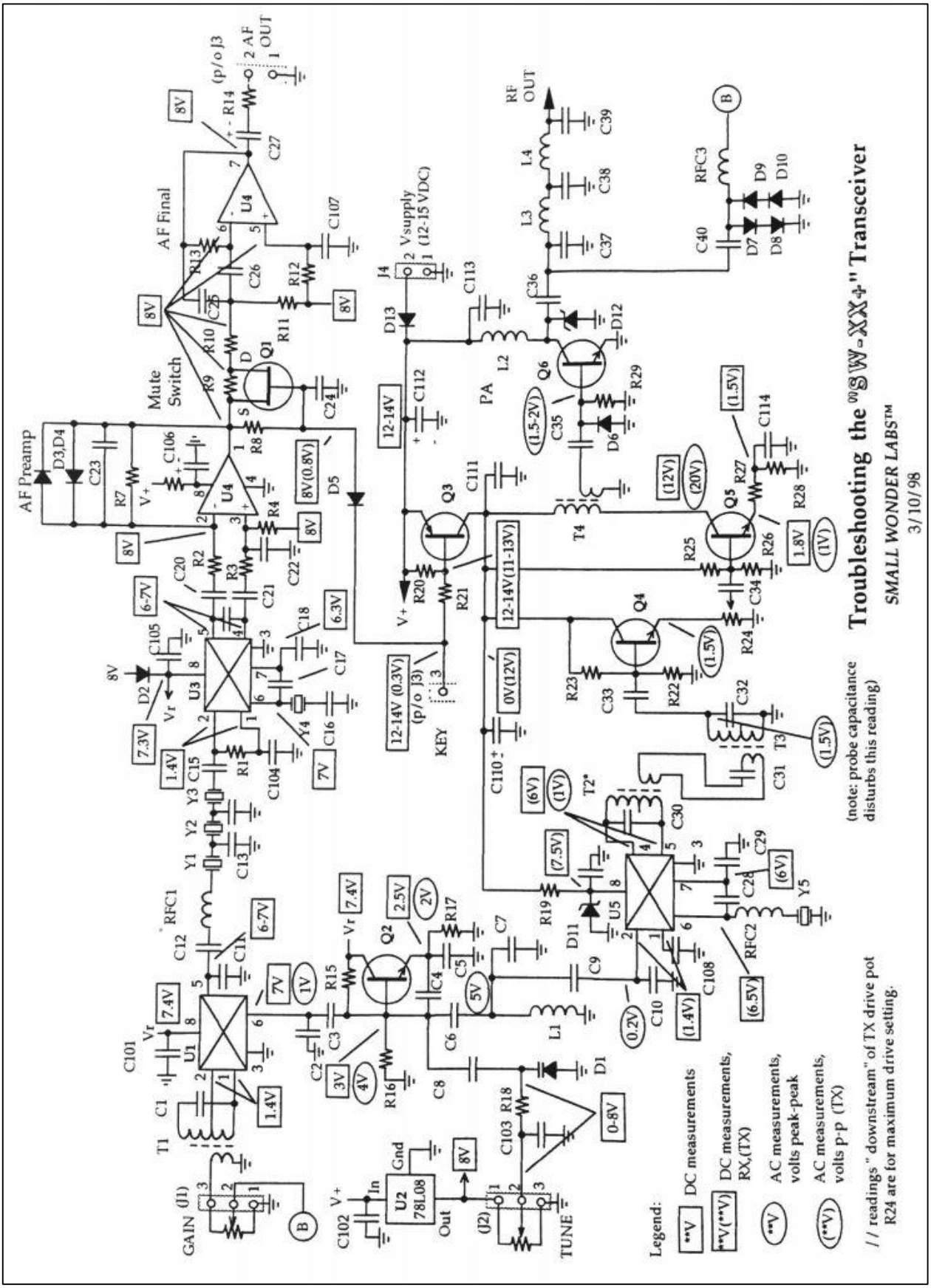




5) Parts List:

SW30+ PARTS LIST					
QTY	DESIGNATOR	DESCRIPTION	Marking	P/N	Alt P/N
2	C3, 9	10 pF ceramic disk capacitor	100	810-FK18C0G1H100D	
3	C7a, 11, 40	22 pF NPO ceramic disc capacitor	220	810-FK18C0G1H220J	810-FG18C0G1H220JNT6
3	C2, 7b, 28	47 pF NPO ceramic disc capacitor	470	810-FK18C0G1H470J	810-FG18C0G1H470JNT6
2	C7c, 17	68 pF NPO ceramic disc capacitor	680	810-FK18C0G1H680J	810-FG28C0G1H680JNT6
1	C7d	82 pF NPO ceramic disc capacitor	820	810-FK18C0G1H820J	
1	C7e	100 pF NPO monolithic capacitor	101J	81-RDE5C1H101J0K1H3B	
2	C7f, 8	120 pF NPO monolithic capacitor	121	81-RDE5C1H121J0K1H3B	
5	C7g, 18, 22, 23, 31	150 pF NPO monolithic capacitor	151	810-FK18C0G2A151J	
1	C29	220 pF ceramic disc capacitor	221	810-FK18C0G1H221J	
5	C10, 12, 13, 14, 15	270 pF ceramic disc capacitor	271	810-FK18C0G1H271J	
2	C37, 39	330 pF ceramic disc capacitor	331J (orange)	594-F331K29Y5RN63J5R	
1	C38	680 pF ceramic disc capacitor	681J	81-RDE5C1H681J0K1H3B	
1	C25	820 pF monolithic capacitor (mylar)	821	810-FK28C0G1H821J	
1	C26	2200pF uF monolithic capacitor (mylar)	222	810-FG24X7R2E222KNT6	
3	C4, 5, 6	3300 pF NPO monolithic capacitor	332	810-FG28C0G1H332JNT6	
11	C21,33,34,35,102,103,104,105, 108, 109,111	0.01 uF ceramic disc capacitor	103	810-FK18C0G1H103J	
1	C19	0.033 uF disc or monolithic capacitor	333 (orange)	594-K333K15X7RF5TH5	
7	C20,24,36,101,107,113,114	0.1 uF monolithic capacitor	104Z	81-RDEF51H104Z0K103B	
1	C110	3.3 uF 50V radial electrolytic capacitor	3.3uF	667-EEA-GA1H3R3H	
2	C27, 106	47 uF 16V radial electrolytic capacitor	47uF	667-EEA-GA1C470H	
