

**Duke City Hamfest Buildathon  
WWVR Receiver Builder's Guide  
& Buildathon Notes**



**by Rex Harper W1REX  
10/06/2019**

**PRELIMINARY**

This kit was designed for the Buildathon I hosted at the 2019 Duke City Hamfest in Albuquerque NM. One of the special things I do on the Buildathon kits is to place the actual part values on the silk screen layer instead of descriptors such as R1, R2, R3 etc. This allows for an easier build without having a lot of paperwork to shuffle. **HOWEVER**, please read this guide all the way through to completely familiarize yourself with the kit and what it entails before starting your build.

The first thing you should do is take an inventory of the parts in the kit and check them off against the Bill of Materials list to make sure that you have a complete kit.

## Bill of Materials

<b>WWV Receiver KIT</b>			
QTY.	DESCRIPTION	QTY.	DESCRIPTION
1	WWVR main pcb		
1	WWVR band module pcb	1	5-60pf trimmer capacitor
3	RCA connector	1	56pf capacitor (560)
1	Stereo jack	1	220pf monolithic capacitor (221)
2	2x7x.1" female header connector	4	.1uf monolithic capacitor (104)
2	2x7x.1" male header connector	1	.33uf monolithic capacitor (334)
2	8 pin DIP IC socket	4	100uf electrolytic capacitor
1	1x4x.1" SIP socket	1	470uf electrolytic capacitor
1	SPDT miniature switch		
1	1K 9mm linear potentiometer	1	LM78L06 voltage regulator
2	10K 9mm linear potentiometer	1	SA612 mixer IC
1	2" #6 machine screw	1	LM386 audio amplifier IC
1	#6 nut		
		2	FT37-61 toroid
3	10 ohm 1/4W resistor (BRN/BLK/BLK)	3'	magnet wire
1	10K ohm 1/4W resistor (BRN/BLK/ORG)	1	10Mhz quartz crystal
1	100K ohm 1/4W resistor (BRN/BLK/YEL)	2"	ribbon cable for gimmick cap

Hopefully, all the parts are there and you can continue on with the build. If something is missing, please send me an email with complete kit/part description and a good mailing address to send you the missing part(s).

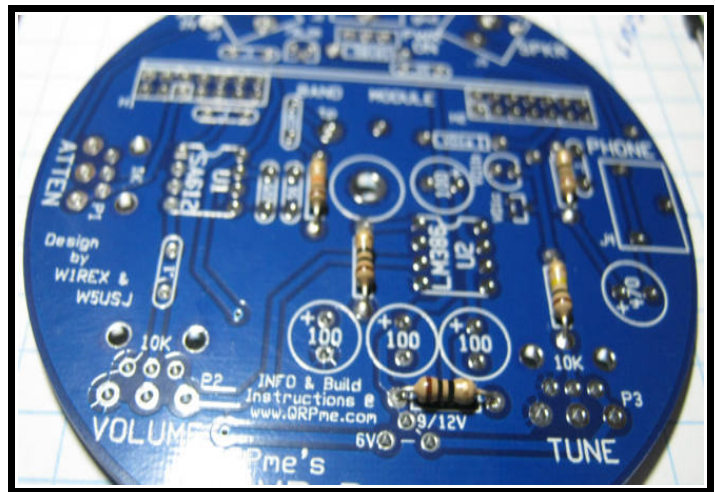
Use my contact email address: [w1rex@megalink.net](mailto:w1rex@megalink.net)

At the Buildathon, we used my Brass Set circuit board holders during the build so we didn't have to pay any particular order in which parts to install in sequence. If you have some sort of pcb holder, then order of parts assembly is not that critical. If you are

just building the board on your bench with no holder mechanism, then you want to install parts from the lowest profile to the tallest in order to have the easiest time in soldering. Resistors, diodes, sockets, monolithic caps, header connectors, other connectors, electrolytic caps, potentiometers and switches is a recommended parts sequence. Even though part height is not a problem with the Brass Set pcb holders, we stuck to this sequence... We did install small batches of parts before turning the board over for soldering because time was an issue. Installing 3 or 4 parts at a time then soldering & clipping leads allowed us to build the main board in about 2 hours. Pick the parts in a 'batch install' so that are spread out over the board and not clumped together gives you more maneuvering room for your soldering iron.

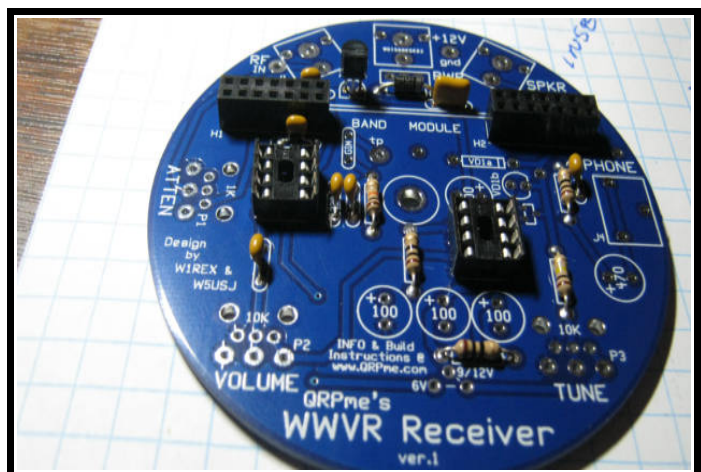
EXPERIENCED builders need not pay any attention at all to what I say....and JUST BUILD!

Get the ball rolling with the 5 resistors...  
3 - 10 ohm = BRN/BLK/BLK  
1 - 10K ohm = BRN/BLK/ORG  
1 - 100K ohm = BRN/BLK/YEL



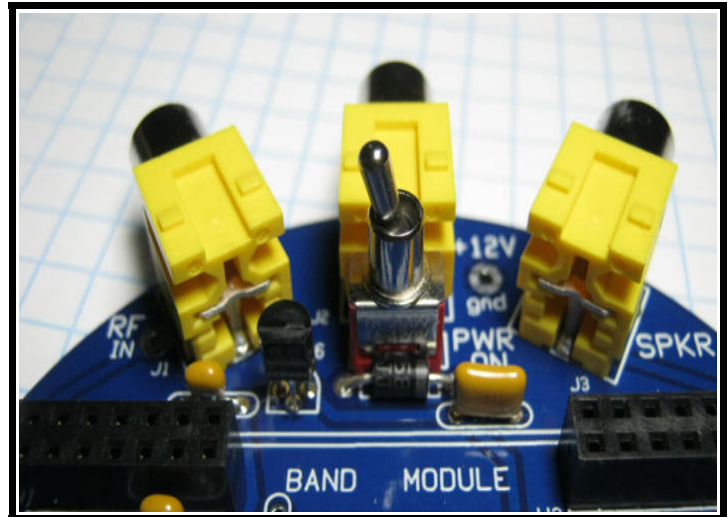
1N5818 diode & monolithic caps make a good second batch. Note orientation of stripe for the diode on the silk screen.

DIP IC & header sockets and voltage regulator are a good third batch. IC sockets and regulator have their orientations indicated on the silk screen.





RCA jacks and SPDT switch round out the top section of the board.



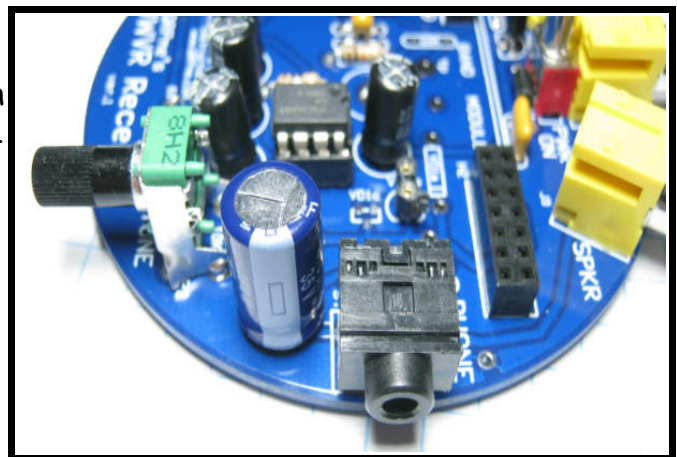
3 potentiometers can go next. The two 10K mount towards the front in the TUNE & VOLUME positions and the 1K is on the left in the ATTEN location. The 5 electrolytic cap are next. Pay attention to the polarity markings on the caps!

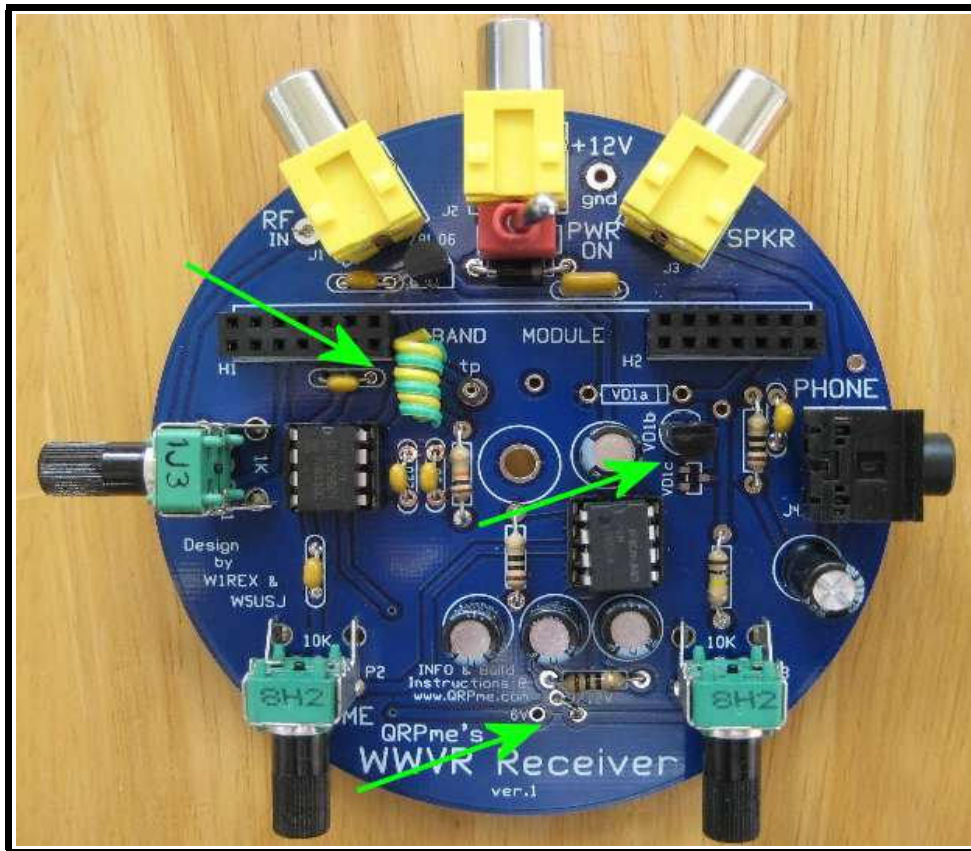
Install a jumper from the 9/12V pad to the common pad to the lower right. This selects the maximum varactor voltage.



The stereo phone jack and varactor 'socket' pins are the last things on the main board. Cut 2 individual socket pins off the 4 pin strip. Insert the 2 pins onto the leads of any spare part like a resistor and solder the socket pins into the Vd1b pads.

The main board should be done now and you can move on to the band module.





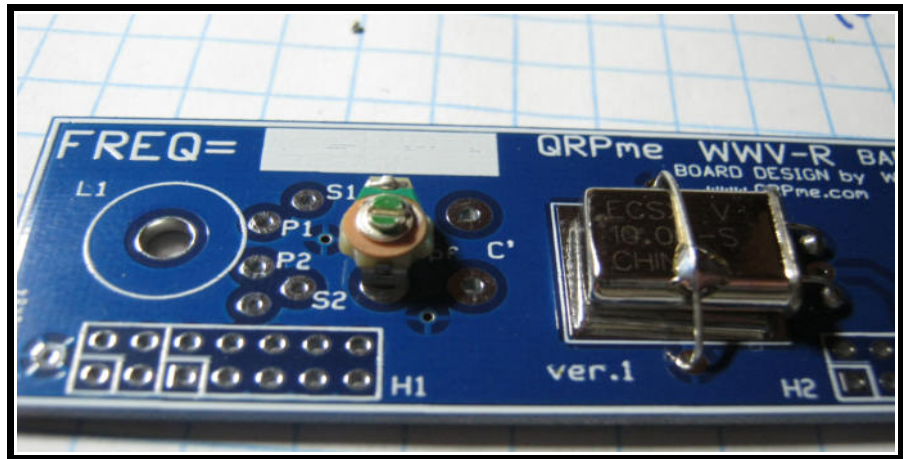
## Fully assembled main board

**TOP:** 2" of ribbon cable is coiled up and inserted into the GIM pads to make a low capacitance 'gimmick' capacitor. SEE the notes on the schematic for making the gimmick capacitor. The tp uses another SIP socket pin for measuring the local oscillator frequency out of the SA612 mixer chip. You only need to add these items if you want to monitor the local oscillator frequency with and external frequency counter.

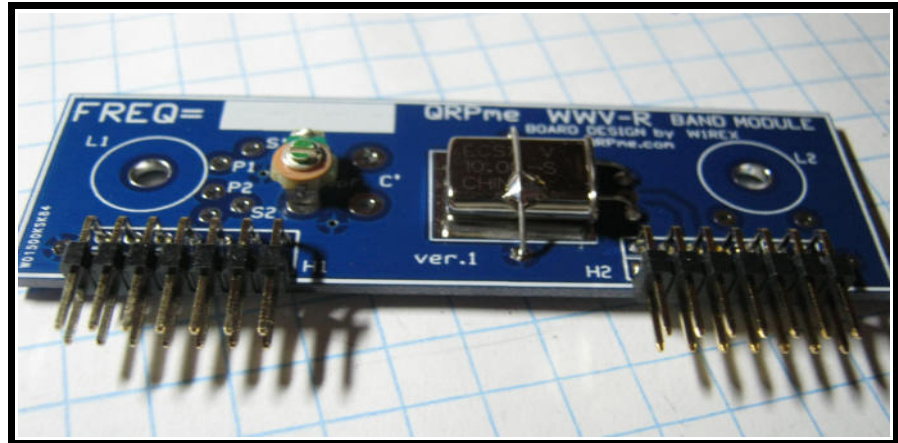
**MIDDLE:** the orientation of the MV209 varactor is the flat side to the band module.

**BOTTOM:** two voltages are available for the varactor tuning voltage: 6 volts from the voltage regulator and either 9 to 12 volts coming directly from the input voltage RCA jack.

Mount the crystal and trimmer capacitor on the band module board. The crystal case should be grounded to a pad right beside the crystal.



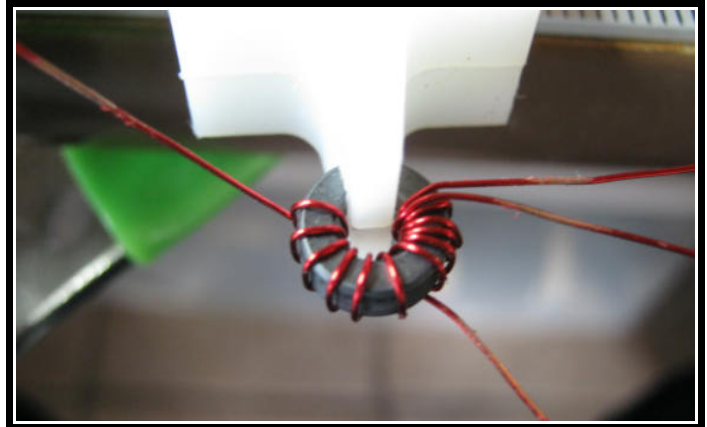
Solder on the two header connectors...



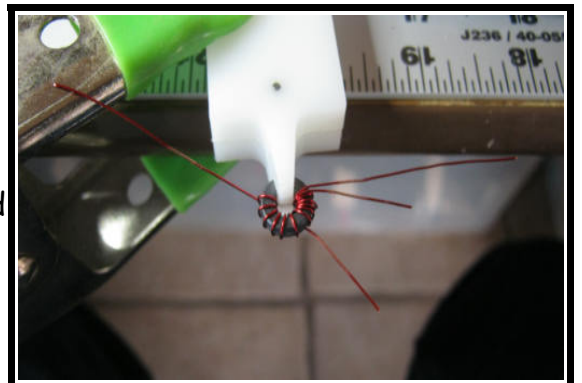
The T1 transformer is next. I use the QRPme Toroid EZ tool for easy two handed toroid winding.

Check the schematic for notes about winding transformer L1 (T1) and inductor L2.

T1= 10 turn Secondary & 3 turn Primary  
L2= 17 turns for 10uh



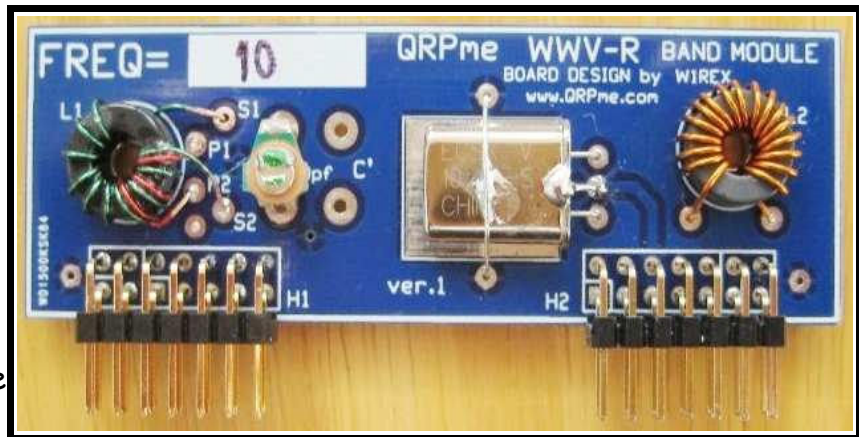
A long shot to show how I deal with multiple winding pairs when using the same color magnet wire. I wound the secondary winding first and cut the leads off long. Adding the primary winding and then cutting the leads short allows me to easily tell them apart...





Completed band module with L1 & L2 toroids installed.

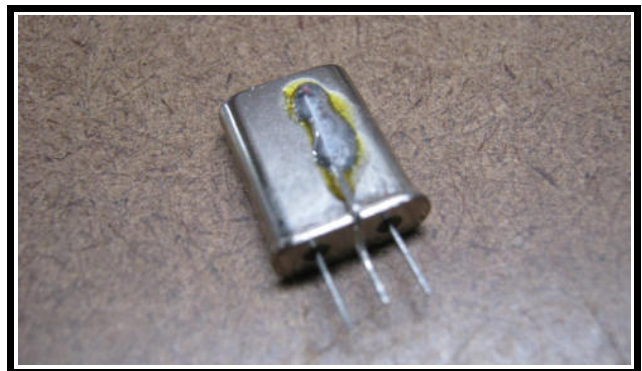
Note that the secondary windings on the transformer S1 & S2 have been swapped when installed on the pcb for a cleaner build and to keep the leads as short as possible.



For a 5Mhz band module, the values for T1 are a 15 turn secondary still with a 3 turn primary link. The L2 toroid has 17 turns for 15uh.

Of course, this is really a generic direct conversion receiver with a crystal specific band module. You could use it to monitor almost any frequency of interest if you have the specific crystal and calculate and modify the turns on both T1 and L2.