1	C112	220 uF 16V or 25V electrolytic capacitor	220uF	667-EEA-1EHG221	667-EEU-FC1C221B
1	C16	install jumper W1			
1	D1	MVAM109 Varicap diode	109	Diz	
9	D2-D10	1N4148A silicon diode	1N4148	771-1N4148,133	
1	D11	7.5V 1/2W 5% Zener diode, 1N5236B	1N5236B	512-1N5236B	
1	D12	30V 1/2W 5% Zener diode, 1N5256	1N5256	512-1N5256	
1	D13	1N4001 silicon diode	1N4001	512-1N4001	
1	L1	T-50-6, 3.36 uH, 29 turns #24	Yellow (.5" dia)	Diz	
1	L2	FT37-43, 12.6 uH, 6 turns #24	Black		
2	L3, 4	T37-6 0.68 uH 15 turns #24	Yellow (.37" dia)	Diz	
1	Q1	2N5485 JFET	2N5485	610-2N5485	
1	Q3	2N3906 PNP transistor	2n3906	512-2N3906BU	
3	Q2, 4, 5	2N4401 NPN transistor	2N4401	512-2N4401BU	
1	Q6	2SC2166 transistor	2166	RF Parts	
3	R6, 14, 27	10 Ohm 1/4W 5% resistor	Br,K,K,Gd	660-CF1/4CT52R100J	603-CFR-25JR-5210R
2	R28, 29	51 Ohm 1/4W 5% resistor	Gr,Br,K,Gd	660-CF1/4CT52R510J	291-51-RC
2	R1, 26	470 Ohm 1/4W 5% resistor	Y,V,Br,Gd	660-CF1/4CT52R471J	603-CFR-25JR-52470R
1	R24	500 Ohm trim pot	Blue	652-3306P-1-501	
1	R19	1K Ohm 1/4W 5% resistor	Br,K,R,Gd	660-CF1/4CT52R102J	603-CFR-25JB-1K0
2	R17, 25	2.2K Ohm 1/8W 5% resistor	R,R,R,Gd	660-CF1/4CT52R222J	279-CFR16J2K2
4	R2, 3. 21, 22	10K Ohm 1/4W 5% resistor	Br,K,O,Gd	660-CF1/4CT52R103J	603-CFR-25JR-5210K
4	R10, 16, 20, 23	22K Ohm 1/4W 5% resistor	R,R,O,Gd	660-CF1/4CT52R223J	603-CFR-25JR-5222K
1	R15	47K Ohm 1/4W 5% resistor	Y,V,O,Gd	660-CF1/4CT52R473J	603-CFR-25JR-5247K
3	R4, 7, 11	510K Ohm 1/4W 5% resistor	Gr,Br,Y,Gd	660-CF1/4CT52R514J	291-510K-RC
4	R8, 12, 13, 18	1 Meg Ohm 1/4W 5% resistor	Br,K,Gr,Gd	660-CF1/4CT52R105J	603-CFR-25JR-521M