If you wanted to construct a band module for 40m, then you would use the same values as with the 5Mhz band module: 3 turn/15 turn L1 and 17 turn L2. You could also install a 3 pin SIP socket where the crystal leads are soldered and then plug & play various 40m crystals to move around the band. For best results, you should make a phantom middle pin for the crystal out of a junk crystal lead and have it soldered to the case.



If you have any comments or suggestions for improving this Builder's Guide please forward them to: [wirex@megalink.net](mailto:wirex@megalink.net).



Here are my notes for what I did to get my Duke City Hamfest Buildathon WWVR Receiver up and running and tuning WWV while I was in my hotel room.

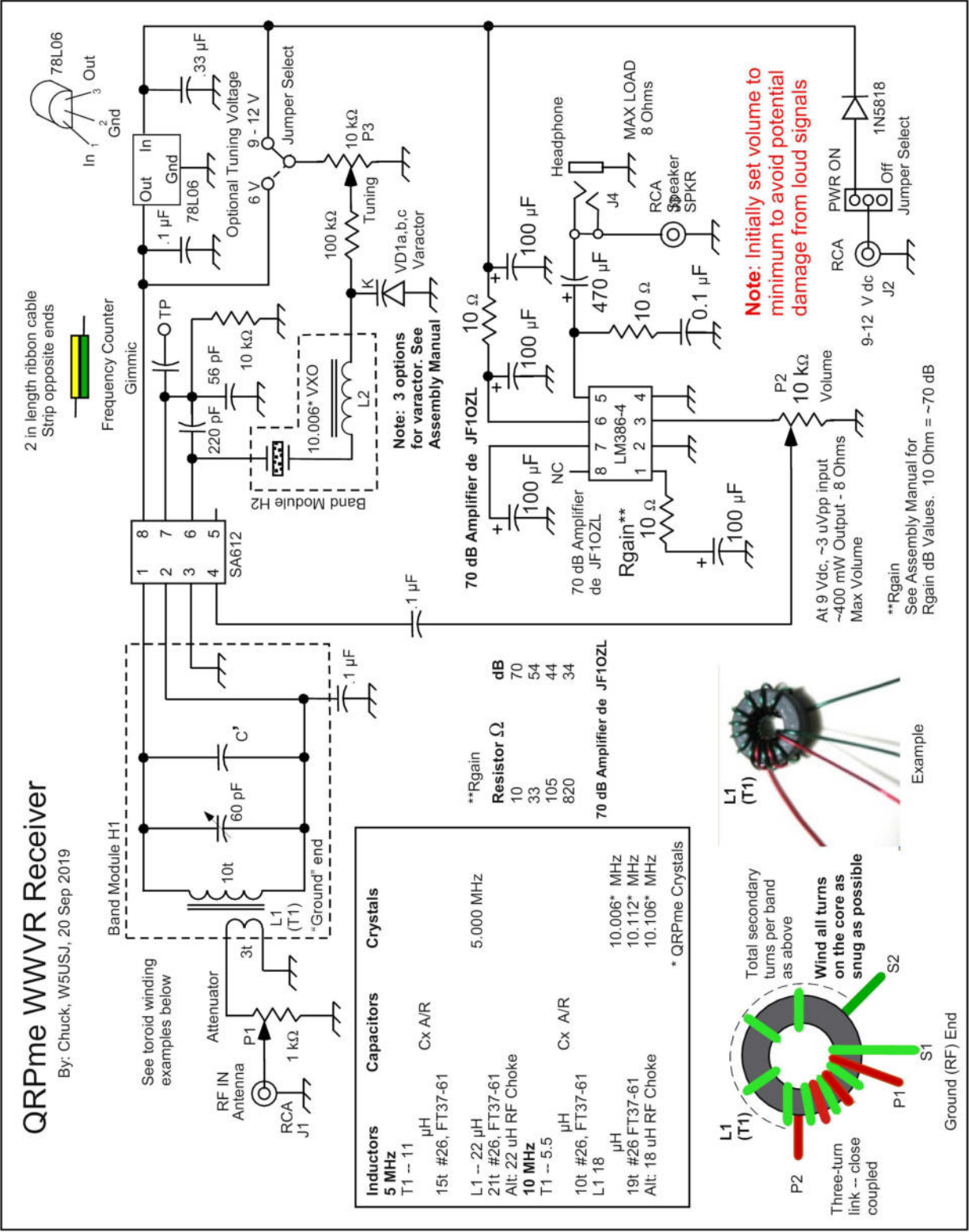
1. Schematic is posted but there were some last minute changes for the Buildathon kits:
  - a.) Last minute substitution of 10MHz crystals for the 10.006MHz xtals in the schematic
  - b.) Last minute swap of MV209 varactor for the varactors originally used in the prototype and documented in the schematic.
2. We don't have to pull the crystals as hard to get to 10MHz so the L2 choke on the band module should be changed from 18uh to 10uh which is 17 turns on the toroid instead of 19 turns. I actually had a 10uh axial choke so I stuck that into SIP pins I installed at L2 to help debug the problem.
3. MV209 varactor should be installed in the 2 pin LED style VD1b location with the flat side to the band module board.
4. Transformer T1 on the band module is a little awkward to install. The S2 pad is out of position so swap the Secondary winding leads mounting S1 @ pad marked S2 on the silk screen and then solder S2 lead into pad S1. I originally went up and over the whole toroid but that creates a long lead and an ugly instal.
5. I think I got most of the main round boards modified and working on Sunday morning as most of the builders dropped by my booth to check out the solution to the problem. I inspected the boards, made any necessary connections and tested them out using my modified band module board. I used the NoS 4-FER Frequency Counter kit that was the Duke City Hamfest Buildathon kit from 2018 to debug and check out my kit in my room on Saturday night.
6. I purchased about 40 feet of speaker wire at the flea market on Saturday to make a long wire antenna to see if I could get a signal while debugging Saturday night. The only signal I could get was NOISE. Since the hotel is practically brand new, almost all the lighting in the casino and hotel is LED and compact florescent bulbs. Both types create lots of RF hash and HF reception on 10MHz was impossible. I just hooked up the WWVR kit to my vertical antenna here at home and tuned right in to 10MHz. I could tune and eventually hear WWV but there is a Spanish language broadcaster sitting right next to WWV that made tuning it in kinda tricky. I will be trying out WWV on 5MHz soon.....

Hope this helps you all get your band modules completed and kits receiving WWV. Thank you all for participating in the Buildathon.

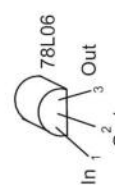


# QRPme WWVR Receiver

By: Chuck, W5USJ, 20 Sep 2019



2 in length ribbon cable Strip opposite ends



Frequency Counter

Gimmic

Optional Tuning Voltage

Jumper Select

Band Module H2

Note: 3 options for varactor. See Assembly Manual

70 dB Amplifier de JF1OZL

70 dB Amplifier de JF1OZL

Headphone

MAX LOAD 8 Ohms

RCA SPKR

Note: Initially set volume to minimum to avoid potential damage from loud signals

At 9 Vdc, ~3 uVpp input ~400 mW Output - 8 Ohms Max Volume

\*\*Rgain See Assembly Manual for Rgain dB Values. 10 Ohm = ~70 dB

PWR ON

Jumper Select

Inductors	Capacitors	Crystals
5 MHz T1 -- 11	µH	Cx A/R
15t #26, FT37-61		
L1 -- 22 µH		5,000 MHz
21t #26, FT37-61		
Alt: 22 uH RF Choke		
10 MHz		
T1 -- 5.5	µH	Cx A/R
10t #26, FT37-61		10,006* MHz
L1 18		10,112* MHz
19t #26 FT37-61		10,106* MHz
Alt: 18 uH RF Choke		

\* QRPme Crystals

**Rgain	Resistor Ω	dB
10	70	54
33	105	44
105	820	34

70 dB Amplifier de JF1OZL