1	R9	4.7 Meg Ohm 1/4W 5% resistor	Y,V,G,Gd	660-CF1/4CT52R475J	603-CFR-25JR-524M7
2	RFC1, RFC3	10 uH RF choke	Br,K,K,Gd (fatter)	434-MICC/N100J-01	
1	RFC2	6.8 uH RF choke	B,Gy,Gld (fatter)	434-MICC/N-6R8J-01	
4	S1, 2, 3, 4	8-PIN low profile IC socket. Tin plt'd		575-199308	
3	T1, 2, 3	10.7 MHz IF transformer	Silver cans	42IF123-RC (Dave)	
1	T4	FT37-43 toroid core, 8T pri #24 (22.4 uH), 1T sec stranded	black		
1	U2	78L08 Voltage regulator IC	78L08	863-MC78L08ABPG	
3	U1, 3, 5	NE602AN	NE602	Diz	
1	U4	NE5532 IC	NE5532	595-NE5532APE4	
5	Y1-Y5	7.68MHz HC-49U 20pF XTAL		520-HCA768-20X	
	MISCELLANEOUS				
1	PCB	Printed Circuit Board		MYRO PCB	
1	R30	RF ATTEN pot, 5K OHM, linear taper, OFF-ON		CT3046-ND	
1	R31	VFO TUNE pot,100K OHM, linear		987-1327-ND	
1	J2	CW KEY jack, 3.5mm mono chassis mount			
1	J1	Headphone jack, 3.5mm stereo chassis mount		Diz	
1	J4	Jack, DC PWR IN		490-PJ-065B	
1	P1	Plug, DC OWR IN, 2.5mm center		171-PA5525-1-E	
4	Spacer	Spacer, AL, hex tapped, #4, 1/4" (holds the pcb on the screw)		NAPPCO: NAP-2100-440-AL-0	
4	Nut	#4-40		NAPPCO:	
4	Screw	Machine screw, pan #4-40x3/8", phillips		NAPPCO:	
2	Nut	Nut, 0.5"		George	
1	Wire-1	Ribbon cable, 10 wires, 6", split 3/3/3 for pots & jacks			
2	Wire-2	Hookup wire, stranded,6", Red/White & Green/White, Pwr		George	
1	Wire-3	Magnet wire, #24 enameled, 60", for L1-L4 and T4		1175-1711-ND	
1	Wire-4	Coax, RG-174Y, 8" (for RF OUT connection)		George	
1	J3	Antenna connector, BNC		523-31-221-RFX	
1	Knob-1	For RF ATTEN pot		45KN017-GRX	
1	Knob-2	For VFO TUNE pot		450-2039-GRX	

6) Troubleshooting Schematic:



7) Circuit Board Layout: