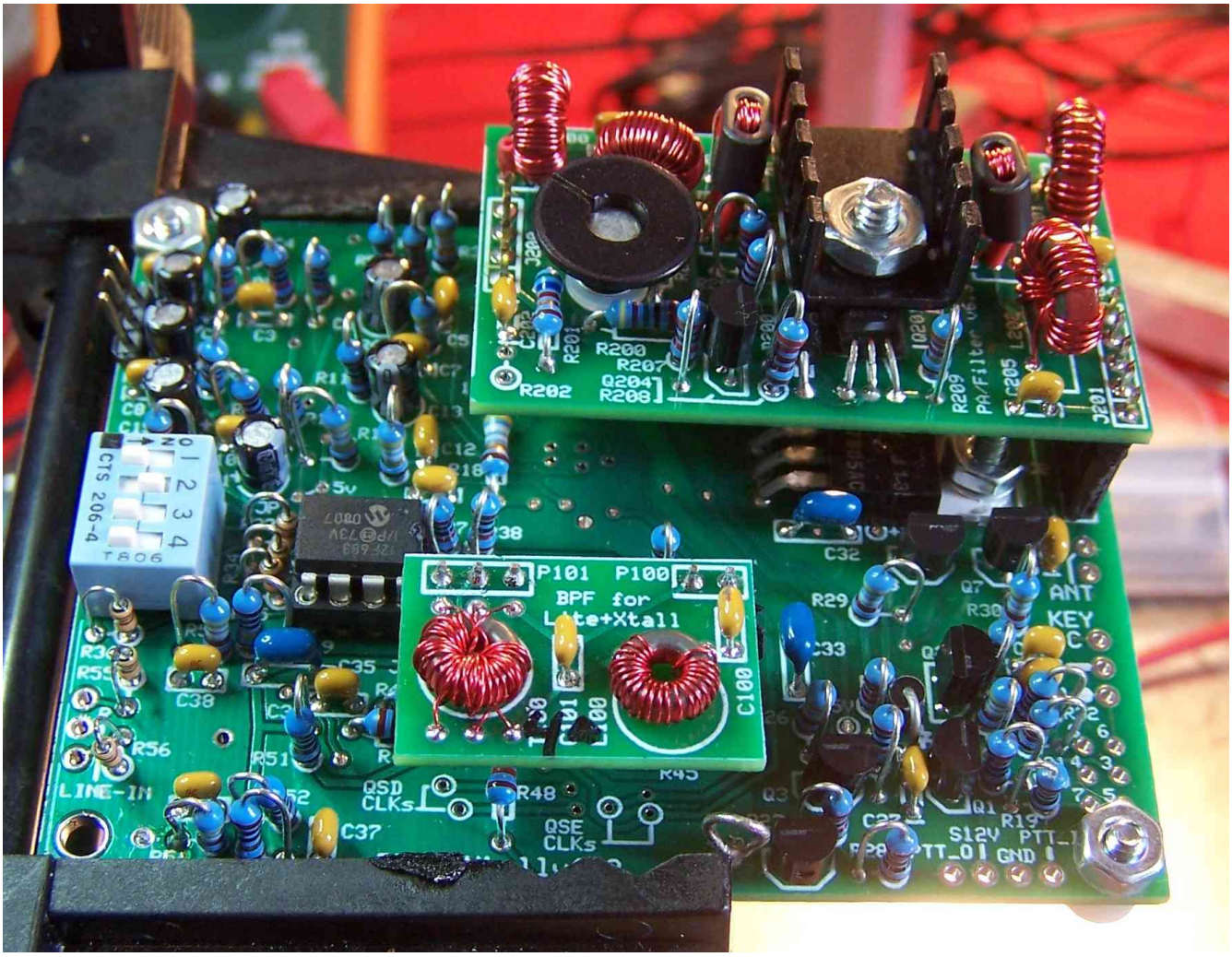
Enhanced Builders' Notes

WB5RVZ has prepared enhanced builders' notes on several Softrock kits.

The most recently completed set is the set describing the stages of building the new RXTX V6.3.



These notes are web-based and can be accessed via the following link:
http://golddredgervideo.com/wb5rvz/RXTX_V6_3/index.htm

Softrock RXTX V6.3 - Xtall Homepage (as of 7 JUN 2009)

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

This is the home page for the Detailed Builder's Notes for the Softrock RXTX V6.3 Software Defined Radio transceiver, the latest in a series of SDR kits offered by Tony Parks KB9YIG. Availability, Pricing, and Ordering can be found at: Tony's website.

These notes were developed as the author moved through an actual build. The kit is a multi-band transceiver, using plugable bandpass filter and PA/LPF boards to provide operation across popular ham bands from 160m to 10m. This build focuses on the implementation using 80/40 meter plug boards . These instructions and included component bills of material provide the guidance for constructing all plug boards for all bands, however, pictures and examples will be based on the 80/40 m boards .

Much of the documentation was initially developed from the original RXTX V6.2 and Lite+Xtall V9.3 documentation and based upon an excellent work by Leonard, KC0WOX, without which this could not have been accomplished. As the build progressed, the author posted necessary changes to the affected web pages and logged them in the "revisions" page. If your browser is caching pages, you may need to hit the "refresh" key (F5 on IE and Firefox) to get the latest version of the page.

The intent in providing these detailed instructions is to help the less experienced builder through what might otherwise be a daunting task. The instructions provide a stage-by-stage build process, allowing the builder to build a single stage and then test it ("sanity check") before moving on to the next stage.

> If you are a more experienced builder and would prefer to build the kit entirely and then test it (i.e., you would prefer not to follow the staged approach herein), here is the very abbreviated sequence of steps for building the main board:
>
> - mount all the SMT caps
> - mount all the SMT ICs. If a CMOS Si570 is used do not mount U8
> - mount all the resistors and diodes using the board silkscreen patterns to determine if the part is mounted flat to the board or hairpin style. If a CMOS Si570 is used, omit R43.
> - If a CMOS Si570 is used be sure to add the CMOS jumper wire
> - mount all the ceramic caps except for C34 which is mounted after J3 and J4 are mounted

- mount all the electrolytic caps (observe the polarity marks)
- mount transistors
- mount J3 and J4 with using the 9-pin piece of header as a tool to get good alignment of J3 and J4.
- mount C34
- mount U4 using #4 hardware
- mount J1 and J2
- mount the PIC 8-pin socket
- mount the DIP switch
- build BPF board(s)
- build PA/Filter board(s)

For the rest of us, read on.

Some stages may provide considerable background info. For those who would rather skip the background info and just get with the building, the *critical* steps and tests in each stage will be highlighted by special Icons:

This icon identifies a construction step in the build stage

This icon identifies a test operation in the build stage

This icon identifies a test (not strictly needed) you can perform if you have an oscilloscope. One should be able to successfully build and test this kit with only a DMM of average accuracy.

This icon indicates that the builder can use a ham transceiver (RX or TX) to perform a test on frequency related tests.

This icon indicates that the builder should be especially aware of a possible "gotcha" in the current build step.

The builder can register into the Softrock users group on Yahoo to pose any questions, comments, or issues to the many talented users/builders who are constantly posting to and reading from that group.

Any comments or corrections should be directed to the author, Robby WB5RVZ, and would be most appreciated.

Credit is due to several sources, including, but not limited to, Tony KB9YIG, Leonard KC0WOX, and Alex VE3NEA.

Schematic

Each stage will begin with a subset of the overall schematic diagram. You can reference the two full diagrams provided with the kit by clicking on the following links:

- Sheet 1 - TX and Misc
- Sheet 2 - RX
- Sheet 3 - Band-specific PA and Filter Boards
- Sheet 4 - Band-specific RX Bandpass Filter Boards
- Sheet 5 - Additional Low Pass Filters (for 80 and 30m)

Schematic subsets have been annotated with "fat" dots on the "hairpin" end of resistors which are mounted as such. For flat-mounted resistors, the dot corresponds to the left-hand lead (if the resistor is mounted horizontally) or the top lead (if the resistor is mounted vertically). This provides the builder with come convenient test points (i.e., the "hairpin", "top", or "left-hand" leads) immediately recognizable in the schematics.

Bill of Materials

Before beginning work on the kit, you should inventory it against the Billof Materials. In each stage, there will be a subset of the Bill of Materials related to that stage alone. You can use that subset as a checklist of the components to be installed in the stage.

Build Notes

Each stage will have a set of graphics (board top and bottom) and Summary and Detailed instructions on how to complete that stage. Where there may be "gotchas" or special techniques or special sequences of tasks, they will be noted under the "Build It" icon

The summary instructions for each page will immediately follow the stage schematic. It is an abbreviated set of tasks for that build stage, summarizing the detailed build notes which follow, and ending with a clickable link to go diretly to the Testing Section. This will enable the builder to review the entire stage and then, print out the first 1 or 2 pages of the stage to serve as a hardcopy schematic, BOM, and sequenced tasklist for that stage.

To maximize the test opportunities (and the learning value of the kit), the stages should be built and tested in the following order, first reviewing the stage instructions on line and then proceeding on to install and test the stage

- Inventory the kit
- Build and test the 12, 5 and 3.3 Vdc power supplies
- Build and test the Local Oscillator
- Build and test the Dividers
- Build and test the RX OpAmps
- Build and test the RX Mixer(QSD)
- Build and test the RX BPF(s);
- Build and test the TX OpAmps
- Build and test the TX Mixer (QSE)
- Build and test the PTT circuits
-
- Build and test the RX Switching circuits
- Build and test the PA/Filter(s)/
-
- Install the External Connectons

Testing

Each stage will have a "Testing" Section, outlining one or more tests that, when successfully completed, provide you with the confidence and assurance that you are heading in the right direction towards a fully tested and built transceiver. This kit can be built and reliably tested using nothing more than a common multimeter.

Most stages will have a current draw test, in which the builder tests the stage's current draw in two different ways:

- **First, testing the draw through a current-limiting resistor**
- **Then, when that test is OK, removing the current-limiting resistor and measuring the real current draw.**

Tests assume that the builder has a decent digital multimeter of sufficiently high input impedance as to minimize circuit loading issues. Measurements will be taken of current draws, test point voltages, and resistances.

When you perform a test, you should always record the results of the test where indicated in the Testing section. This will make troubleshooting via the reflector much

easier, since you will be communicating with the experts using a standard testing and measurement regime.

When comparing measurements to those published in these notes, the builder should be aware that actual and expected values could vary by as much as +/- 10%. The idea behind furnishing "expected/nominal" measurement values is to provide the builder with a good, "ballpark" number to determine whether or not the test has been successful. If the builder has concerns about his measurements, he should by all means pose those concerns as a query in the Softrock reflector so the experts can provide assistance.

Dummy Load. You will need a 50 ohm dummy load for transmitter testing. If you do not have an oscilloscope, the dummy load should have a rectified output, such that you can measure the dc voltage at the output and convert to power measurement. An excellent QRP dummy load for this purpose is the Norcal Dummy Load, which has the added advantage of providing an excellent learning platform for those unfamiliar to SMT soldering.

Optional testing. If the builder has (access to) a dual channel oscilloscope, along with an audio signal generator and an RF signal generator, and feels the need to perform tests beyond the basic DMM tests, certain stages will include in their testing section some optional tests involving this advanced equipment.

The IQGen or DQ-Gen programs available free from Michael Keller, DL6IAK, can be used in a pinch to get the sound card to produce audio tones for injection into the circuit.

You can always use Rocky to generate I and Q signals for tests requiring these audio signals (this is the author's preferred way)

Background Info

Tools

Soldering

View above video example on Youtube

- Read the Primer on SMT Soldering at the Sparkfun site. It is a very good read and it speaks great truths. Then take the time to watch the video tutorial on soldering an SOIC SMD IC.
- Solder Stations. Don't skimp here. Soldering deficiancies account for 80 percent of the problems surfaced in troubleshooting. It is preferable to have an ESD-safe station, with a grounded tip. A couple of good stations that are relatively inexpensive are:

  - Velleman VTSS5U 50W Solder Station (approx $20 at Frys)
  - Harbor Freight ESD Solder Station (under $50)

ESD Protection

- Avoid carpets in cool, dry areas.
- Leave PC cards and memory modules in their anti-static packaging until ready to be installed.
- Dissipate static electricity before handling any system components (PC cards, memory modules) by touching a grounded metal object, such as the system unit unpainted metal chassis.

- If possible, use antistatic devices, such as wrist straps and antistatic mats (see Radio Shack's Set for $25 or the JameCo AntiStatic mat for $15)).
- Always hold a PC card or memory module by its edges. Avoid touching the contacts and components on the memory module.
- Before removing chips from insulator, put on the wrist strap connected to the ESD mat. All work with CMOS chips should be done with the wrist strap on.
- As an added precaution before first touching a chip, you should touch a finger to a grounded metal surface.
- If using a DMM, its outside should be in contact with the ground of the ESD mat, and both leads shorted to this ground before use.
- See the review of ESD Precautions at this link.

Work Area

- You will need a well-lit work area and a minimum of 3X magnification (the author uses a cheap magnifying flourescent light with a 3X lens. This is suplemented by a hand-held 10 X loupe - with light - for close-in inspection of solder joints and SMT installation.
- You should use a cookie sheet or baking pan (with four sides raised approximately a half an inch) for your actual work space. It is highly recommended for building on top of in order to catch stray parts, especially the tiny SMT chips which, once they are launched by an errant tweezer squeeze, are nigh on impossible to find if they are not caught on the cookie sheet.

Misc Tools

- It is most important to solidly clamp the PCB in a holder when soldering. A "third-hand" (e.g., Panavise or the Hendricks kits PCB Vise) can hold your board while soldering. In a pinch, you can get by with a simple third-hand, alligator clip vise. Jan G0BBL suggests "A very cheap way is to screw a Large Document Clip to a woodblock which will clamp the the side of a PCB."
- Magnifying Head Strap
- Tweezers (bent tip is preferable).
- Diagonal side cutters.
- Small, rounded jaw needle-nose pliers.
- Set of jewelers' screwdrivers
- An Exacto knife.
- Fine-grit emery paper.

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

Before commencing build activities, you are strongly encouraged to carefuilly inventory your kit.

The bill of materials (BOM) outlined here covers the components and values needed for building the RXTX V6.3 transceiver. The transceiver requires two boards for each band to be covered. These boards are designated BPF-# for Bandpass filter and PAF-# for the PA/Filter, with the "#" being a placeholder for the numbers 1 thru 4, as indicated in the links below:

1.
    1. BF/PAF-1: the 160 m band
    2. BF/PAF-2: the 80/40 m band
    3. BF/PAF-3: the 30/20/17 m band
    4. BF/PAF-4: the 15/12/10 m band

The Basic kit includes all 4 RX BPF boards. For TX, the builder may order a minimum of 1 and a maximum of 4 PAF boards, in addition to the main kit.

The BOM below is grouped by type of materials and, for those materials that have measureable values, sorted by value.

The bills of materials for each of the four BP/PAF boards are found at the links described above.

Bill of Materials - Main Board

Resistors

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	R46	10	brown-black-black-gold-brown	Resistor 1%	1	FlatH	MixerRX
[___]	R47	10	brown-black-black-gold-brown	Resistor 1%	1	FlatH	MixerRX
[___]	R49	10	brown-black-black-gold-brown	Resistor 1%	1	W-E	OpAmpRX
[___]	R50	10	brown-black-black-gold-brown	Resistor 1%	1	W-E	OpAmpRX

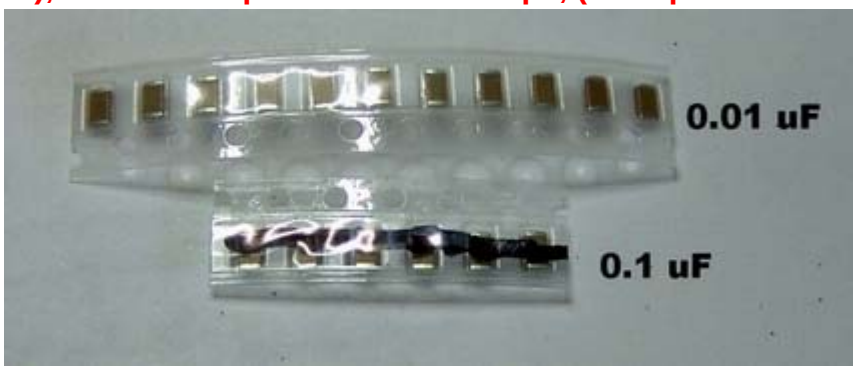
[___]	R23	22.1	red-red-brown-gold-brown	Resistor 1%	1	FlatH	PTT
[___]	R03	49.9	yellow-white-white-gold-brown	Resistor 1%	1	S-N	OpAmpTX
[___]	R06	49.9	yellow-white-white-gold-brown	Resistor 1%	1	E-W	OpAmpTX
[___]	R09	49.9	yellow-white-white-gold-brown	Resistor 1%	1	E-W	OpAmpTX
[___]	R12	49.9	yellow-white-white-gold-brown	Resistor 1%	1	S-N	OpAmpTX
[___]	R17	49.9	yellow-white-white-gold-brown	Resistor 1%	1	FlatV	MixerTX
[___]	R18	49.9	yellow-white-white-gold-brown	Resistor 1%	1	FlatV	MixerTX
[___]	R33	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W	LO
[___]	R34	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W	LO
[___]	R35	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W	LO
[___]	R36	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W	LO
[___]	R43	100	brown-black-brown-gold	Resistor 5% 1/6W	1	FlatH (Omit for CMOS)	LO
[___]	R55	100	brown-black-brown-gold	Resistor 5% 1/6W	1	N-S	OpAmpRX
[___]	R56	100	brown-black-brown-gold	Resistor 5% 1/6W	1	S-N	OpAmpRX
[___]	R28	221	red-red-brown-black-brown	Resistor 1%	1	E-W	PTT
[___]	R41	1 k	brown-black-black-brown-brown	Resistor 1%	1	N-S	LO
[___]	R42	1 k	brown-black-black-brown-brown	Resistor 1%	1	S-N	LO
[___]	R51	1 k	brown-black-black-brown-brown	Resistor 1%	1	S-N	OpAmpRX
[___]	R52	1 k	brown-black-black-brown-brown	Resistor 1%	1	E-W	OpAmpRX

[___]	R01	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S	OpAmpTX
[___]	R02	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W	OpAmpTX
[___]	R04	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S	OpAmpTX
[___]	R05	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N	OpAmpTX
[___]	R07	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N	OpAmpTX
[___]	R08	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W	OpAmpTX
[___]	R10	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S	OpAmpTX
[___]	R11	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N	OpAmpTX
[___]	R19	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W	PTT
[___]	R20	10 k	brown-black-black-red-brown	Resistor 1%	1	W-E	PTT
[___]	R25	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S	PTT
[___]	R37	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S	LO
[___]	R38	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S	LO
[___]	R39	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N	LO
[___]	R40	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N	LO
[___]	R44	10 k	brown-black-black-red-brown	Resistor 1%	1	FlatH	DIV

[___]	R45	10 k	brown-black-black-red-brown	Resistor 1%	1	FlatH	DIV
[___]	R48	10 k	brown-black-black-red-brown	Resistor 1%	1	FlatV	MixerRX
[___]	R13	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	S-N	OpAmpTX
[___]	R14	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E	OpAmpTX
[___]	R16	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	FlatV	MixerTX
[___]	R22	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	N-S	PTT
[___]	R31	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E	PTT
[___]	R32	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E	PTT
[___]	R24	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S	PTT
[___]	R27	22.1 k	red-red-brown-red-brown	Resistor 1%	1	E-W	PTT
[___]	R15	3.32 k	orange-orange-red-brown-brown	Resistor 1%	1	FlatV	MixerTX
[___]	R21	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	N-S	PTT
[___]	R26	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	N-S	PTT
[___]	R29	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	W-E	RXSW
[___]	R30	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	S-N	RXSW
[___]	R53	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	E-W	OpAmpRX
[___]	R54	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	E-W	OpAmpRX

Capacitors

Caveat: Note that the SMT caps come in two different strips: there are nine of the 0.01 uF caps, (one spare included), and two strips of ten 0.1 uF caps, (two spares included).



Do not get them mixed up.

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	C30	0.01 uF	103	ceramic	1		RXSW
[___]	C34	0.01 uF	103	ceramic	1		LO
[___]	C52	0.01uF		SMT 1206 CAP	1		PS3.3V
[___]	C53	0.01uF		SMT 1206 CAP	1		PS3.3V
[___]	C54	0.01uF		SMT 1206 CAP	1		LO
[___]	C56	0.01uF		SMT 1206 CAP	1		Div
[___]	C57	0.01uF		SMT 1206 CAP	1		LO
[___]	C58	0.01uF		SMT 1206 CAP	1		LO
[___]	C59	0.01uF		SMT 1206 CAP	1		MixerRX
[___]	C61	0.01uF		SMT 1206 CAP	1		LO
[___]	C05	0.022 uF	223	ceramic	1		OpAmpTX
[___]	C07	0.022 uF	223	ceramic	1		OpAmpTX
[___]	C12	0.022 uF	223	ceramic	1		OpAmpTX
[___]	C14	0.022 uF	223	ceramic	1		OpAmpTX
[___]	C27	0.033 uF	333	ceramic	1		PTT
[___]	C28	0.047 uF	473	ceramic	1		PTT
[___]	C29	0.047 uF	473	ceramic	1		PTT
[___]	C36	0.047 uF	473	ceramic	1		OpAmpRX
[___]	C37	0.047 uF	473	ceramic	1		OpAmpRX
[___]	C40	0.1uF		SMT 1206 CAP (black marked strip)	1		PS3.3V
[___]	C41	0.1uF		SMT 1206 CAP (black marked strip)	1		OpAmpTX
[___]	C42	0.1uF		SMT 1206 CAP (black marked strip)	1		OpAmpTX
[___]	C43	0.1uF		SMT 1206 CAP (black marked strip)	1		OpAmpTX
[___]	C44	0.1uF		SMT 1206 CAP (black marked strip)	1		MixerTX
[___]	C45	0.1uF		SMT 1206 CAP (black marked strip)	1		MixerTX

[___]	C46	0.1uF		SMT 1206 CAP (black marked strip)	1		MixerTX
[___]	C47	0.1uF		SMT 1206 CAP (black marked strip)	1		Ptt
[___]	C48	0.1uF		SMT 1206 CAP (black marked strip)	1		PS5V
[___]	C49	0.1uF		SMT 1206 CAP (black marked strip)	1		PS5V
[___]	C50	0.1uF		SMT 1206 CAP (black marked strip)	1		PS5V
[___]	C51	0.1uF		SMT 1206 CAP (black marked strip)	1		RXSW
[___]	C55	0.1uF		SMT 1206 CAP (black marked strip)	1		MixerRX
[___]	C60	0.1uF		SMT 1206 CAP (black marked strip)	1		MixerRX
[___]	C62	0.1uF		SMT 1206 CAP (black marked strip)	1		OpAmpRX
[___]	C63	0.1uF		SMT 1206 CAP (black marked strip)	1		Div
[___]	C64	0.1uF		SMT 1206 CAP (black marked strip)	1		OpAmpRX
[___]	C65	0.1uF		SMT 1206 CAP (black marked strip)	1		OpAmpRX
[___]	C02	10 uF 16V		electrolytic	1	E=+	OpAmpTX
[___]	C04	10 uF 16V		electrolytic	1	S=+	OpAmpTX
[___]	C06	10 uF 16V		electrolytic	1	N=+	OpAmpTX
[___]	C09	10 uF 16V		electrolytic	1	E=+	OpAmpTX
[___]	C11	10 uF 16V		electrolytic	1	W=+	OpAmpTX
[___]	C13	10 uF 16V		electrolytic	1	N=+	OpAmpTX
[___]	C15	10 uF 16V		electrolytic	1	E=+	OpAmpTX
[___]	C16	10 uF 16V		electrolytic	1	S=+	MixerTX
[___]	C17	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C18	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C19	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C20	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C21	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C22	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C23	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C24	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C25	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C26	10 uF 16V		electrolytic	1	S=+	PS5V
[___]	C31	10 uF 16V		electrolytic	1	S=+	PTT
[___]	C01	1000 pF	102	ceramic	1		OpAmpTX
[___]	C08	1000 pF	102	ceramic	1		OpAmpTX
[___]	C03	100pF	101	ceramic	1		OpAmpTX
[___]	C10	100pF	101	ceramic	1		OpAmpTX
[___]	C38	220 pF	221	ceramic	1		OpAmpRX

[___]	C39	220 pF	221	ceramic	1		OpAmpRX
[___]	C32	4.7 uF	475	ceramic	1		PS3.3V
[___]	C33	4.7 uF	475	ceramic	1		PS3.3V
[___]	C35	4.7 uF	475	ceramic	1		OpAmpRX

Semiconductors and ICs

Note: In the earlier kits, Tony had included two SOT-23 ICs: U8 and U5. U8 was the FIN1002, required when using the non-CMOS version of the SI570. In later kits, Tony ships only the CMOS version, making the inclusion of U8 unnecessary. If your kit is one of those that wasshipped with the CMOS Si570 AND included U8, simply ignore that chip. The other SOT-23 chip, U5, is the 3.3v voltage regulator and can be recognized by its markings ("LFEA").

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	U6	12F683		CPU and socket	1	(top)	LO
[___]	D1	1N4003		Diode	1		PS5V
[___]	D2	1N4003		Diode	1		PTT
[___]	Q1	2N3904		Transistor (NPN) TO-92	1		PTT
[___]	Q3	2N3904		Transistor (NPN) TO-92	1		PTT
[___]	Q4	2N3904		Transistor (NPN) TO-92	1		PTT
[___]	Q2	2N3906		Transistor (PNP) TO-92	1		PTT
[___]	U9	74AC74		SOIC-14 SMT Dual FF	1	(bottom)	DIV
[___]	Q7	BS170		TO-92 Transistor (N-Channel, FET)	1		RXSW
[___]	Q8	BS170		TO-92 Transistor (N-Channel, FET)	1		RXSW
[___]	U8	FIN1002		SOT-23 Diff LVDS Rcvr	1	(bottom - code="FN02X") Omit for CMOS	LO
[___]	U10	FST3253		SOIC-16 Dual 4:1 Mux/Demux Bus Switch	1	(bottom)	MixerRX
[___]	U3	FST3253		SOIC-16 Dual 4:1 Mux/Demux Bus Switch	1	(bottom)	MixerTX
[___]	U4	LM7805		IC TO-220 5V voltage regulator	1	(top)	PS5V

[___]	U5	LP2992AIMS-3.3V		SOT-23 3.3v Regulator	1	(bottom - Code="LFEA")	PS3.3V
[___]	U11	LT6231		SOIC-8 Dual OpAmp	1	(bottom)	OpAmpRX
[___]	U7	Si570 LVDS or CMOS		Programmable XO/VCXO	1	(bottom)	LO
[___]	U1	TLV2462		IC SOIC-8 dual Op-Amp	1	(bottom)	OpAmpTX
[___]	U2	TLV2462		IC SOIC-8 dual Op-Amp	1	(bottom)	OpAmpTX

Cores

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	BN-43-2402	BN-43-2402 core	BN-43-2402	binocular core	1	RFC1	Main board

Connectors

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	J3	2-pin socket		connector (female)	1		MixerRx
[___]	J4	3-pin socket		connector (female)	1		MixerRx
[___]	J1	4-pin socket		connector (female)	1		MixerTX
[___]	J2	5-pin socket		connector (female)	1		MixerTX
[___]	DB9	DB9 Interface		connector (female)	1		EXTCONN

Hardware, Misc Components

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	#4 spacer	#4 1/8" nylon spacer		hardware	4	main board	INI
[___]	#4 lock	#4 metal lock washer	n/a	hardware	1	main board	INI
[___]	#4 nylon	#4 nylon washer		hardware	4	main board	INI
[___]	4-40 screw	4-40 3/8" machine screw		hardware	5	main board	INI
[___]	4-40 nut	4-40 hex nut		hardware	5	main board	INI
[___]	SW1	4-pos dip switch		Dip Switch (8 pins)	1	mount so pos 1 is toward top of board	LO
[___]	main board	RXTX + Xtall V6.3		PCB for main circuit	1		INI

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - Power Supplies

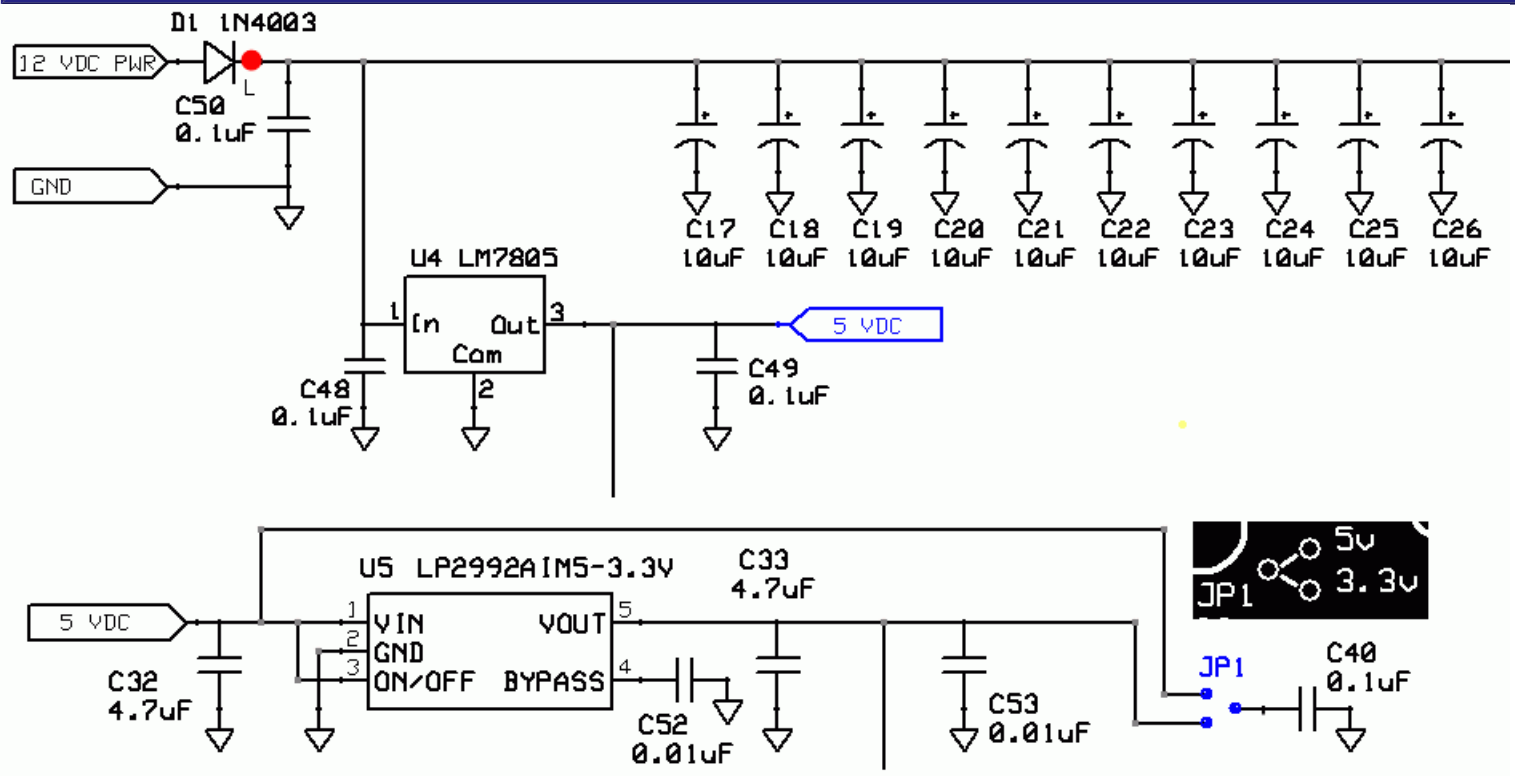
Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

The first stage covers a lot of initialization work, in addition to installing and testing the three dc power supplies - 12, 5, and 3.3 Vdc.

The first step is to install ALL of the SMT capacitors (they are numbered C40 and above) to the bottom of the board. This helps protect the ICs from static discharge failures later in the build. It also gently introduces the builder to working with SMT components. A test after the SMT caps are mounted is to make sure there are no shorts to ground on the +5 and +3.3 volt power nets.

Schematic



Summary Build Notes

- Fasten Board Mounting Hardware
- Install All SMT Caps (some are .1, some are .o1 uF - see bottomside map below) and test for shorts
- Install U5
- Install U4 and D1
- Install electrolytic caps and ceramic caps
- Install ground testpoint loop
- Test the stage

Bill of Materials

Power Supplies

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[ ]	C17	10 uF 16V		electrolytic	1	S=+
[ ]	C18	10 uF 16V		electrolytic	1	S=+
[ ]	C19	10 uF 16V		electrolytic	1	S=+
[ ]	C20	10 uF 16V		electrolytic	1	S=+
[ ]	C21	10 uF 16V		electrolytic	1	S=+
[ ]	C22	10 uF 16V		electrolytic	1	S=+
[ ]	C23	10 uF 16V		electrolytic	1	S=+
[ ]	C24	10 uF 16V		electrolytic	1	S=+
[ ]	C25	10 uF 16V		electrolytic	1	S=+
[ ]	C26	10 uF 16V		electrolytic	1	S=+
[ ]	C32	4.7 uF	475	ceramic	1	
[ ]	C33	4.7 uF	475	ceramic	1	
[ ]	D1	1N4003		Diode	1	
[ ]	U4	LM7805		IC TO-220 5V voltage regulator	1	(top)
[ ]	U5	LP2992AIM5-3.3V		SOT-23 3.3v Regulator	1	(bottom - code="LFEA")

SMT Caps

Note that there are two different types of SMT cap: 0.1 uF and 0.01 uF

Check Check	Designation Designation	Component Component	(Color) Code (Color) Code	Type Type	Qty Qty	Notes Notes
[ ]	C52	0.01uF		SMT 1206 CAP	1	
[ ]	C53	0.01uF		SMT 1206 CAP	1	
[ ]	C54	0.01uF		SMT 1206 CAP	1	
[ ]	C56	0.01uF		SMT 1206 CAP	1	
[ ]	C57	0.01uF		SMT 1206 CAP	1	
[ ]	C58	0.01uF		SMT 1206 CAP	1	
[ ]	C59	0.01uF		SMT 1206 CAP	1	
[ ]	C61	0.01uF		SMT 1206 CAP	1	
[ ]	C40	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C41	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C42	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C43	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C44	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C45	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C46	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C47	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C48	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C49	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C50	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C51	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C55	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C60	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C62	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C63	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C64	0.1uF		SMT 1206 CAP (black marked strip)	1	
[ ]	C65	0.1uF		SMT 1206 CAP (black marked strip)	1	

Detailed Build Notes

Board Hardware

The first step of construction is to fasten the board mounting hardware to the corner holes of the board. From the bottom side of the board each corner hardware group consists of:

- **a 3/8 inch long 4-40 Phillips machine screw,**
- **a 1/8 in long nylon spacer,**
- **the circuit board,**
- **a #4 nylon washer and**
- **a 4-40 hex nut.**

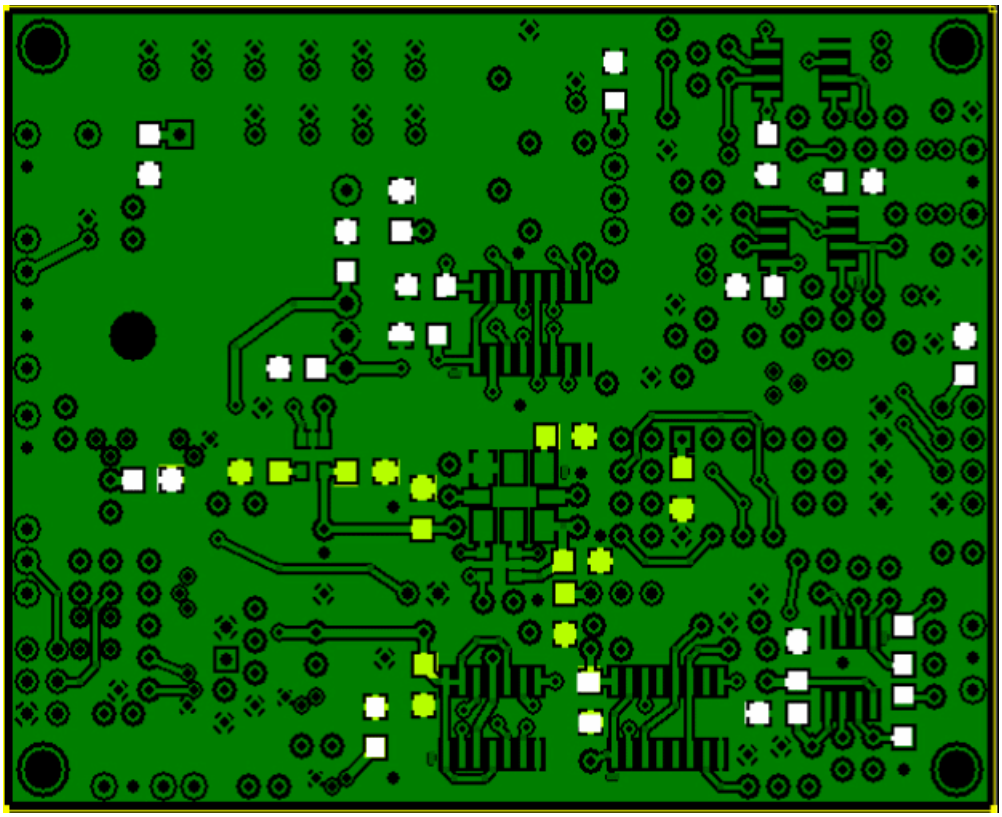
Install SMT Caps

First, mount all of the SMT caps for the bottom of the main board. The 8 0.01 uF caps are found in a clear plastic strip. The 18 0.1 uF caps are in a plastic strip marked with a black stripe. (There are actually 20 caps in the kit; you have two free throws!)

Use the graphic below to determine placement. The 0.01 uF caps' locations are marked in the picture with yellow solder pads; the 0.1 uF caps are marked with white solder pads.

- **Mount the eight 0.01 uF caps (from the clear plastic strip) first. Use the yellow colored pads.**
- **Then mount the eighteen 0.1 uF caps (from the black-marked plastic strip) on the remaining (whte) SMT cap pads**

Gotcha: (this applies, as well, to all soldering work on the bottom of the board) be careful when soldering SMT components to avoid "splashover" of molten solder into/onto adjacent holes. It is very easy to plug up a hole and be forced at some later stage to stop work and "unplug" the hole. A fine toothpick is a handy solder "guard" when you need to protect one or more adjacent holes.



Test SMT Caps for shorts

- Perform this test BEFORE moving on to the Power Supply components. Note: an auto-ranging ohmmeter will likely indicate a brief reading of several tens of MegOhms before finally going to off-scale.

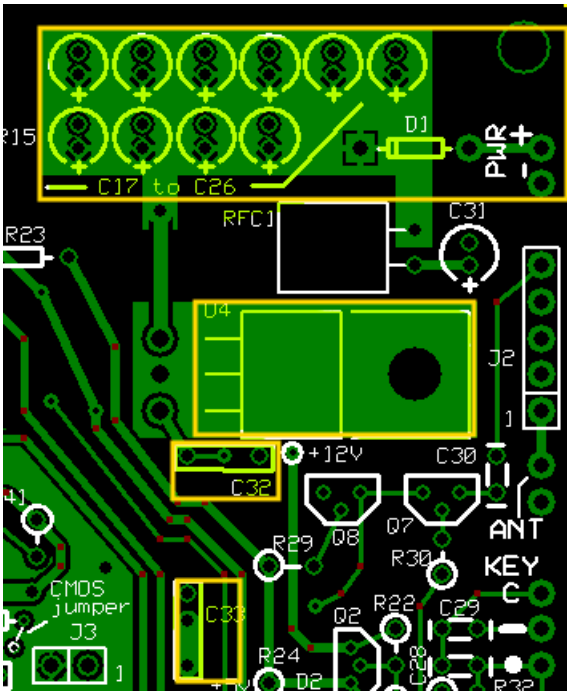
- Note: the test points for the 5 and 3.3 Vdc rails are at JP1. JP1 is for selecting either 3.3 volts or 5 volts to the second set of holes under the 4-position DIP switch.
- JP1 is not needed for normal operation of the v6.3 board.
    - **refer to the 12, 5, and 3.3 V test points referenced in the testing section, belownts referenced in the testing section, below**
    - **using your ohmmeter, test the power in terminals for any short**
    - **next, test the +12 V rail for any shorts**
    - **next, test the 5 volt rail for any short**
    - **finally, test the 3.3v rail for any short.**
    - **If a short is discovered on any line, check back through the main schematic to identify potential SMT caps (C40-C65) which could be shorted. Resolder the offender.**

Install U5 (LP2292AIM5-3.3v)

- **Install U5 (LP2292AIM5-3.3v) on the bottom side of the board (vicinity of C52-C53).**
- **Install this 3.3 V voltage regulator first.**
- **Take care with this IC. It is very tiny and installation is very prone to solder bridges. (see the SMT IC Installation Guidelines). Be very careful not to launch this chip with your tweezers. You'd likely never find it again!**
- **Take ESD precautions when working with this IC.**

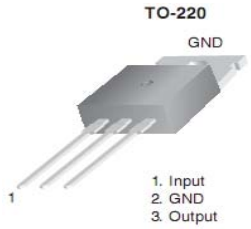
Check	Designation	Component	Type	Qty	Notes	Orientation
	U5	SOT23-5 LP2992AIMS-3.3V	3.3v Regulator		(bottom - code="LFEA")	

Install Power Supply Topside Components



Install U4 (LM7805)

- Install the 5 volt regulator. It mounts on top of the circuit board and the tab is fastened to the circuit board by 4-40 hardware (4-40 machine screw, #4 star lock washer, and hex nut) provided in the kit.
  Watch out for the potential for the lower edge of this IC to overlap the +12 V test point and the C32 mounting holes.



- Bolt U4 to the board and solder and clip the leads.

Install D1 (1N4003)

Install D1 "flat" style, with the anode end in the round hole and the cathode end in the square hole

Install Electrolytics - C17-C26

Pay careful attention to the polarity of the electrolytic capacitors (C17-C26). The positive lead is the longer lead; the negative lead is the lead marked by a grey stripe down the side of the can. The positive lead is oriented toward the "south" of the board.

Install ceramic Capacitors

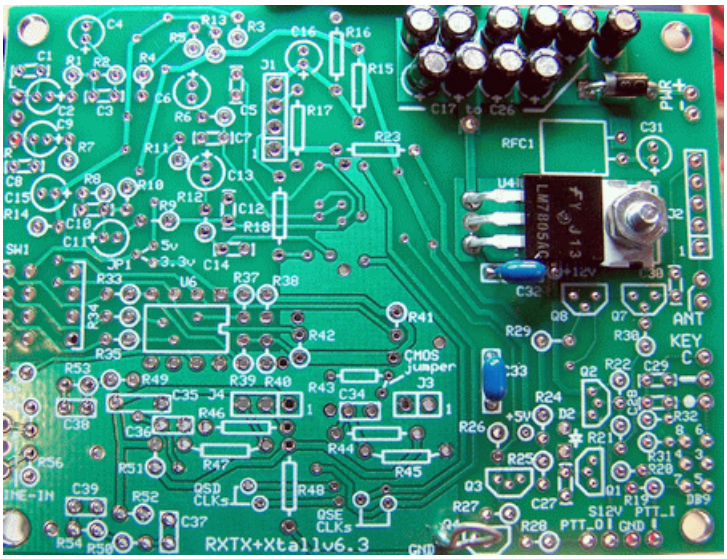
Install C32 and C33 topside. See the guidelines on installing Ceramic Capacitors.

Install a loop for ground testpoints.

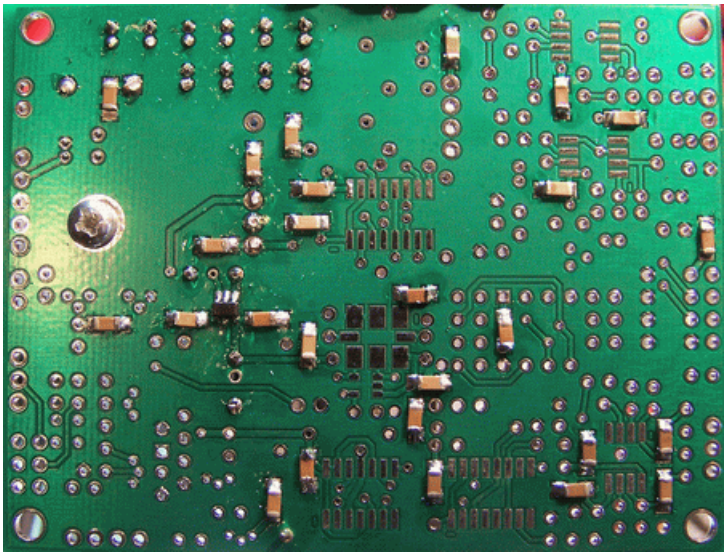
- Install a short piece of hookup wire (the long lead snipped from D1 after its installation is great for this purpose) into the hole near the center of the board at the bottom edge designated "GND" to allow a ground test point.
- Note, use a fairly stout piece of wire because this will get a lot of abuse during testing.

Completed board

Topside



Bottomside

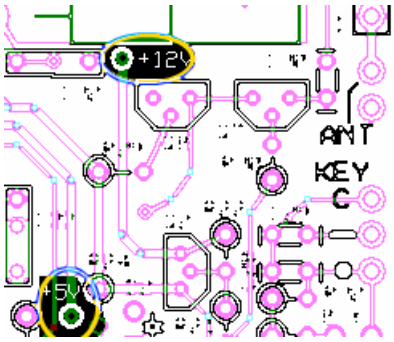


Testing

Current Draw (DMM)

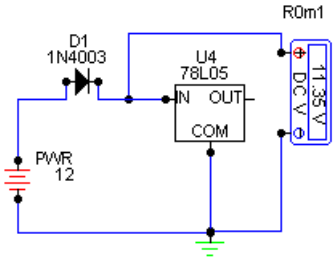
- Before you power the board up for the first time, connect a ma meter in series with the power lead and to be safe, put a 1k ohm resistor in series with the power lead. This can be in either the + or - line. This will limit the current flow to <=12 mA if you have a short on the board.
- After you see that the current isn't excessive, remove it, and re-measure the current draw. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.
- The current draw with this initial stage and no other loads should be < 4 mA
- The author measured 3.1 mA.
- Your measurement is:_____

12 Volt Rail



- Power up the board with 12 Vdc
- Using a DMM, measure the voltage with respect to ground at the +12 V point on the board.
- This should be approximately 12 volts DC. It should show a voltage drop from the power source on the order of .5 to .7 Vdc, representing the effect of D1's ohmic resistance in the circuit.
- The author's board measured 11.4 Vdc with a power source that measured ~12 Vdc).

- **Here is a simulation of the expected rail voltage, showing D1's effect:**



- **Your power source measurement is _____**
- **Your 12 V testpoint measurement is _____**

5 Volt Rail (DMM - 5 Vdc)

- **Power up the board with 12 Vdc**
- **Using a DMM, measure the voltage with respect to ground at the +5V point of JP1 (just above U6 on the top of the board).**
- **This should be in the range of 4.5 - 5.5 volts DC.**
- **The author's board measured 4.97Vdc).**
- **Your measurement is_____**

3.3 Volt Rail (DMM - 3.3 Vdc)

- **With the board powered up and using a DMM, measure the voltage with respect to ground at the 3.3V test point of JP1.**
- **This should be approximately 2.9 - 3.6 volts DC (the author's board provided 3.28 Vdc).**
- **Your measurement is_____**
- **If you do not get a good 3.3 Vdc reading, go back and check the soldering on U5.**

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs;
TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall Local Oscillator

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

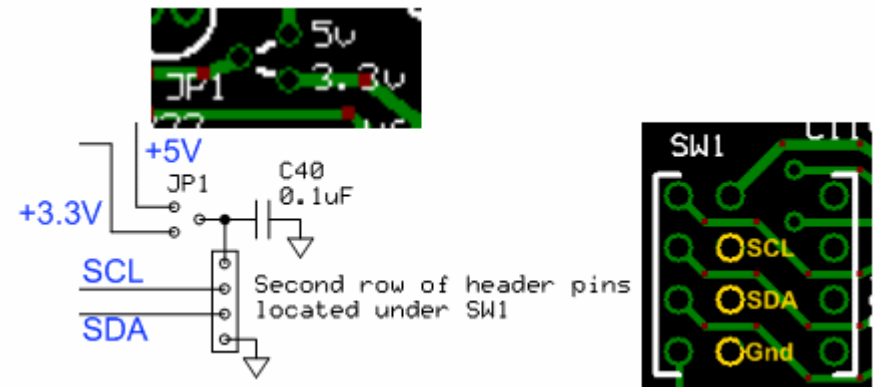
Introduction

Theory of Operation

The local oscillator (U7)is a programmable oscillator, whose programmatic parameters are set by the microcontroller, U6.

U6 is programmed with 16 different values corresponding to the settings of dip switch SW1. Without U6 in the circuit, U7 would default to an output frequency of 56.320 mHz. The IC U8 is needed if the version of U7 is the "LVDS" version. If U7 is a CMOS version, U8 (and R43) is not required and, instead a jumper wire is installed to bypass them.

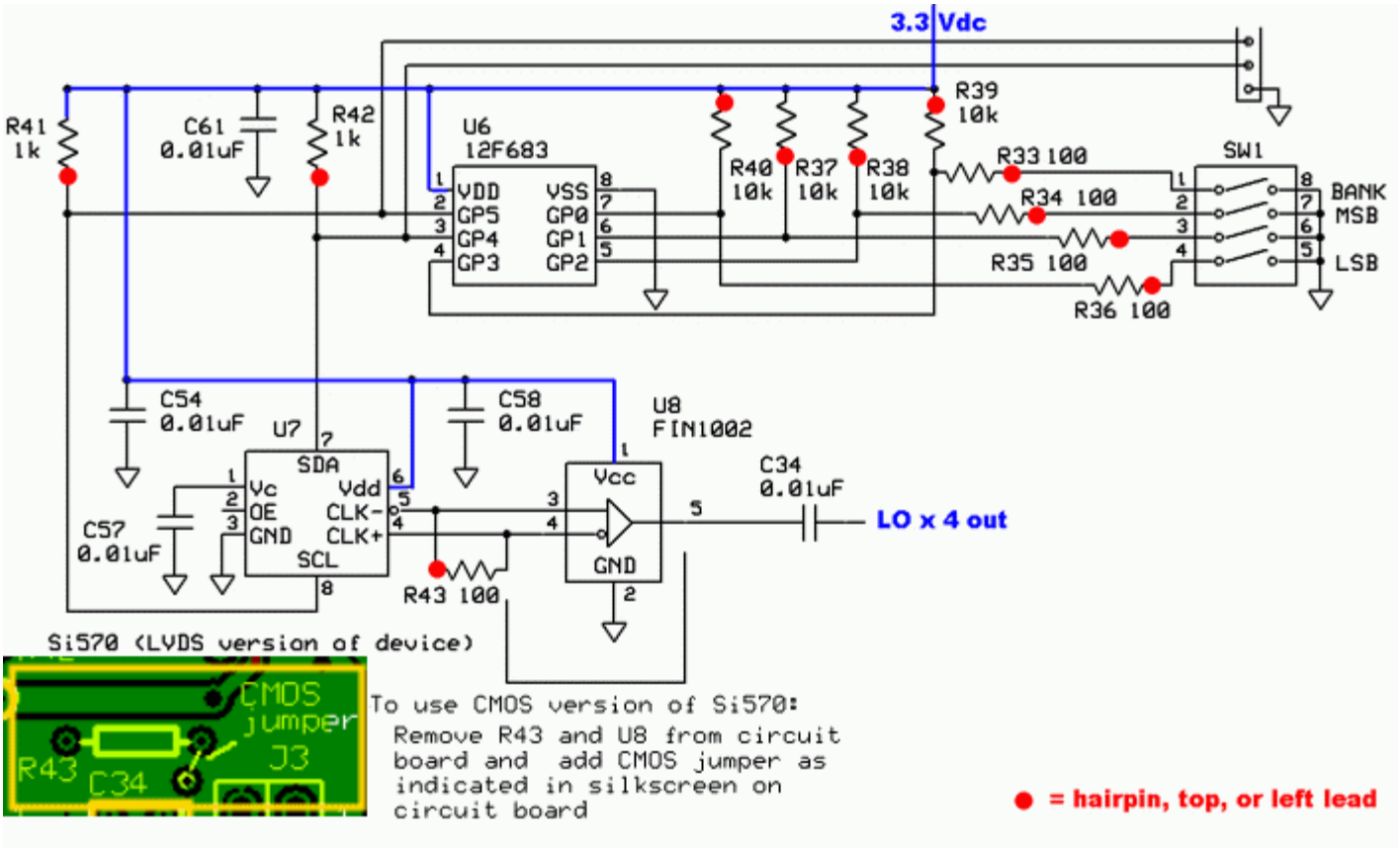
This LO stage must produce an output rf signal that is four times the desired center frequency for the radio. This is then fed to the dividers/phasors section to produce the two center-frequency signals that are in quadrature.



The board has also been designed to include I2C SDA and SCL signal access as well as either regulated 5 volts or 3.3 volts. Under the DIP switch location is a second row of holes such that a double-row header, eight pins in all, may be mounted in place of the DIP switch. The signals available on the header include the four DIP switch inputs to the PIC, GND, SDA, SCL and either regulated 5 volts or regulated 3.3 volts. (The regulated voltage selection is by soldering in a wire jumper at a three hole via the "JP1" group near the DIP switch position.)

Schematic

(Click for full RX Schematic)



Summary Build Notes

- Install U8 (if LVDS), then U7
- Install SW1
- Install Resistors R33-R43 (skip R43 if CMOS)
- Install C34
- Install U6 socket
- Plug in U6
- Test the Stage

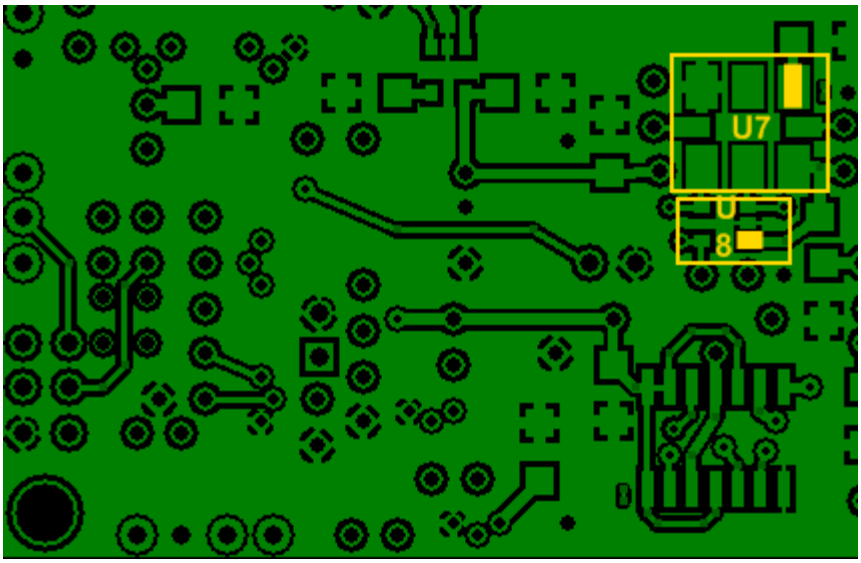
Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C34	0.01 uF	103	ceramic	1	
[__]	R33	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W
[__]	R34	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W
[__]	R35	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W

[__]	R36	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W
[__]	R37	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R38	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R39	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R40	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R41	1 k	brown-black-black-brown-brown	Resistor 1%	1	N-S
[__]	R42	1 k	brown-black-black-brown-brown	Resistor 1%	1	S-N
[__]	R43	100	brown-black-brown-gold	Resistor 5% 1/6W	1	FlatH (Omit for CMOS)
[__]	SW1	4-pos dip switch		Dip Switch (8 pins)	1	mount so pos 1 is toward top of board
[__]	U6	12F683		CPU and socket	1	(top)
[__]	U7	Si570 LVDS or CMOS		Programmable XO/VCXO	1	(bottom)
[__]	U8	FIN1002		SOT-23 Diff LVDS Rcvr	1	(bottom) Omit for CMOS

Detailed Build Notes

Bottomside Components



Mount the two ICs (U8, then U7)

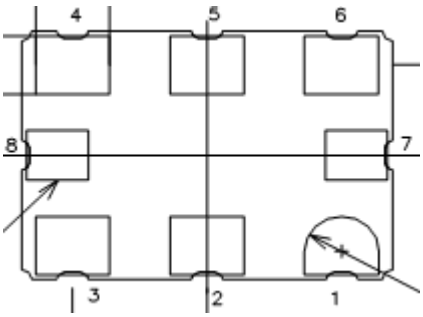
. Take ESD precautions. See the guide for mounting SMT ICs.

Take great care mounting U8. It is very tiny and mounts just below pins 4 and 5 of U7. This is an area that is very ripe for solder bridges! Carefully check the soldering of U8, especially around pin 2 (the ground connection) and pin 5 (VCC). You do not want to short 5Vdc to ground at that point! A good post-soldering test on U8 is to check the resistance between U8 pin 1 and ground. If it is low, you have a soldering problem.

Note: if the kit is a CMOS SI570, then do NOT install U8.

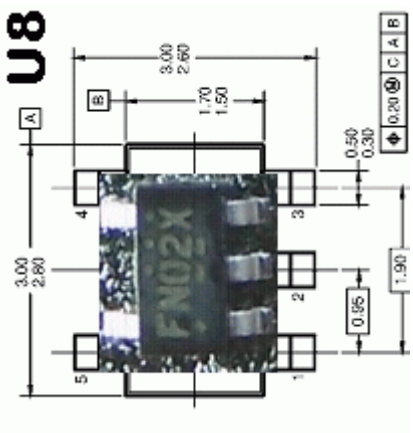
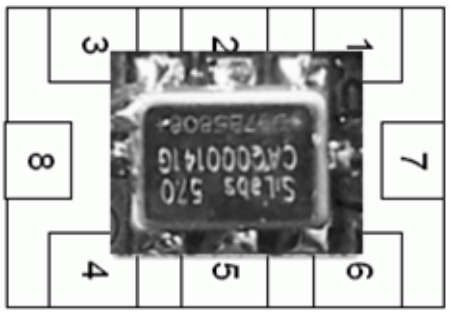
Note: Exercize great care in soldering U7. Use the minimum solder to achieve a joint, wicking away any excess.

Also note that U7 has 8 pins; (7 and 8 are at either end of the chip and are quite narrow). Most LO issues can be traced to soldering this chip.



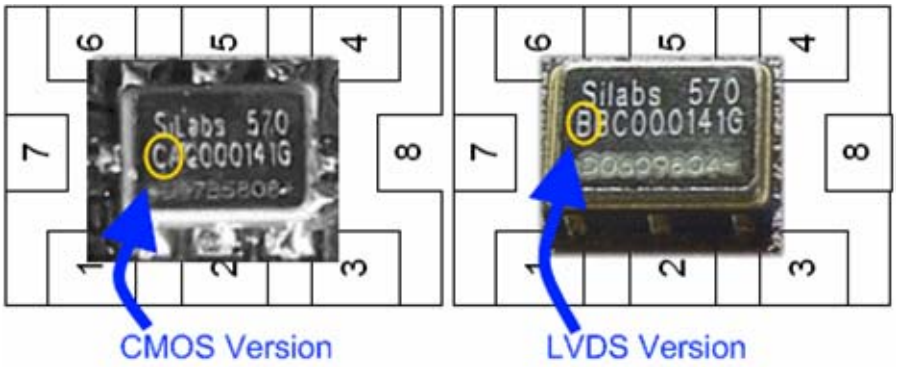
Also note that you will be installing the IC on the bottom of the board such that the writing on the chip is upside down with respect to the top edge of the board. You can recognize the #1 pin on the Si570 chip by the rounded shape (on the underside of the chip).

Check	Designation	Component	Picture

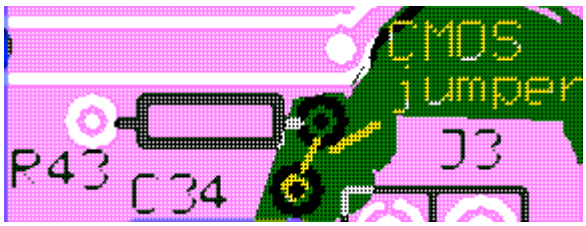
	U8* (omit if Si570 is CMOS)	**FIN1002**	
	U7 (If there is a "C" at the beginning of the part number just after the Si570 then it is a 3.3 volts CMOS version, otherwise it is an LVDS version)	**Si570 CMOS (or LVDS)**	

Topside Components

SI570 - CMOS vs. LVDS



If the kit is a CMOS SI570 kit:

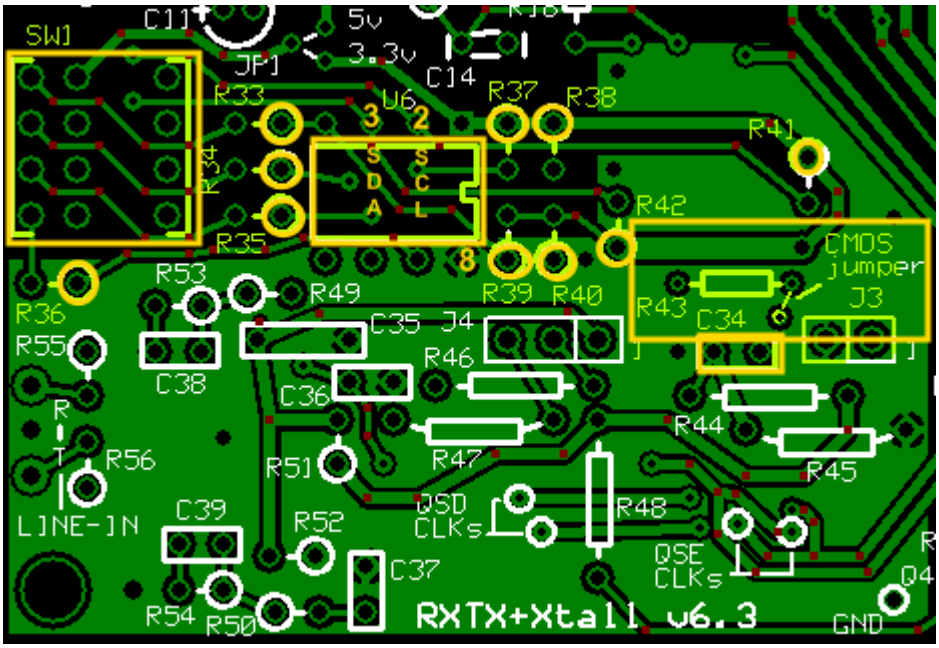
- 

- **Do NOT install R43 and U8**
- **Instead, install a jumper wire between the hole of R43 and the hole connected to U8 -Pin5 (reference the illustration above).**

- **When installing the jumper (if you do), you may want to install it so that you can clip test leads on the jumper.**

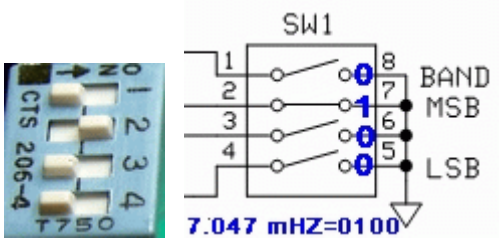
For a discussion of SI570's versions and the need for the FIN1002, see see the analysis by J. K. DE Marco PY2WM.

Topside Layout



Mount SW1

Mount the 8 pin Dip Switch. Orient the switch such that the numbers (1, 2, 3, 4) are closest to the right hand edge of the board and read, in their ordinal sequence, from top to bottom[1].



This switch provides a means to select one of 16 "center" frequencies, depending upon the settings for SW1.

[1] If you accidentally mount SW1 backwards (as the author did on an earlier project), all is not lost. The switches will still work; you'll just have to remember that the MSB corresponds to switch #4 and the LSB corresponds to #1 when dialing in the frequency "nibbles".

Mount the resistors

first (see the guide to mounting resistors) .

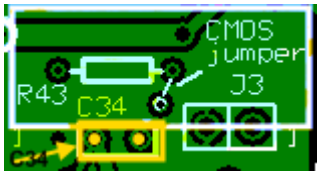
If your Si570 is the COMS version, save one of the clipped leads from the 100 ohm resistors to use in the CMOS jumper.

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	R33	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W
[__]	R34	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W
[__]	R35	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W
[__]	R36	100	brown-black-brown-gold	Resistor 5% 1/6W	1	E-W
[__]	R37	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R38	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R39	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R40	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R41	1 k	brown-black-black-brown-brown	Resistor 1%	1	N-S
[__]	R42	1 k	brown-black-black-brown-brown	Resistor 1%	1	S-N

[__]	R43	100	brown-black-brown-gold	Resistor 5% 1/6W	1	FlatH (Omit for CMOS) Note: watch out if you are installing R43. It is easy to install it to the wrong holes due to the proximity of the CMOS jumper holes!

*Note: if the kit is an SI570 CMOS kit, do NOT install R43

Mount C34

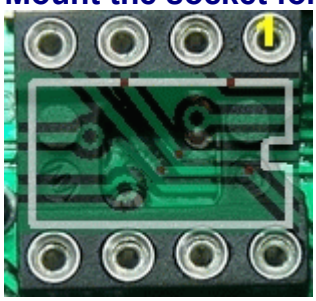


Mount the ceramic capacitor C34 (see guide for mounting ceramic capacitors).

Take care in mounting C34 in the correct holes (the two horizontally oriented holes just below the holes for R43).
Thanks to David KD0R for identifying the potential for erroneously mounting C34 in the holes intended for J3

Check	Designation	Component
	C34	0.01 µF (code 103)

Mount the socket for U6



The socket should be oriented so that the notched end is on the right (be careful placing the pins correctly - "measure twice, cut once")

Plug U6 into its socket

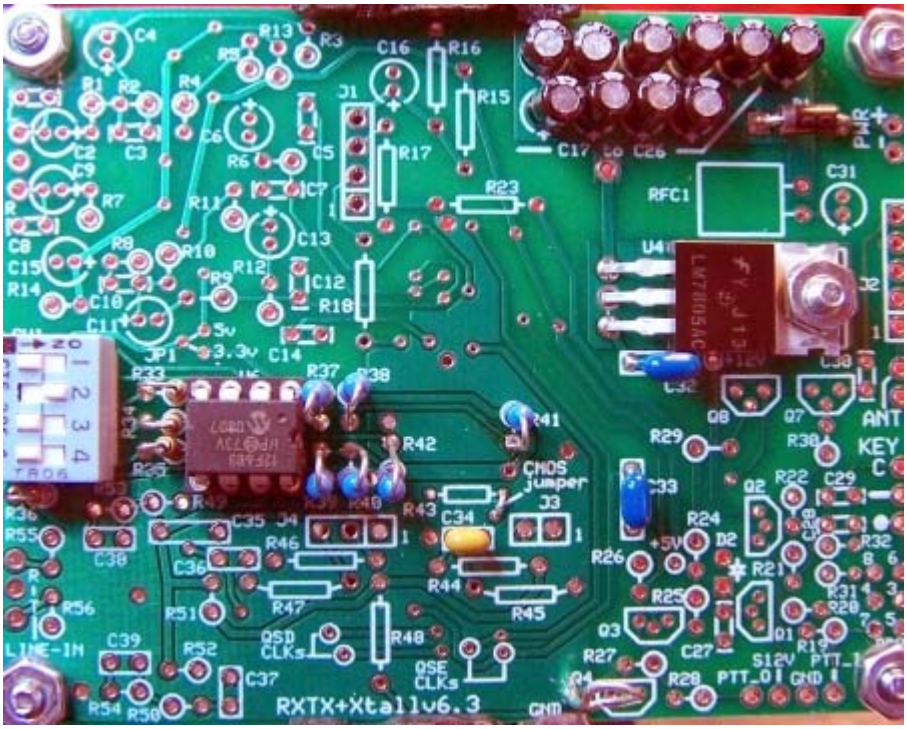
Take care to match the notch correctly.

Check	Designation	Component	Picture

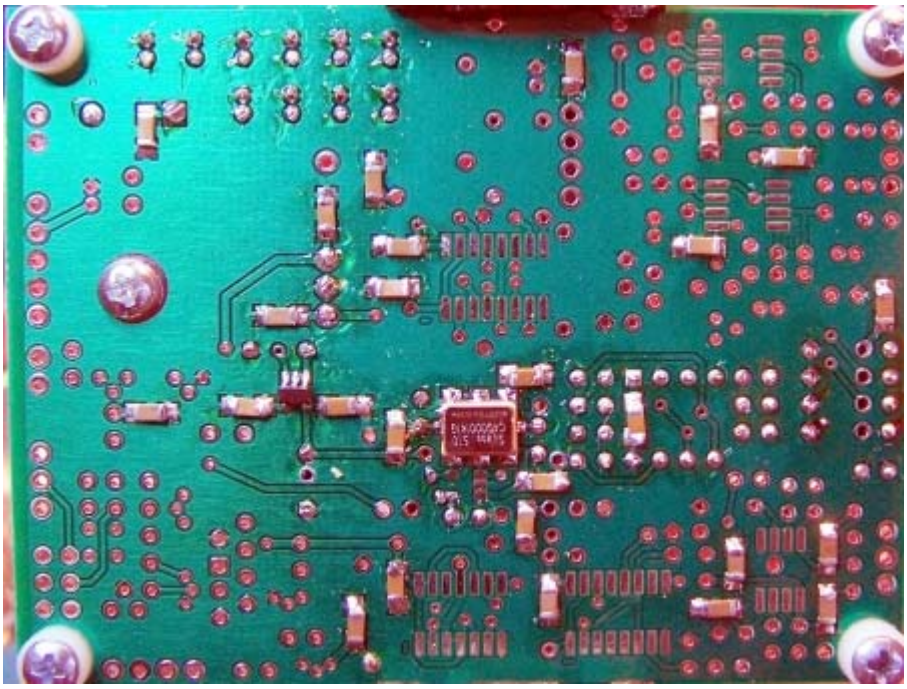
	U6	**12F683 (topside)**	

Completed Board

Topside



Bottomside



Testing

Current draw here is for the CMOS version of the Si570. Adjust these appropriately for the LVDS version's higher current draw.

Current Limited Power Test

- **Connect a 100 ohm resistor in series with the power line and apply 12 V dc power**
- **the current should be relatively low (less than 120 mA (around 75 mA is nominal))**
- **Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.**
- **A voltage of around 2 V dc indicates the power rails are not shorted**

Current Draw (DMM)

- **If your kit is the LVDS version, expect your readings to be a little higher by about 10 - 15 mA**
- **Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.**
- **First, you want to measure the current draw with U6 NOT plugged in and the dip switches all in the OFF position. You should a maximum draw of < 84 mA. (Author got 75 mA). Yours: _____**
- **Then, turn all the dip switches ON (U6 still NOT plugged in) and the current draw should be slightly more (1 or 2 mA more). Author measured 76 mA. Yours: _____**
- **Finally, with the power off, reset the dip switches for 7.046 MHz ("0100" as shown in the " as shown in the SW1 Settings), plug in U6, power up, and measure the**

current draw. This should now be no more than 84 mA. Your measurement is: _____

- You can You can try other switch settings for current draw and the measurements should a swing of about 10 mA, depending upon the SW1 settings from SW1=0000" to SW1="1111".

SSW1/U6 Tests (DMM - 3.3 Vdc, 33 mVdc)

You can test the SW1 programming of U6 by checking the dc voltages at pins 1 thru 7.

Pins 1 thru 3 should always be at the 3.3V rail Vdc.

Voltages at pins 4 thru 7 will vary, depending upon their corresponding dip switch settings (pins 4 thru 7 correspond to dip switches 1 thru 4):.

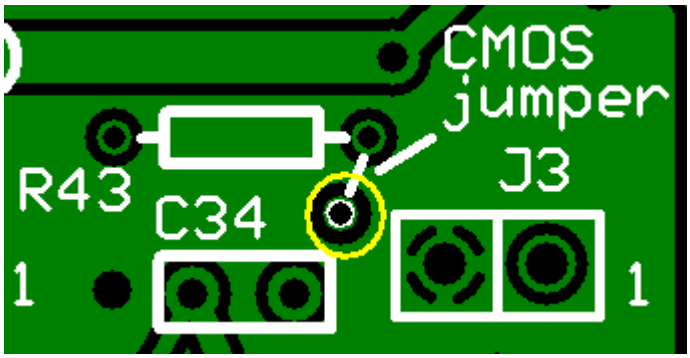
- When the switch is ON, the corresponding voltage drops to LOW (< 40 mV). Your measurement is: _____
- When the switch is OFF, the corresponding pin's voltage is HIGH (at the 3.3 V rail). Your measurement is: _____
- If the voltages are not as expected, remove U6 from its socket and retest to ensure that the SW1/U6-Socket wiring is good.
- In this case, if the tests are passed with U6 removed, you should suspect U6.should suspect U6.
- If pins 2 and 3 do NOT measure at the 3.3V rail, investigate the solder connections on U7

Frequency Test

You can validate the LO's frequency output by tuning your HF receiver to four times one of the center frequencies (see SW Settings) and loosely coupling the receiver's antenna via a tickler wire close to the board going to the antenna socket. You should hear the output as quieting in the receiver in AM mode (or a tone if in CW mode).

Some builders have experienced the case where a given switch setting seems to yield signals at 3 times the expected frequency value, only to discover that they were actually getting the third harmonic. (see the series of reflector mesages begining with message #30011).

(Optional) LO Output (Scope/Freq Counter)



Measure the frequency of the signal at the lower CMOS jumper hole. The Local Oscillator should output a signal at the four times the center frequency selected by the switch settings of SW1.

Do not attempt these scope tests unless you have a good quality, calibrated scope with correctly compensated probes. Lesser quality scopes are good for little more than indicating the presence or absence of a signal, something you can do with an external ham radio RX.

Test

- **Set the switches of SW1 to 0100 to get a center frequency of 7.046 MHz**
- **(See Sw1 Switch Settings)**
- **Apply power to the board**
- **Test the output of (U8 in the LVDS version of the kit or U7 in the CMOS version) at the lower of the twoholes provided for the CMOS jumper: the frequency should about 28.18 MHz (4 times the desired center frequency of 7.046 MHz).**

  The AC pk-pk voltage should be aproximately equal to or less than 3.3 V p-p

  The waveform should approximate a square wave (depending upon the bandwidth and calibration of your scope - see below).
- **If you get 56.32 MHz (or 14.08 times 4) with SW1 set as above, or regardless of SW1 settings, this means:**
  - **that U6 has not been installed or**
  - **U6 has been incorrectly installed or**
  - **pins 7 or 8 of U7 may have bad solder joints**

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - Dividers

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

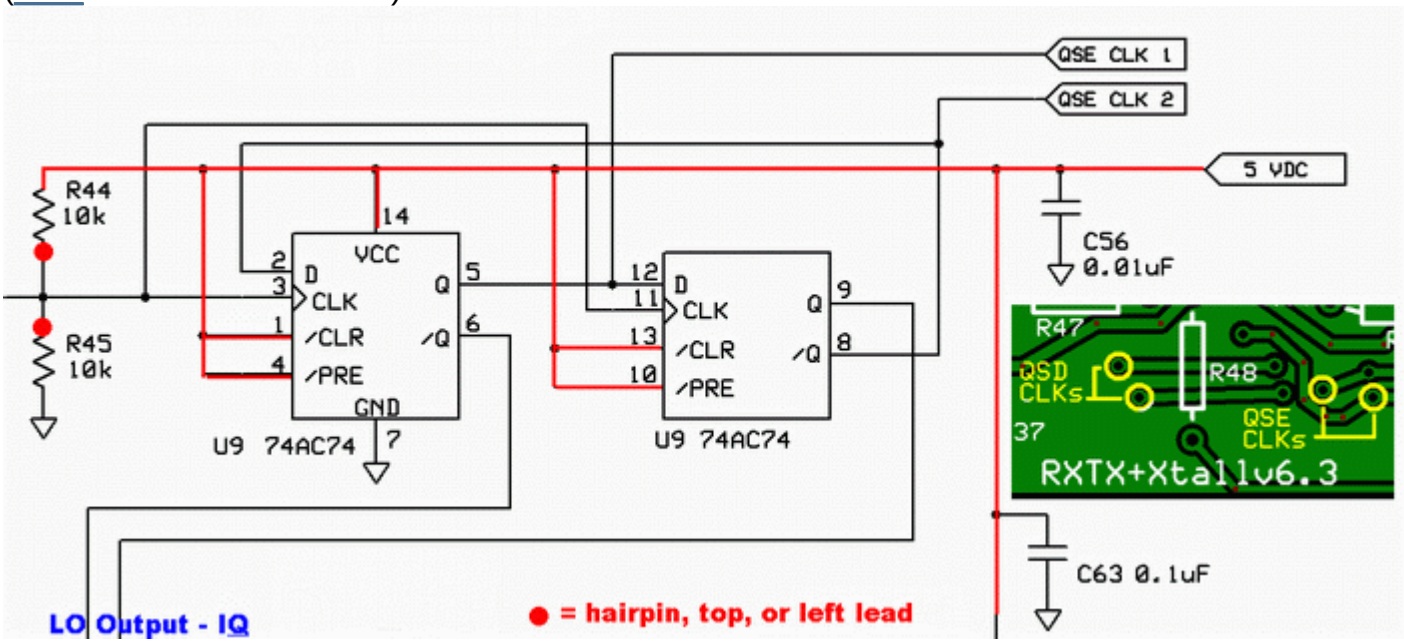
Theory of Operation

The Dividers stage takes in the local oscillator's signal and divides it by 4, producing two output signals. Each output signal is at a frequency that is ¼ the stage's input signal and is a square wave with 50% duty cycle. The 50% duty cycle is with respect to the4 5V rail.

The signals are "in quadrature", that is, they are 90° out of phase with each other. These are provided to the TX and RX mixer stages as clocking signals. They are called out on testpoints marked "QSD", for the I and Q signals to mix down the incoming "chunk" of RF, and "QSE", for the I and Q signals which mix up the PC's line out signals.

Schematic

(Click for full RX Schematic)



Summary Build Notes

- Install U9
- Install Resistors R44-45
- Test the stage

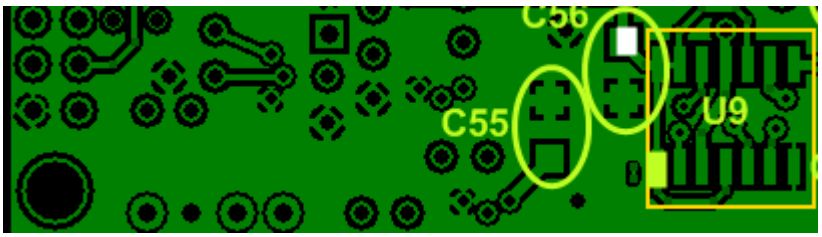
Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	R44	10 k	brown-black-black-red-brown	Resistor 1%	1	FlatH
[__]	R45	10 k	brown-black-black-red-brown	Resistor 1%	1	FlatH
[__]	U9	74AC74		SOIC-14 SMT Dual FF	1	(bottom)

Detailed Build Notes

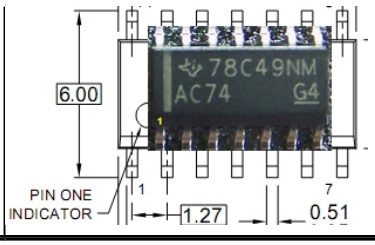
This stage mainly adds the frequency division and phase-shifting capabilities via the AC74 dual flip flop. The builder must take necessary ESD precautions. See the guidelines on installing SMT ICs.

Bottomside Components

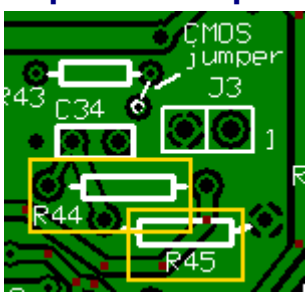


Install The AC74 SMT IC, U9
See the guide for installing SMT ICs.
Note, also, that ESD Precautions are in order here.

- **Install IC U9.**
- **See table below for orientation**

Check	Designation	Component	Orientation
	U9	**74AC74**	

Topside Components



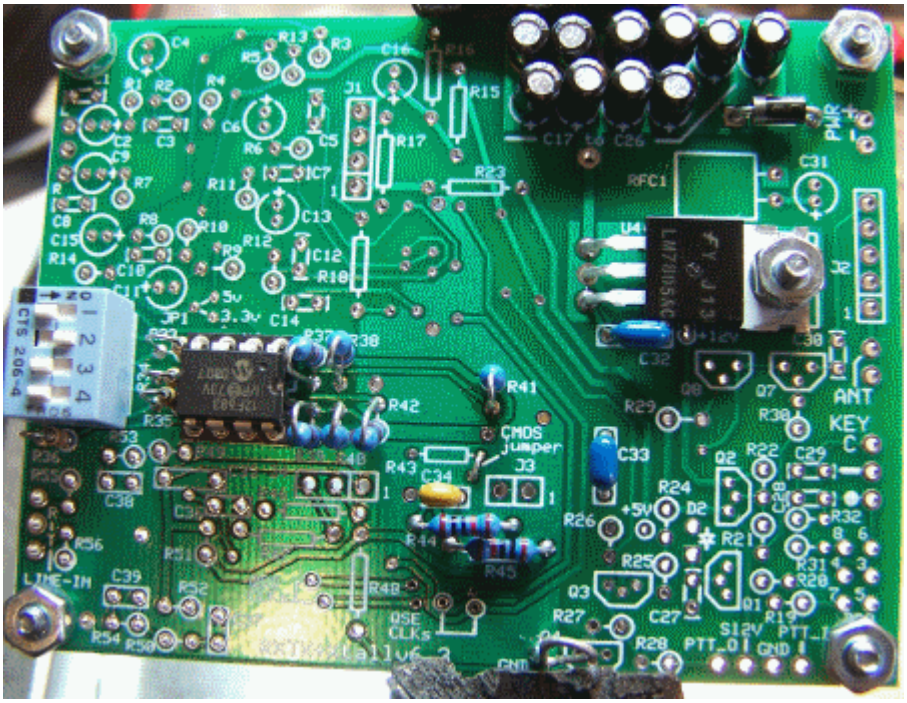
Install the 2 Resistors

- **Install the two resistors (R44 and R45) that provide the voltage divider for the IC.**

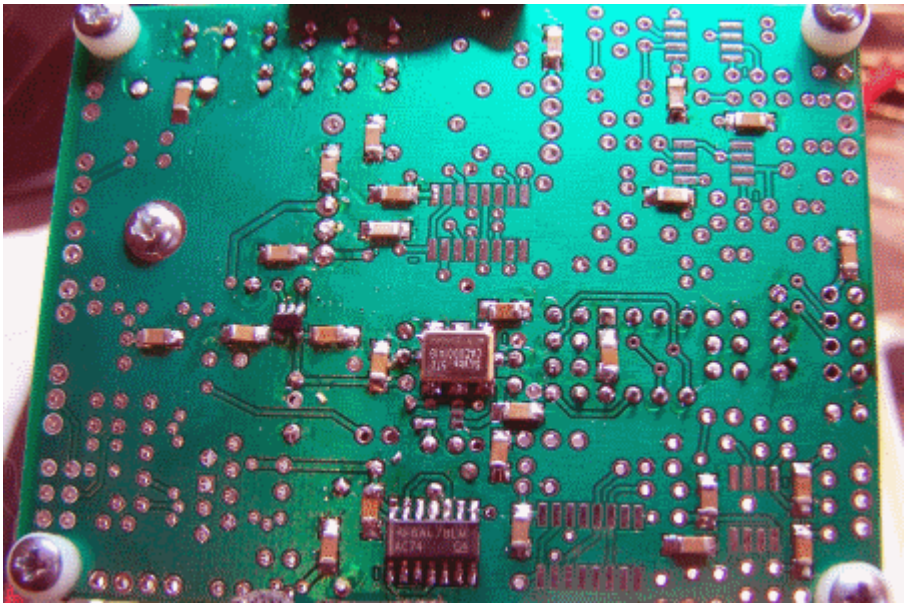
- **R44 and R45 are installed flat style and horizontal**

Completed Board

Topside



Bottomside



Testing

Current Limited Power Test

- **Connect a 100 ohm resistor in series with the power line and apply 12 V dc power**

- the current should be less than 120 mA (nominally around 80 mA)
- Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.
- A voltage of around 2 V dc indicates the power rails are not shorted

Current Draw(DMM)

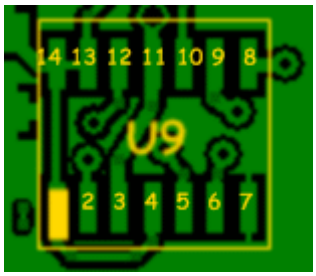
- Current numbers here are for the CMOS version of the Si570. You will need to adjust these upward by anywhere from 12 to 15 mA for the LVDS version.
- Then set SW1 to "0100", apply power, and measure the current with your DVM's mA meter.
- The current draw should be < 88 mA (or about 4 - 6 mA greater than the preceding stage's current draw). Author measured 79.6 mA.
- Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.

Voltage Tests (DMM - 2.5 Vdc)

To determine if the dividers are clocking correctly, we need to check the pin voltages on U9. Unexpected values here usually point to problems with soldering U9 and/or the voltage dividing resistors R44 and R45.

If these tests are successful, you can be fairly certain that the dividers are clocking correctly.

- Using a DMM, measure the output of the voltage divider with respect to ground. Measure at the left-hand lead of either R44 or R45. This should yield approximately ½ the 5 volt rail voltage.
- Measure the voltages (with respect to ground) on the pins of U9. It is best to test for these voltages at the actual pins (not the pads), thereby ensuring correct soldering of the pins to the pads.

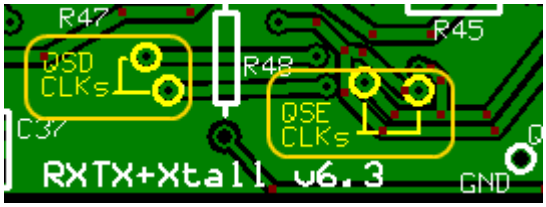


Test Point	Units	Nominal	As Actually Measured (Power ON)
(topside) left-hand lead of R44 or R45	Vdc	2.5 (½ the 5 volt rail)	
U9, Pins 1, 4, 10, 13, 14	Vdc	5	
U9, Pins 2, 3, 5, 6, 8, 9, 11, 12	Vdc	2.5 (½ the 5 volt rail)	
U9, Pin 7	Vdc	0	

U9 Center Frequency Output Test

You can validate the dividers' frequency output by tuning your HF receiver to one of the center frequencies (see SW Settings) and loosely coupling the receiver's antenna via a tickler wire laid over the board. You should hear the output as quieting in the receiver.

(Optional Test) U9 Output

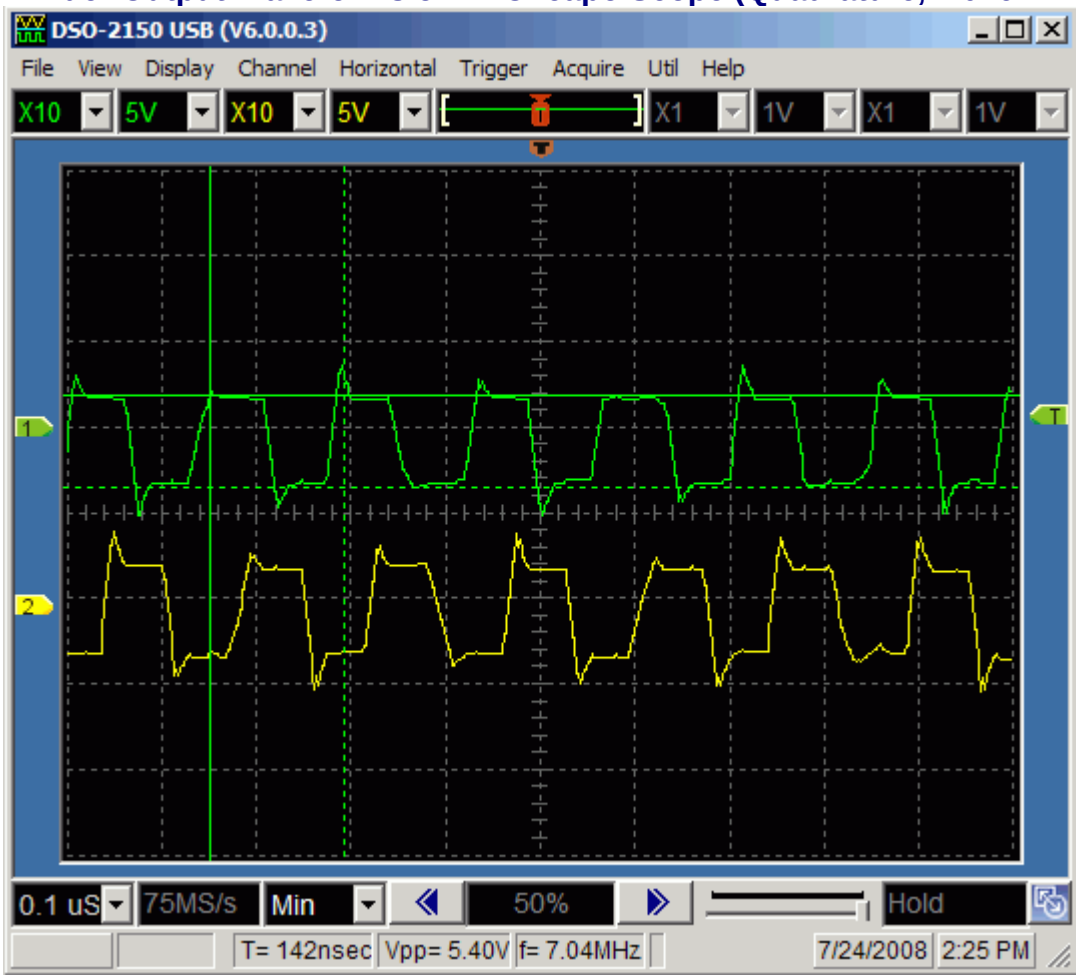


While not necessary, you may also check the dividers' output using a scope. U9 sends I and Q signals to the mixer's S0 and S1 inputs. These signals are available at the 2 QSD testpoints (as well as at the 2 QSE testpoints) near the bottom edge of the board's topside (see above).

Do not attempt these scope tests unless you have a good quality, calibrated scope with correctly compensated probes. Lesser quality scopes (such as the one shown below!) are good for little more than indicating the presence or absence of a signal, something you can do with an external ham radio RX.

- **Use a dual channel oscilloscoipe, triggering on Channel 1, and**
- **measure the S0 and S1 outputs at the QSD (or, if you wish, QSE) testpoints on the top side of the board, as indicated above.**
- **They should both be the same frequency (¼ of the LO Output) - assuming you use the SW 1 settings from the LO test, that would be 7.046 mHz) and should be in quadrature (90° out of phase with each other). The image below shows approximations of p-p voltages and frequencies of the 2 quadrature signals.**
- **They should be approximately 5V p-p square waves. The square waves may have a fair amount of ringing on them depending on your scope quality and connection to the circuit board (see Waveforms below).**

Divider Output Waveforms on El Cheapo Scope (Quadrature, 7.046 MHz)



Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - RX OpAmps

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

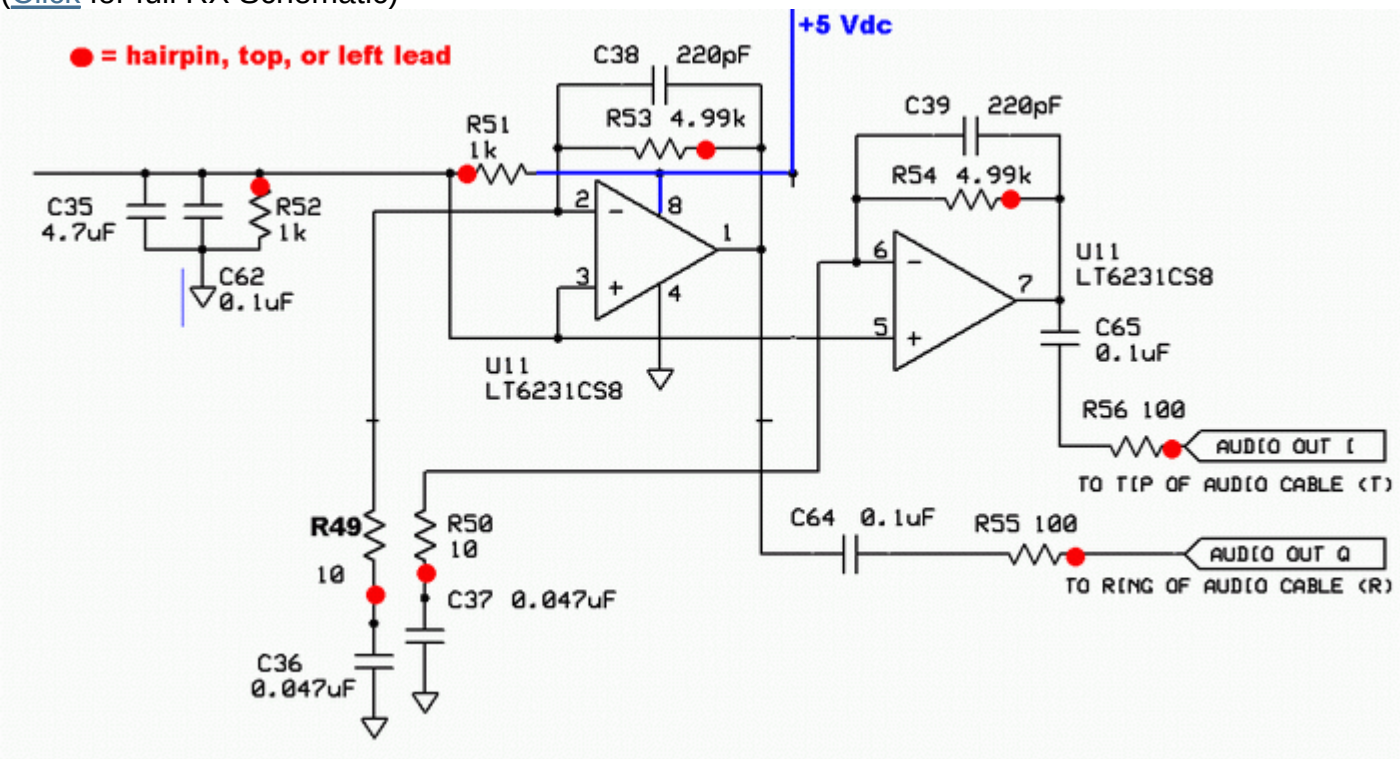
Theory of Operation

This stage amplifies the quadrature audio frequency difference products from the Mixer stage via R49 and R50.

R51 and R52 make up a voltage divider that provides the 2.5 Vdc bias to the Op-Amps, configured as an inverting amplifier. The ratios of R53/R49 and R54/R50, respectively, determine the voltage gain of the output over the input for each Op-Amp. That voltage gain is theoretically 499:1, or about 54 dB. Each Op-Amp's output is capacitively coupled through a 100 ohm resistor to the "Ring" (Q) and "Tip" (I) Audio Out terminals for input to the PC's sound card.

Schematic

(Click for full RX Schematic)



Summary Build Notes

- Install U11

- Install Resistors R49-R56
- Install Ceramic Caps C35-39
- Test the Stage

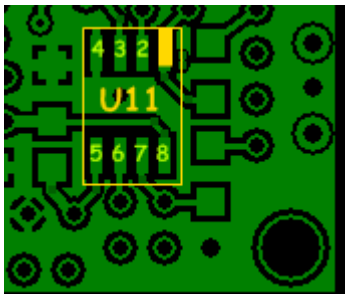
Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C35	4.7 uF	475	ceramic	1	
[__]	C36	0.047 uF	473	ceramic	1	
[__]	C37	0.047 uF	473	ceramic	1	
[__]	C38	220 pF	221	ceramic	1	
[__]	C39	220 pF	221	ceramic	1	
[__]	R49	10	brown-black-black-gold-brown	Resistor 1%	1	W-E
[__]	R50	10	brown-black-black-gold-brown	Resistor 1%	1	W-E
[__]	R51	1 k	brown-black-black-brown-brown	Resistor 1%	1	S-N
[__]	R52	1 k	brown-black-black-brown-brown	Resistor 1%	1	E-W
[__]	R53	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	E-W
[__]	R54	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	E-W
[__]	R55	100	brown-black-brown-gold	Resistor 5% 1/6W	1	N-S
[__]	R56	100	brown-black-brown-gold	Resistor 5% 1/6W	1	S-N
[__]	U11	LT6231	6231	SOIC-8 Dual OpAmp	1	(bottom)

Detailed Build Notes

This stage mainly adds the amplification capabilities via the dual LT6231 Operational Amplifier, U11. The builder must take necessary ESD precautions. See the guidelines on installing SMT ICs.

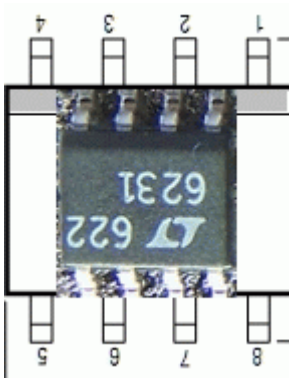
Bottomside Components



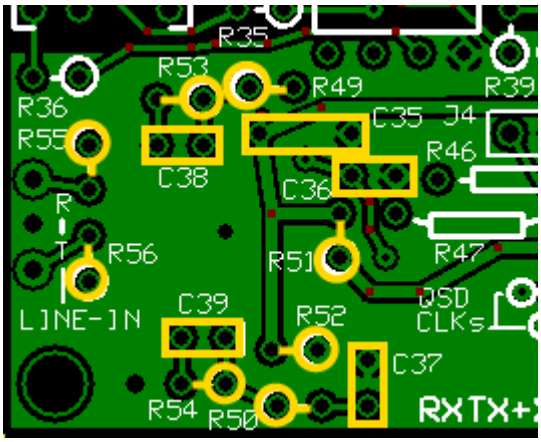
Install U11
(see notes on ESD precautions and SMT IC Installation)

- **Install U11, the LT6231 Operational Amplifier, on the bottom of the board (note orientation below)**
- **Watch out for solder splashover on the holes around this IC**

>

Check	Designation	Component	Orientation
	U11	LT6231	SOIC-8 OpAmp 

Topside Components



Install Resistors

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	R49	10	brown-black-black-gold-brown	Resistor 1%	1	W-E
[__]	R50	10	brown-black-black-gold-brown	Resistor 1%	1	W-E
[__]	R51	1 k	brown-black-black-brown-brown	Resistor 1%	1	S-N
[__]	R52	1 k	brown-black-black-brown-brown	Resistor 1%	1	E-W

[__]	R53	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	E-W
[__]	R54	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	E-W
[__]	R55	100	brown-black-brown-gold	Resistor 5% 1/6W	1	N-S
[__]	R56	100	brown-black-brown-gold	Resistor 5% 1/6W	1	S-N

- Install resistors R49-R56 (observe the correct "hairpin" orientation - see BOM table above).
- Be careful mounting R54 - there is a temptation to mount it one hole over to the left. 

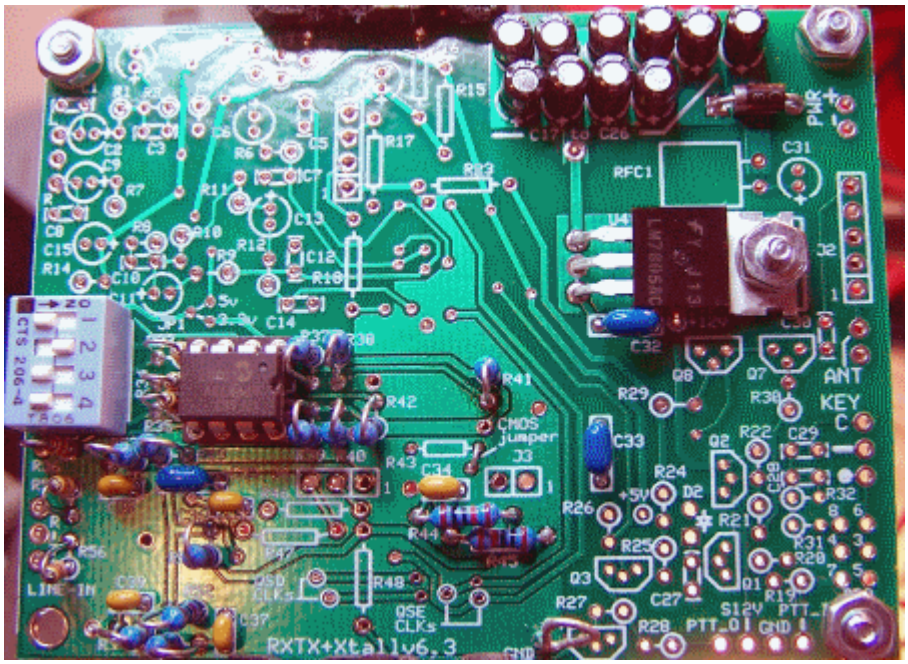
Install Ceramic Caps

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C35	4.7 uF	475	ceramic	1	
[__]	C36	0.047 uF	473	ceramic	1	
[__]	C37	0.047 uF	473	ceramic	1	
[__]	C38	220 pF	221	ceramic	1	
[__]	C39	220 pF	221	ceramic	1	

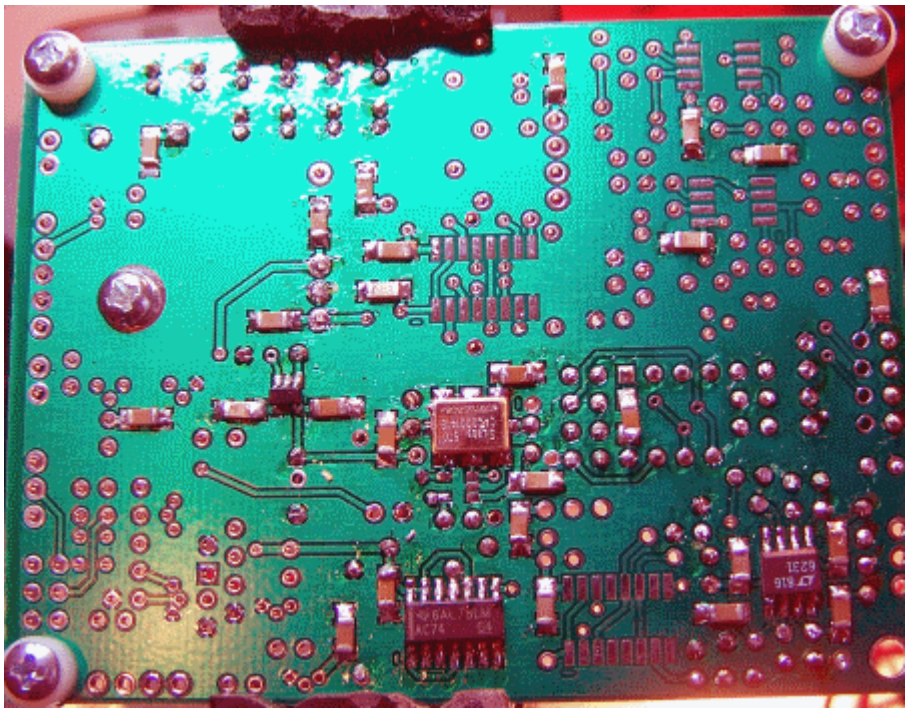
- Install the 5 ceramic capacitors (C35-C39)

Completed Stage

Top



Bottom



Testing

Current Limited Power Test

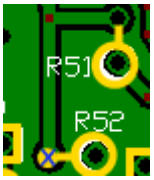
- **Connect a 100 ohm resistor in series with the power line and apply 12 V dc power**

- the current should be less than 120 mA (nominally 90 mA)
- Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.
- A voltage of around 2 V dc indicates the power rails are not shorted
- Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.

Current Draw (DMM)

- Remember the 12 - 15 mA upward adjustment for the LVDS version of the Si570.
- Set SW1 for a center frequency of 7.046 MHz ("0100")
- Apply power and measure the current with your DVM's mA meter.
- The current draw on the CMOS version of the Si570 should be < 98 mA .Author measured 88.5 mA
- Your measurement is:_____

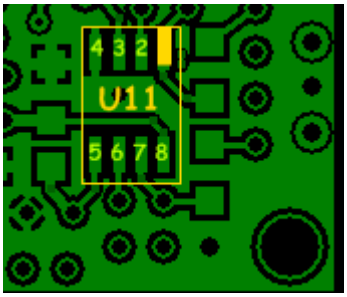
Voltage Divider R51/R52 (DMM)



- Measure the voltage at the R52 hairpin lead with respect to ground.
- It should read approximately 2.5 Vdc (½ the 5 volt rail).

Test Point	Units	Nominal	Your Measurement
R52 hairpin lead	Vdc	~2.5	

Pin Voltages (DMM)

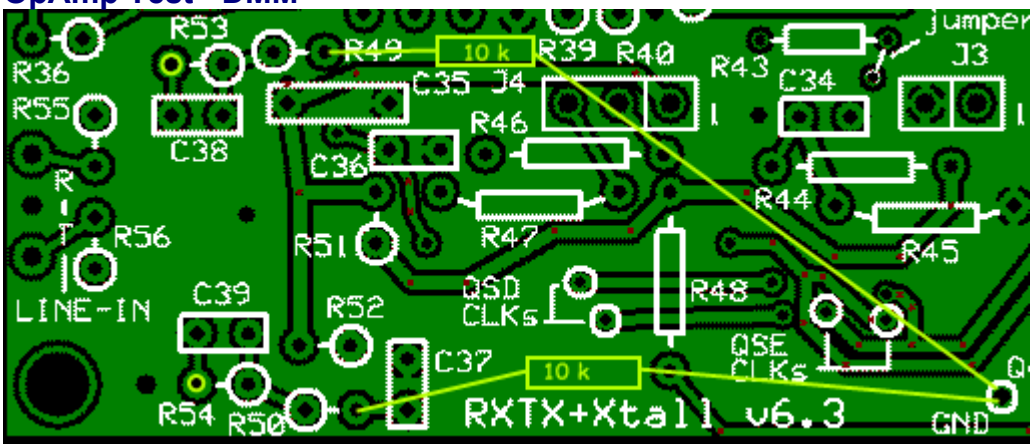


- Measure the voltages at the pins of U11.
- It is best to test for pin voltages at the actual pins (not the pads), thereby ensuring correct soldering of the pins to the pads.

Test Point	Units	Nominal	Your Measurement
U11, Pins 1, 2, 3, 5, 6 & 7	Vdc	~2.5	

U11, Pin 8	Vdc	~5	
U11, Pin 4	Vdc	0	

OpAmp Test - DMM



Tony Parks suggested this next test for those who do not have an oscilloscope and/or audio frequency generator, since it requires only a DMM and some clip leads.

The test will test each of the two Op-Amps, but the steps described are for the second Op-Amp and involves R50 and R54. The test for the first Op-Amp involves, respectively, R49 and R53.

If the Op-Amp being tested is working, then the voltage measured at the output of the Op-Amp will increase to accomodate the effect of the changed bias on the input. Passing these tests gives you more than enough confidence to move on to the Mixer stage.

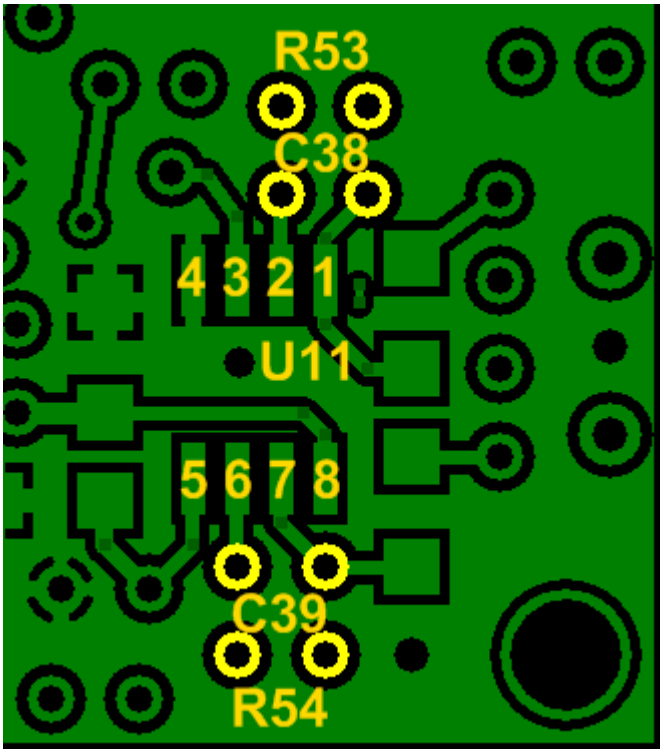
- Obtain a 10k resistor (or use the 10k resistor - R1 - that is to be installed in the TX Opamps stage)
- using the DMM, measure the dc voltage with respect to ground at the hairpin of R54.
  The result should be approximately ½ the 5 Vdc rail.
- keep the DMM lead on R54's hairpin
- Using two clip leads, "bridge" the 10k resistor between the hairpin of R50 and ground. See the diagram to the left.
- Observe the voltage reading at R54 hairpin. If OpAmp 1 is working, the voltage should have jumped to around3.6 - 3.8 Vdc
- Remove the resistor/clip lead from R50 and the voltage at R54 should go back to ½ the 5 Vdc rail.
- Follow these same steps for OpAmp2, substituting R49 for R50 and R53 for R54.

Test Point	Nominal	Your Measurement

R54 hairpin - R50 unbridged	½ 5V rail	
R54 hairpin - R50 bridged	around 3.75 Vdc	
R53 hairpin - R49 unbridged	½ 5V rail	
R53 hairpin - R49 bridged	around 3.75 Vdc	

Trouble SHooting the Functional Test

If you do not see the voltage gain shown in the above table, check the following:



R54 Hairpin shows no gain

Look for:

- **A solder bridge between pins 7 and 6 of U11.**
- **A short between the pads of C39.**
- **A short between the pads of R54.**
- **The correct value (4.99kΩ for R54)**

R53 Hairpin shows no gain

Look for:

- **A solder bridge between pins 1 and 2 of U11.**
- **A short between the pads of C38.**
- **A short between the pads of R53.**

- **The correct value (4.99kΩ; for R54)**

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - RX Mixer

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

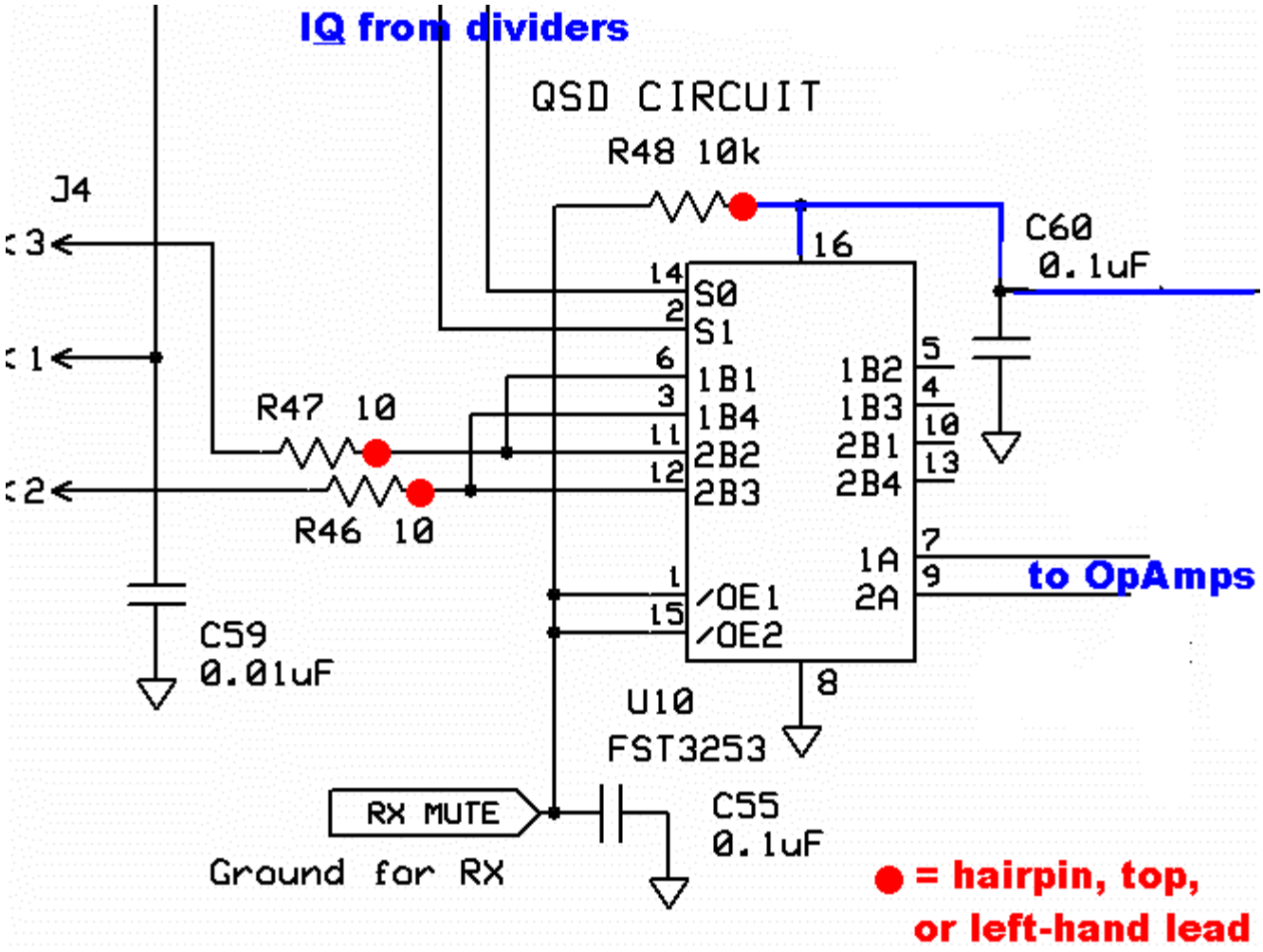
Introduction

Theory of Operation

The mixer stage acts like two traditional direct conversion mixers operating in tandem. Each takes in half of the filtered RF from the bandpass filter stage and one of the quadrature center frequency signals, then "mixes" them to with an output being the traditional mixer products, in this case, two audio frequency signals that represent the difference between the two inputs (RF and Local Oscillator). These two signals are referred to as the I (in-phase) and Q (Quadrature) signals and are fed into the high gain Op-Amps stage for amplification and delivery to the audio outputs (and, thence, to the PC's sound card). The mixer is enabled when the RX_Mute line is grounded through Q4 (not shown here)

Schematic

(Click for full RX Schematic)



Summary Build Notes

- Install sockets J3 and J4
- Install Resistors R46-48
- Install U10
- Test the Stage

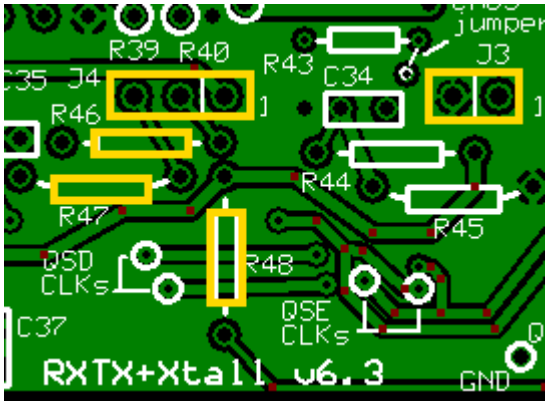
Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	J3	2-pin socket		connector (female)	1	
[__]	J4	3-pin socket		connector (female)	1	
[__]	R46	10	brown-black-black-gold-brown	Resistor 1%	1	FlatH
[__]	R47	10	brown-black-black-gold-brown	Resistor 1%	1	FlatH
[__]	R48	10 k	brown-black-black-red-brown	Resistor 1%	1	FlatV

[__]	U10	FST3253		SOIC-16 Dual 4:1 Mux/Demux Bus Switch	1	(bottom)

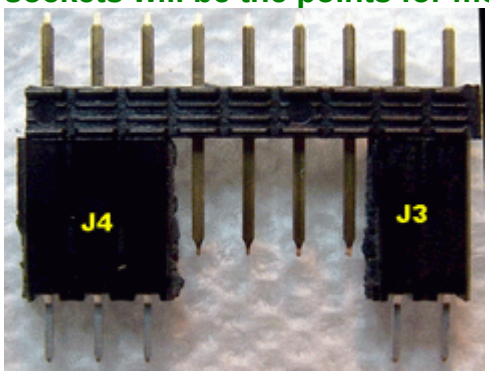
Detailed Build Notes

Topside Components



Install Sockets J3 and J4

Use the provided 9 pin header strip to align the sockets during installation. These sockets will be the points for mounting the Bandpass Filter (BPF) board.



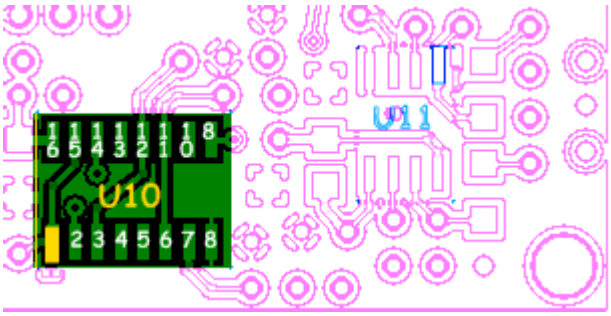
- **Install J3 (2 pin socket)**
- **Install J4 (3 pin socket)**

Install the 3 resistors

- **Install resistors R46-R48 to the top side of the board (all are "flat" orientation)**

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	R46	10	brown-black-black-gold-brown	Resistor 1%	1	FlatH
[__]	R47	10	brown-black-black-gold-brown	Resistor 1%	1	FlatH
[__]	R48	10 k	brown-black-black-red-brown	Resistor 1%	1	FlatV

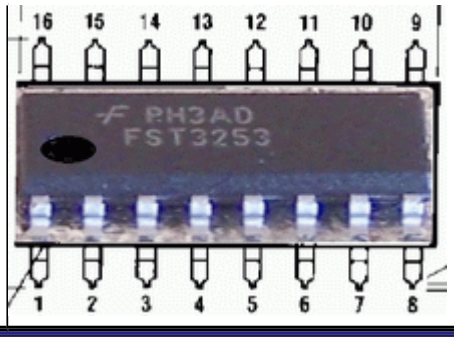
Bottomside Components



Install U10

Follow the guidelines for ESD precautions and SMT IC Installation.

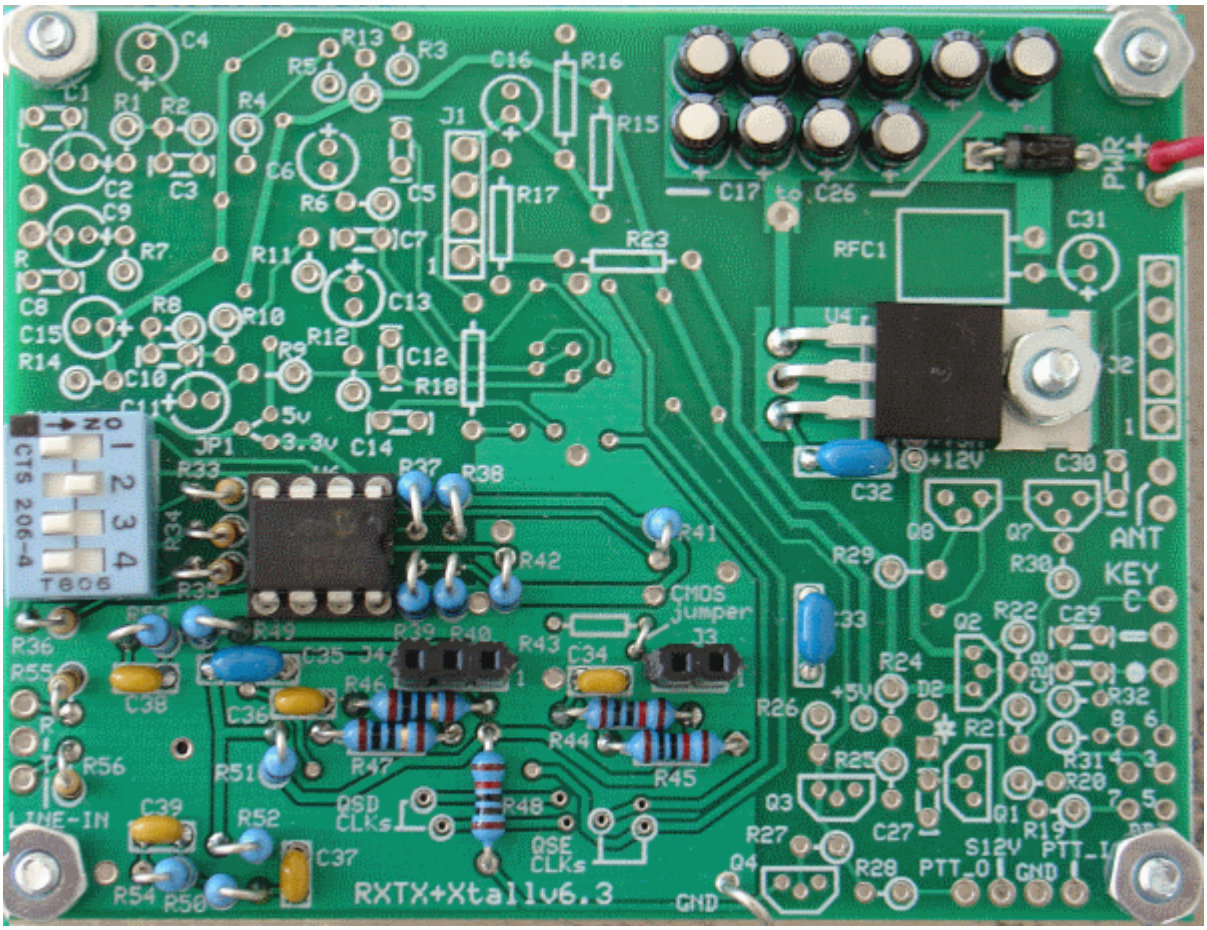
- **Install U10, the FST3253 Switch (Mixer), to the bottom side of the board on the 14 SOIC pads provided.**
- **The IC is oriented such that when the dot/depression on the top is on the left hand side, pin 1 is at the bottom left (see table below).**

Check	Designation	Component	Orientation
	U10	FST3253MX SOIC-16 SMT Mixer	

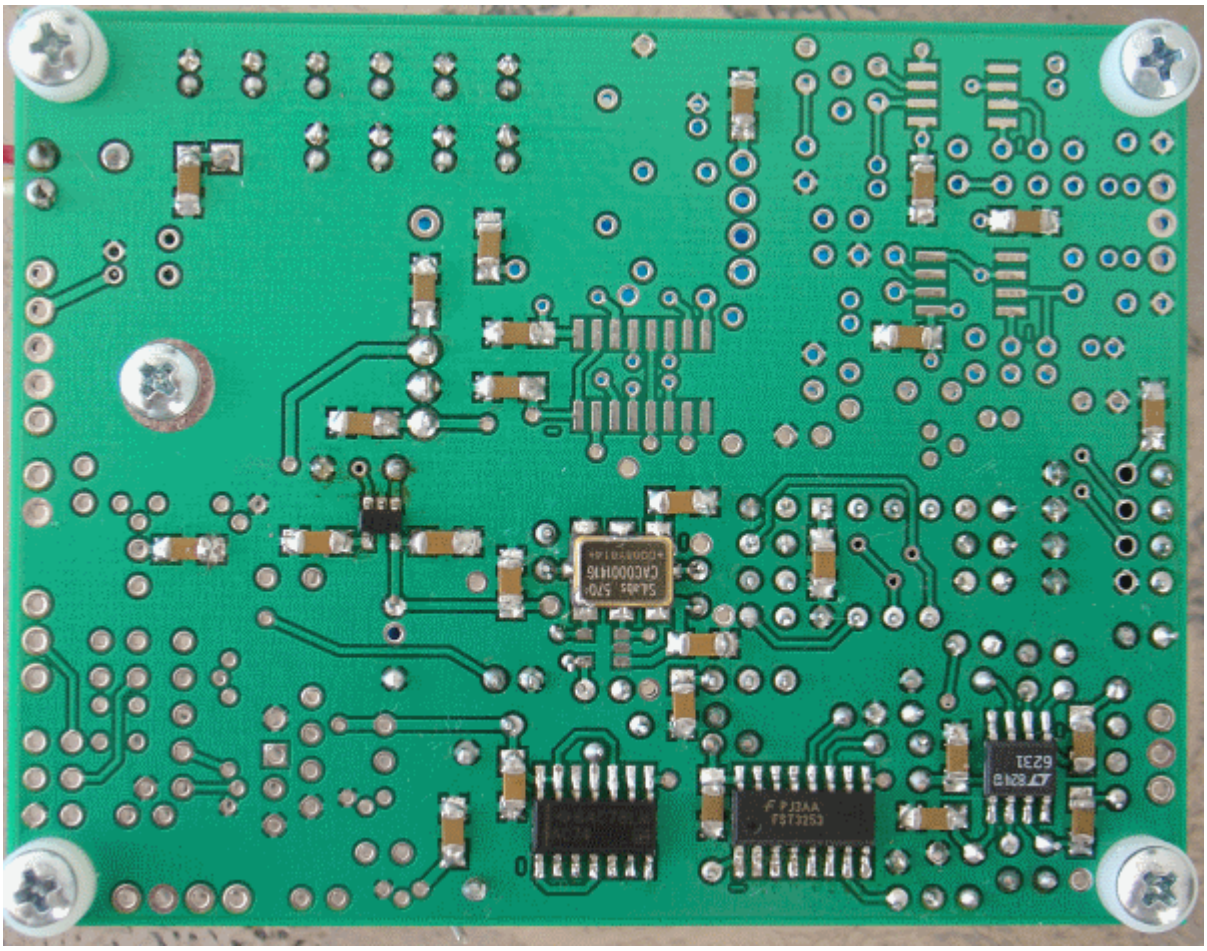
Completed Boards

(pictures courtesy of Oleg Titov)

Topside


C4
R13
R5
R3
C16
R16
C1
R1
R2
R4
J1
R15
C2
C3
C6
R6
C5
R17
C17 to C26
C9
R7
C7
R23
RFC1
C31
R11
C13
C8
R8
R10
C15
R12
R9
C12
R18
R14
C16
C11
5v
3.3v
C14
JP1
U4
J2
R33
R37
R38
+12V
C32
C30
ANT
KEY
R34
R41
Q8
Q7
R29
R30
R42
R35
CMOS
Jumper
J3
C33
R22
C29
Q2
R36
R49
R39
R40
R43
C34
R24
R55
C35
J4
C38
R46
+5V
D2
R26
R32
C36
R21
R44
R31
R25
R56
R51
R47
R45
R20
Q3
Q1
LINE-IN
C39
R52
QSD
CLKs
R48
C27
R19
R27
S12V
PTT_I
C37
QSE
CLKs
Q4
R28
PTT_O
GND
R54
R50
RXTX+Xtallv6.3
GND

Bottomside



Testing

Note: these tests require you to have built and plugged in at least one bandpass filters.

If you have not yet done so, you can still conduct the current and voltage tests provided you short pins 1, 2, and 3 of J4 together to provide the DC equivalent of the T100 secondaries.

Current Limited Power Test

- **Connect a 100 ohm resistor in series with the power line and apply 12 V dc power**
- **the current should be less than 120 mA (nominally 90 mA)**
- **Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.**
- **A voltage of around 2 V dc indicates the power rails are not shorted**
- **Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.**

Current Draw (DMM)

- **Remember the 12-15 mA adjustment for the LVDS version.**

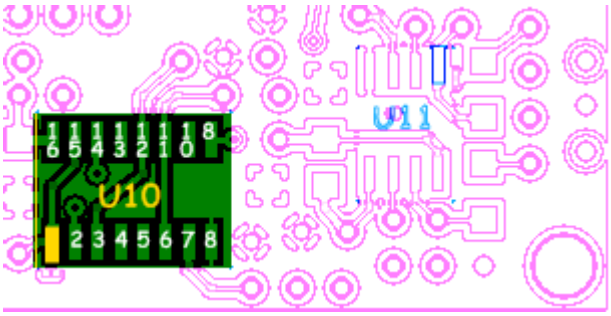
- Then measure the current with your DVM's mA meter.
- The current draw should be < 98 mA (not appreciably different from the previous stage). The author measured 89 mA (not appreciably different from the previous stage).
- Your measurement: _____.

Resistance Measurements

With the power OFF, measure the resistance between pins 15b and 16 of U10. You should see approximately 10k ohm resistance (the author got 9.97k ohms). Any resistance significantly below 10k ohms and you probably have a bad FST 3253. Tx to Mike K0JTA for this hint.

Pin Voltages (DMM - 0, 2.5, and 5 Vdc)

Measure U10 Pin Voltages



- Temporarily mount a shunt wire in the Q4 holes between the collector and the emitter, grounding the RX Mute lead and, thus, enabling the RX mixer.
- Using a DMM, measure the dc voltage (with respect to ground) of the pins of U10.
- It is best to test for these voltages at the actual pins (not the pads), thereby ensuring correct soldering of the pins to the pads.

Test Point	Units	Nominal	Your Measurement	Circuit
U10, Pin 8	Vdc	0		Mixer
U10, Pin 16	Vdc	5V rail		Mixer
U10, Pins 1&15	Vdc	0 - 50 mV		Mixer
U10, Pin 2 (from divider)	Vdc	½ 5V rail		Mixer
U10, Pin 14 (from divider)	Vdc	½ 5V rail		Mixer
U10, Pin 7 (to OpAmp)	Vdc	½ 5V rail		Mixer
U10, Pin 9 (to OpAmp)	Vdc	½ 5V rail		Mixer

If the voltage at pins 1 and 15 is not in the area of 0 - 50 mV, then the mixer will not be enabled and there will be no outputs at pins 7 and 9.

The voltages at pins 3, 6, 11, and 12 will vary fairly widely, depending upon the balance of the QSD clock signals from the divider. The closer they are to being in balance, the closer will be these pins' voltages to ½ the 5 V rail voltage. This variation is more pronounced for the higher frequency SW1 settings.

RX Test in Rocky

An additional test is to run Rocky, feeding the Ring and Tip outputs to the Line In inputs of your PC's sound card.

This test requires you to have completed the 80/40m BPF board. If you have not yet done so, go to that stage and then return to this test.

With the 80/40 BPF board in place and a stereo cable temporarily installed for the ring, tip, and common audio output connections:

- **If you already have not done so, download and install Rocky**
- **Run Rocky and click on the `View > Settings` menu**
- **In the "settings" menu, click on the "DSP" tab**
- **in the "DSP" tab's "Local Oscillator" section, click on the button marked "Single Band" and type in the desired center frequency (7046000). This sets Rocky's center frequency at 7.046 MHz.**
- **Click on the "Audio" Tab and select your sound card (if it is not already selected) in the "I/Q Input Device" dropdown box.**
- **Click on OK to close the "Settings" Menu**
- **Tack solder the audio cable to the board's "Line In" connections and plug the audio cable into your sound card's Line-In input**

- **Plug the 80/40m BPF board into jacks J3 and J4**
- **With RF signal (e.g. 7.059 MHz) injected at the Pin P100-1 of the BPF board, power up the board and click the `File > Start Radio` menu choice.**
- **You should see the Rocky spectrum display resembling the image on the right.**
- **If your signal source can sweep the frequency, observe Rocky's spectrum display as the generator sweeps through the "chunk" of bandwidth centered on the center frequency.**

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - Band Pass Filter (s)

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

Theory of Operation

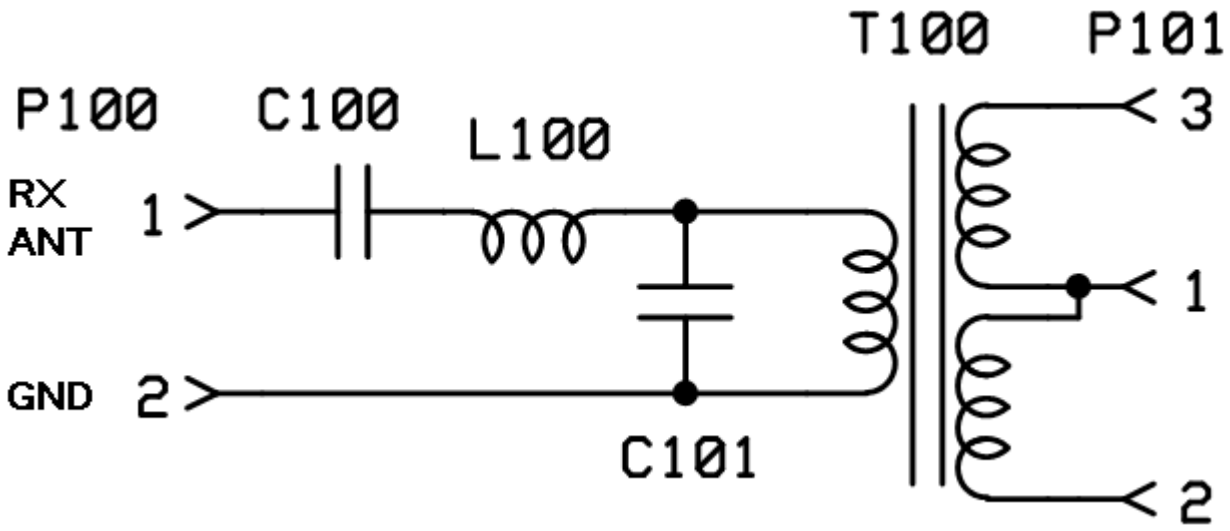
This stage lets the SDR filter out the RF spectrum arriving at the RX antenna into a "chunk" of the RF spectrum corresponding to the desired band(s). This is filtering "in the large", and is designed to minimize interference/harmonics from very strong, out-of-band signals.

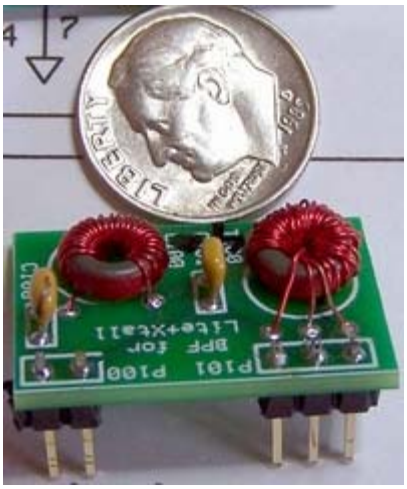
There are four different BPFs, numbered in the Bill of Materials as BPF-1 thru BPF-4. This document will provide the detailed steps for the 80/40m board, BPF-2.

Mike KF4BQ has conducted tests on the BPF boards to determine the frequency boundaries of these "chunks" (the passbands) of RF spectrum. You can view the results here.

Schematic

(Click for full RX Schematic)





Summary Build Notes

- Cut boards
- Wind and install L100
- Wind and install T100
- Install ceramic caps C100-101
- Install Plugs P100 and P101
- Test the Board

Bill of Materials

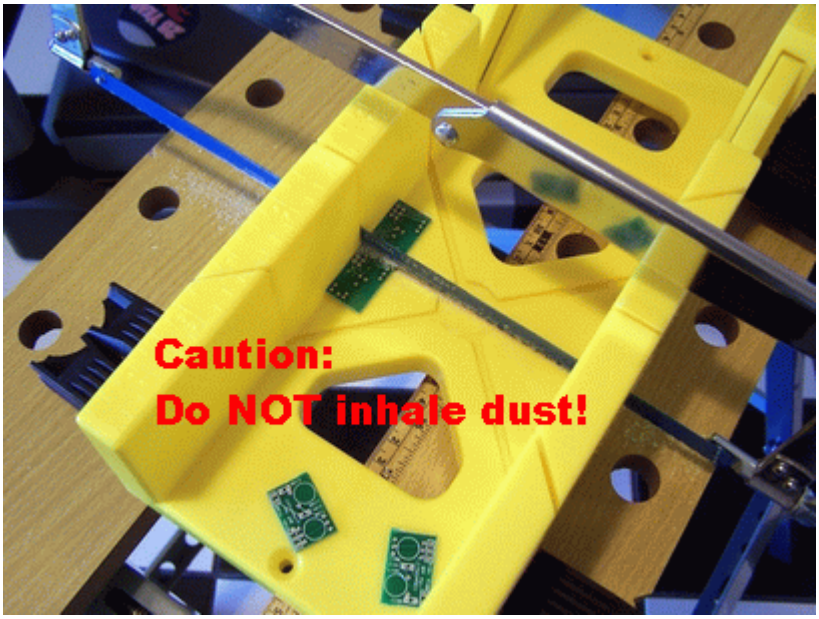
Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	BPF-Board-1	BPF Board for 160m		Lite+Xtall V 6.3 BPF Board	1	BPF-160	BPF-1
[___]	C100-1	390 pF	391	ceramic	1	BPF-1	BPF-1
[___]	C101-1	5600 pF	562	ceramic	1	BPF-1	BPF-1
[___]	L100-1	18.7 uH		T30-2 (red) #30	1	BPF 160: 66 turns #30 (34") (may need overwinding)	BPF-1
[___]	P100-1	2-pin header		connector (male)	1	BPF-1	BPF-1
[___]	P101-1	3 pin header		connector (male)	1	BPF-1	BPF-1
[___]	T100-1	1.4 uH	red	T30-2 (red) #30	1	BPF 160: primary 18 T #30 (12"); secondaries 9 T bifilar #30 (7")	BPF-1
[___]	T30-2 (red)	T30-2 (red)	red	toroid core	2		BPF-1
[___]	BPF-Board-2	BPF Board for 80/40 m		Lite+Xtall V 6.3 BPF Board	1	BPF-80/40	BPF-2
[___]	C100-2	560 pF	561	ceramic	1	BPF-2	BPF-2

[___]	C101-2	680 pF	681	ceramic	1	BPF-2	BPF-2
[___]	L100-2	1.6 uH		T25-2 red #30	1	BPF-80/40: 22 turns #30 (11")	BPF-2
[___]	P100-2	2-pin header		connector (male)	1	BPF-2	BPF-2
[___]	P101-2	3 pin header		connector (male)	1	BPF-2	BPF-2
[___]	T100-2	1.2 uH	red	T25-2 red #30	1	BPF-80/40: primary 18T #30 (10"); secondaries 9T bifilar#30 (5")	BPF-2
[___]	T25-2 (red)	T25-2 (red)	red	toroid core	2		BPF-2
[___]	BPF-Board-3	Board 30/20/17		BPF Board	1	BPF-30/20/17	BPF-3
[___]	C100-3	180 pF	181	ceramic	1	BPF-30/20/17	BPF-3
[___]	C101-3	220 pF	221	ceramic	1	BPF-30/20/17	BPF-3
[___]	L100-3	0.78 uH	yellow	T25-6 yellow #30	1	BPF-30/20/17: 17 turns #30 (9")	BPF-3
[___]	P100-3	2-pin header		connector (male)	1	BPF-3	BPF-3
[___]	P101-3	3 pin header		connector (male)	1	BPF-3	BPF-3
[___]	T100-3	0.6 uH pri	yellow	T25-6 yellow #30	1	BPF-30/20/17: primary 14T #30 (8"); secondaries 7T bifilar #30 (5")	BPF-3
[___]	T25-6 (yellow)	T25-6 (yellow)	yellow	toroid core	2		BPF-3
[___]	BPF-Board-4	Board 15/12/10		BPF Board	1	BPF-15/12/10	BPF-4
[___]	C100-4	82 pF (code 82)	82	ceramic	1	BPF-15/12/10	BPF-4
[___]	C101-4	330 pF (code 331)	331	ceramic	1	BPF-15/12/10	BPF-4
[___]	L100-4	0.53 uH	yellow	T25-6 yellow #30	1	BPF-15/12/10 14 turns #30 (8")	BPF-4
[___]	P100-4	2-pin header		connector (male)	1	BPF-4	BPF-4
[___]	P101-4	3 pin header		connector (male)	1	BPF-4	BPF-4
[___]	T100-4	0.13 uH pri	yellow	T25-6 yellow #30	1	BPF-15/12/10: primary 7T #30 (5"); secondaries 4T bifilar #30 (4")	BPF-4
[___]	T25-6 (yellow)	T25-6 (yellow)	yellow	toroid core	2		BPF-4

Detailed Build Notes

There are four bandpass filters (BPFs) you can build, each on its own board with 2 caps, a coil, a transformer, and two sockets for plugging it into the main board. The Bill of Materials above provides you with the parts list for each board. You only need to build one BPF to test out your receiver capability. It is recommended - especially if you are inexperienced in winding coils and toroids - to begin with a BPF for the band you are least interested in (just to get the practice in a non-threatening fashion).

Saw The Boards



The BPF filter boards are in a strip of four boards and will require the kit builder to hacksaw between the boards to separate the individual BPF boads. It is suggested to use a small plastic miter box and a fine-toothed blade (24 tpi or better) to help cut perpendicularly across the 0.65 inch wide strip. This seems to work well. However, please note the safety warnings on the Softrock reflector (message 23126) concerning the danger in inhaling the dust resulting from sawing. Just use common sense when sawing the boards.

Included with the BPF kits is a 9-pin length of a SIP pin strip. This pin strip was to be used as a tool to align the 2-pin and 3-pin sections of the J3 and J4 sockets on the v6.3 main circuit board. Afterwards the 9-pin strip may be snipped into 2-pin or 3-pin lengths as spares for the pins that mount on the bottom of each BPF board.

Winding Inductors

To learn how to wind coils and transformers, please read the tips from the experts and then view the excellent videos on KC0WOXs Website to solidify your understanding of the task.

Concernimg the number of turns in the windings, David WW2R has reported that he had to adjust the number of windings on L100-1 (the 66 turn coil on the 160m band) because of the fact that the toroid was

not able to accept 66 turns as a single layer, without winding back over some of the existing winding. Overlapping turns caused him to need 69 turns to reach the required inductance of 18.7 uH.

Pete N4ZR pointed out: "The 160-meter L100 requires 66 turns, but only about 40-45 turns will fit on the core in a single layer. You need to keep winding in the same direction in a second layer until you complete the 66-69 turns. I wound 69 originally, but on checking with my MFJ-259, which may not be very accurate the inductance appeared to be a little high.

When winding bifilar windings, it is a lot easier to wind the bifilar winding if you fold the wire in half but don't cut, and use the folded (closed) end (with or without a sewing needle) to feed through the toroid or binocular core.

Wire Lengths

:

Refer to the BOM above to see the recommended length of wire (in inches) for each inductor. These lengths include generous SWAGS to accomodate lead lengths, etc.

When the BOM states `BPF-80/40: primary 18T #30 (10"); secondaries 9T bifilar#30 (5")` this means:

- Primary: use 10" for the single winding.
- Secondaries: Take a 10" length of wire and fold it over at the 5" point, twisting it together into a bifilar strand, winding it evenly distributed over the primary winding for 9 turns.

Core Sizes

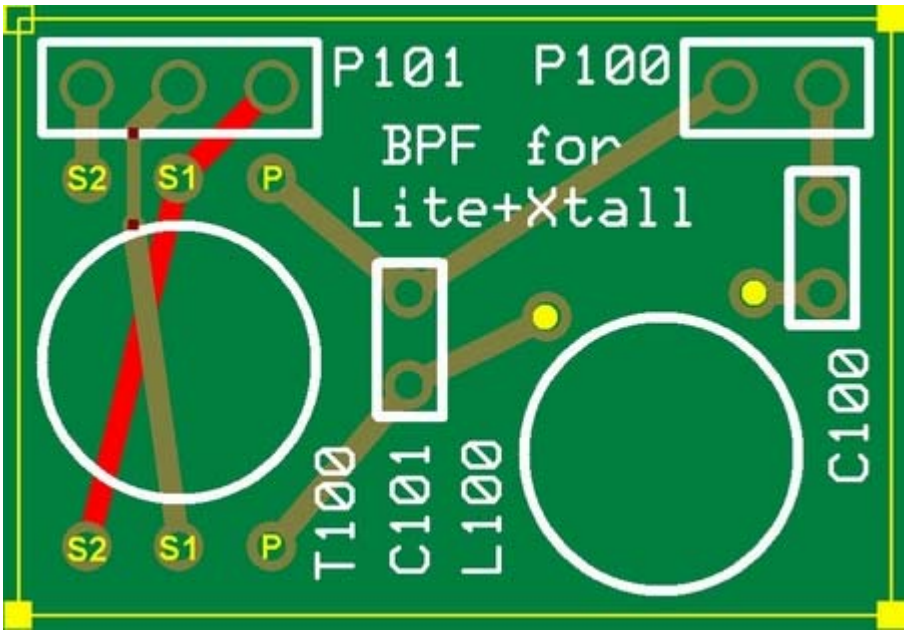
The chart below provides the capacitance values and the winding instructions by band group. Carefully note that some bands use different size and color cores. Be sure to use the right core for the board you are building:

1.
   1. 160 m: T30-2 (red)
   2. 80/40m: T25-2 (red)
   3. 30/20/17/15/12/10m : T25-6 (yellow)

Band specific values

Bands	C100	C101	L100	T100
160m	390pF	5600pF	18.7uH, T30-2(red) core 66T #30 AWG	1.4uH(primary), T30-2(red) 18T #30 AWG on primary 9T #30 AWG on each bifilar
80m/40m	560pF	680pF	1.6uH, T25-2(red) core 22T #30 AWG	1.2uH(primary), T25-2(red) 18T #30 AWG on primary 9T #30 AWG on each bifilar
30m/20m/17m	180pF	220pF	0.78uH, T25-6(yellow) core 17T #30 AWG	0.6uH(primary), T25-6(yell 14T #30 AWG on primary 7T #30 AWG on each bifilar
15m/12m/10m	82pF	330pF	0.53uH, T25-6(yellow) core 14T #30 AWG	0.13uH(primary), T25-6(yel 7T #30 AWG on primary 4T #30 AWG on each bifilar

For Each BPF Board



(referring to the Band Specific Values chart, above):

Build Steps for each BPF Board

Check	Designation	Type	Notes

Horizontal mounting of T100

Horizontal mounting of L100

	L100-#	Coil	Wind, prepare, horizontally mount, and solder the coil, L100, using the correct core size and color and turn count.. • Carefully count the turns[1]. Each pass thru the center is 1 turn. • Leave approximately 1/2 inch for each lead. • Use an emery cloth to scrape the insulation off the leads up to the last 1/8 inch. • Pull the leads through the holes directly above the circle for L100 on the BPF board (marked in yellow above). • Flatten the core horizontally, pull the leads snug, bend them on the bottom side of the board, and solder the leads. • Test for continuity (~0 ohms) from the lower hole of C100 through the coil to the lower hole of C101. • If there is no continuity, check soldering of the leads and resolder as necessary.
	T100-#	Transformer	Wind, prepare, horizontally mount, and solder the transformer, T100 • Transformer T100-# will be mounted horizontally and raised above the board about 1/16 of an inch. In winding T100-#, first wind the primary winding with enameled wire so that the primary winding starts and ends at about the

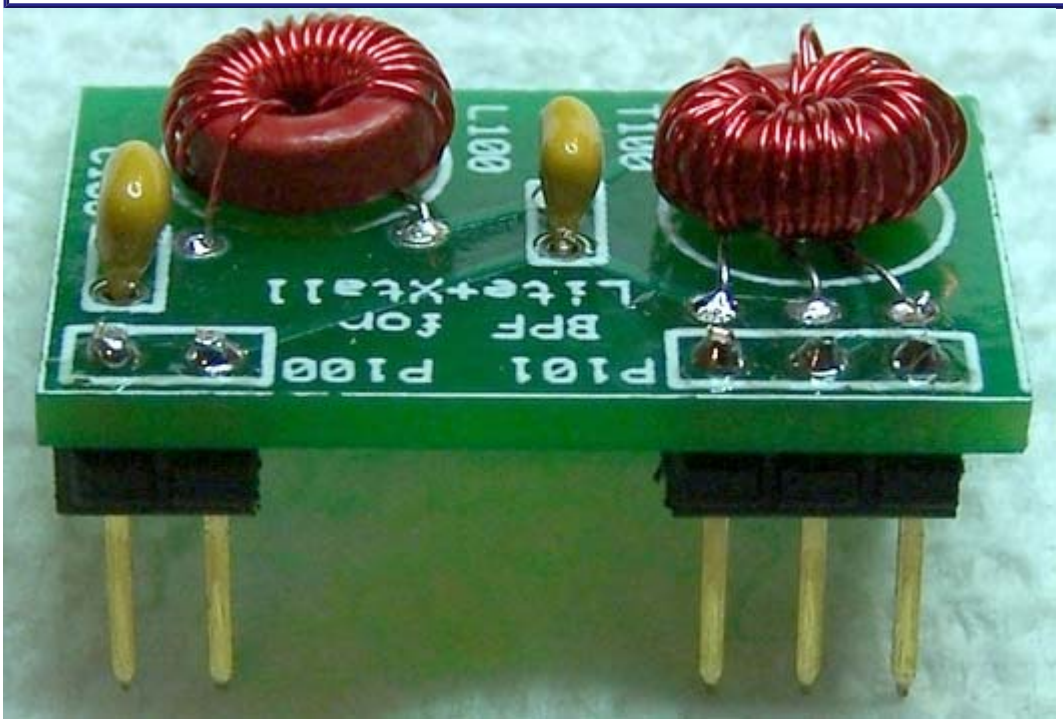
			same point on the core and is uniformly spread around the core. • Twist two pieces of enameled wire together (bifilar) at about 3 twists per inch and wind the secondary windings with the windings starting and ending where the primary winding starts and ends. When you have wound the transformer, you will have 6 leads, 3 (one primary, one secondary 1, and one secondary 2) on each side of the core. • When trimming the wires, recognize that the 3 leads coming from one side of the core may need to be a little longer than those from the other side (to facilitate mounting the transformer horizontally. • Insert the leads, following the annotations on the BPF board above: ◦ "P" represents the primary leads on each side of the core; ◦ "S1" represents the leads for the first secondary winding on each side; ◦ "S2" represents the leads for the second secondary winding on each side. • Test for continuity on the two primary leads ("P" in the image above) by putting your ohmmeter leads on the two holes for C101. If you do not have continuity, then you likely have a soldering issue on the primary leads. • Test for continuity between either of the primary leads and each of the secondary leads. You should see an open circuit. • If you **do** get continuity, look for a short in the transformer or in its solder joints. • Test for continuity between pins 2 and 3 of P101. You should get continuity. • If you do not get continuity, one or more of your secondary leads has a solder problem.
	C100-#	ceramic capacitor	Mount and solder the capacitor, C100

	C101-#	ceramic capacitor	Mount and solder the capacitor, C101
	P100-#	2 pin header	Mount and solder the 2-pin header, P100, on the underside of the board, with the shorter pins going through the holes from the bottomside to the topside and the longer pins extending out from the bottom side to mate with the main board [(2)].
	P101-#	3-pin header	Mount and solder the 3-pin header, P101, on the underside of the board, with the shorter pins going through the holes from the bottomside to the topside and the longer pins extending out from the bottom side to mate with the main board. [(2)]

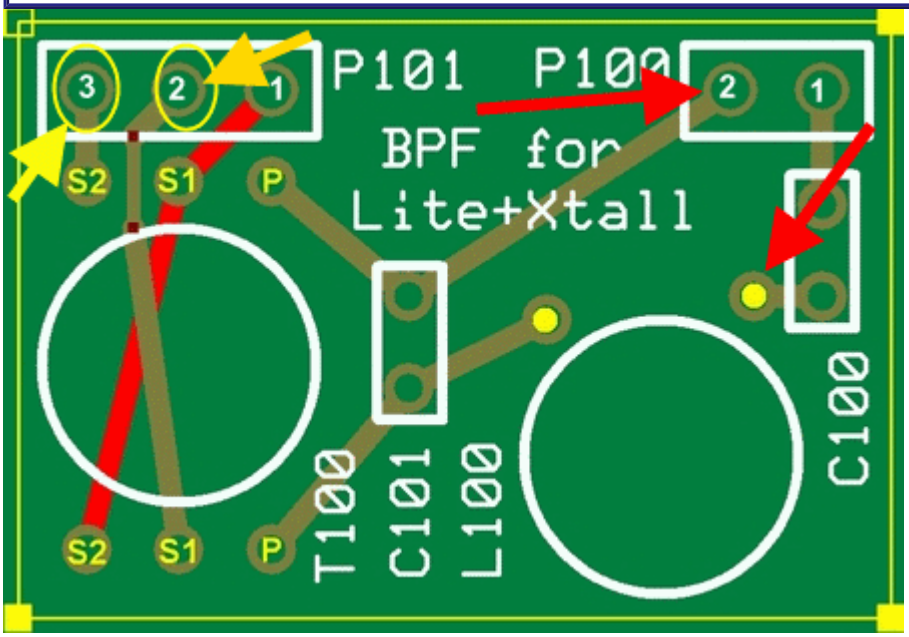
[1] The L-100 for the 160m BPF will require overlapping the windings in order to fit all of them on the toroid. The first layer pretty well fills up after 45 or so turns.

[2] The BPF board connectors (P100 and P101 headers) are mounted, short ends into the holes for P100-# and P101-#, on the bottom of the board with the other components on top.
Use the main board sockets (J1and J2) as a "tool" to align the pin headers on each BPF board so that the two will mate properly. Initially in the build of the main board (Local Oscillator Stage) a 9-pin header piece was used as a tool to align the 2-pin and 3-pin sockets (J1 and J2). This 9-pin header strip can then be snipped to 2-pin and/or 3-pin lengths and used as spares for the BPF board build.

Completed Board (80/40m)



Testing



Continuity

[1] The lengths do not include extra inches for wire lead lengths, etc. and, thus, do not agree with the recopmmended lengths in the Bill of Materials.

Test T100 Primary Resistance

- Using your ohmmeter, measure the resistance from The C100 hole farthest away from P100 to ANT Return. It should be ~0 ohms, indicating continuity in the primary windings of T100, through the L100 windings.
- If you get any appreciable resistance or an open circuit, you should inspect/touch up the solder joints on T100 primary and/or L100.

Test T100 Secondaries Resistance

- Using your ohmmeter, measure the resistance between pins 2 and 3 of P101.
  It should be ~0 ohms, indicating continuity between the ends of the two secondary windings and through the center tap.
- If you get any resistance or an open circuit, you should inspect and/or touch up the solder joints.
- **Note: that the two secondaries are center-tapped so both windings are "connected" continuously in the circuit from pin 2 to pin 3.**

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - TX OpAmps

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

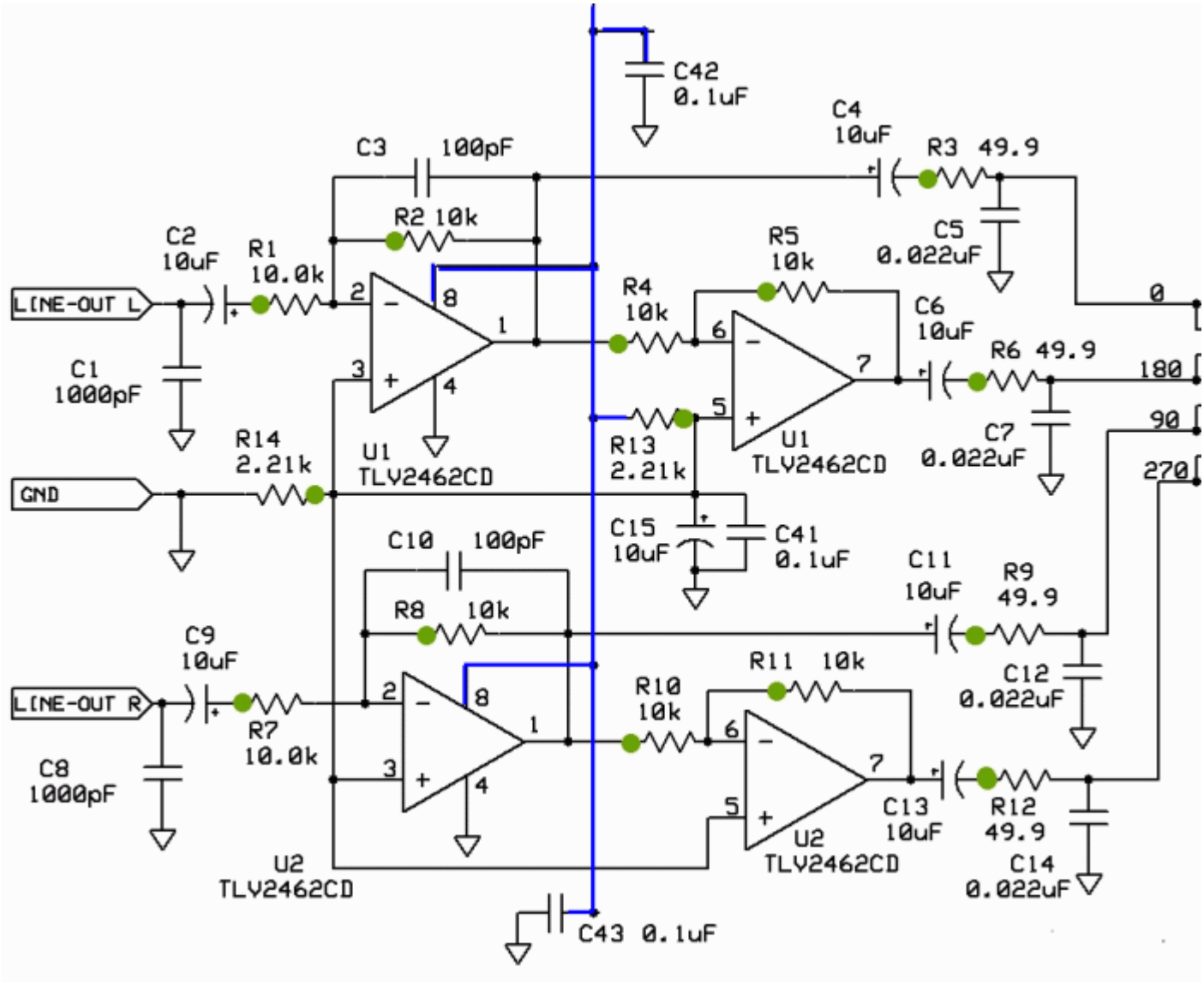
Introduction

This stage has a pretty large part count.. It consists of four unitary gain op-amps, arranged in pairs, one per stereo line out signal into the board. The left channel's input resolves to two signals: 0° and 180°. The right channel's input resolves to two signals: 90° and 270°.

These four outputs will be muxed together in the mixer stage to produce the desired exciter output (thus, the term Quadrature Sampling Exciter (QSE)).

Schematic

(Click for full TX Schematic)



Summary Build Notes

- Install Ceramic Caps C1, C3, C5, C7, C8, C10, C12, and C14
- Install Electrolytic Caps C2, C4, C6, C9, C11, C13, and C15
- Install Resistors R1-R14
- Install U1 and U2
- Test the Stage

Bill of Materials

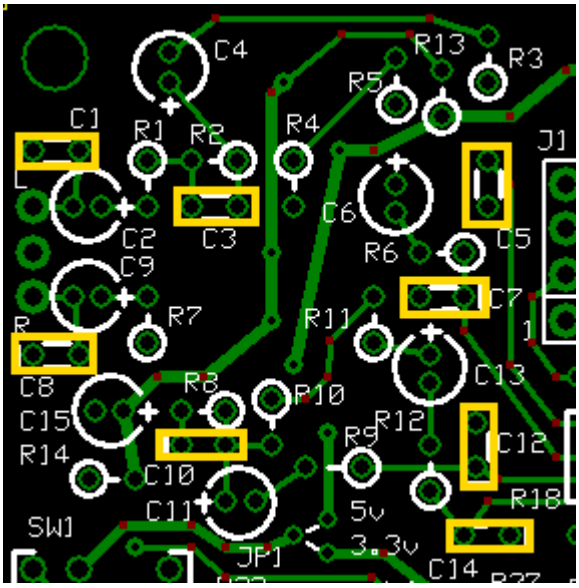
Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C01	1000 pF	102	ceramic	1	

[__]	C02	10 uF 16V		electrolytic	1	E=+
[__]	C03	100pF	101	ceramic	1	
[__]	C04	10 uF 16V		electrolytic	1	S=+
[__]	C05	0.022 uF	223	ceramic	1	
[__]	C06	10 uF 16V		electrolytic	1	N=+
[__]	C07	0.022 uF	223	ceramic	1	
[__]	C08	1000 pF	102	ceramic	1	
[__]	C09	10 uF 16V		electrolytic	1	E=+
[__]	C10	100pF	101	ceramic	1	
[__]	C11	10 uF 16V		electrolytic	1	W=+
[__]	C12	0.022 uF	223	ceramic	1	
[__]	C13	10 uF 16V		electrolytic	1	N=+
[__]	C14	0.022 uF	223	ceramic	1	
[__]	C15	10 uF 16V		electrolytic	1	E=+
[__]	R01	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R02	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W
[__]	R03	49.9	yellow-white-white-gold-brown	Resistor 1%	1	S-N
[__]	R04	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R05	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R06	49.9	yellow-white-white-gold-brown	Resistor 1%	1	E-W
[__]	R07	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R08	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W
[__]	R09	49.9	yellow-white-white-gold-brown	Resistor 1%	1	E-W
[__]	R10	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R11	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R12	49.9	yellow-white-white-gold-brown	Resistor 1%	1	S-N
[__]	R13	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	S-N
[__]	R14	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E
[__]	U1	TLV2462		IC SOIC-8 dual Op-Amp	1	(bottom)
[__]	U2	TLV2462		IC SOIC-8 dual Op-Amp	1	(bottom)

Detailed Build Notes

- **Need to do topside components first, as many holes for these are very close to the IC pads on the bottomside - avoiding solder splashover**

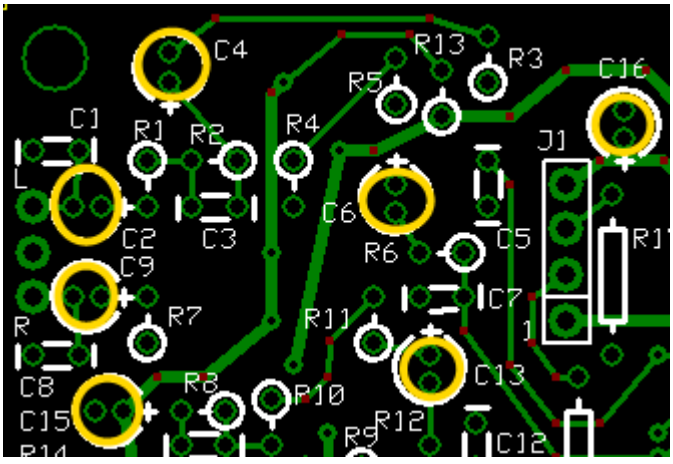
Install the 8 Ceramic Capacitors



Install C1, C3, C5, C7, C8, C10, C12, and C14

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C01	1000 pF	102	ceramic	1	
[__]	C03	100pF	101	ceramic	1	
[__]	C05	0.022 uF	223	ceramic	1	
[__]	C07	0.022 uF	223	ceramic	1	
[__]	C08	1000 pF	102	ceramic	1	
[__]	C10	100pF	101	ceramic	1	
[__]	C12	0.022 uF	223	ceramic	1	
[__]	C14	0.022 uF	223	ceramic	1	

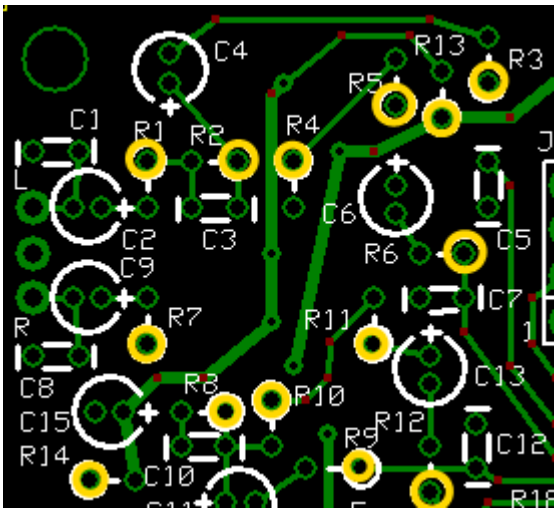
Install the 7 Electrolytic Capacitors



Install the 7 electrolytic caps: C2, C4, C6, C9, C11, C13, and C15
Note the orientation of the positive lead ("notes" column, below)

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C02	10 uF 16V		electrolytic	1	E=+
[__]	C04	10 uF 16V		electrolytic	1	S=+
[__]	C06	10 uF 16V		electrolytic	1	N=+
[__]	C09	10 uF 16V		electrolytic	1	E=+
[__]	C11	10 uF 16V		electrolytic	1	W=+
[__]	C13	10 uF 16V		electrolytic	1	N=+
[__]	C15	10 uF 16V		electrolytic	1	E=+

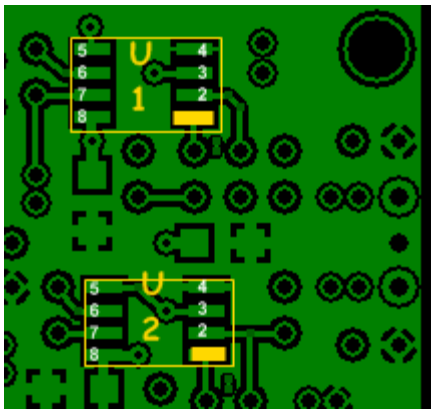
Install the 14 Resistors



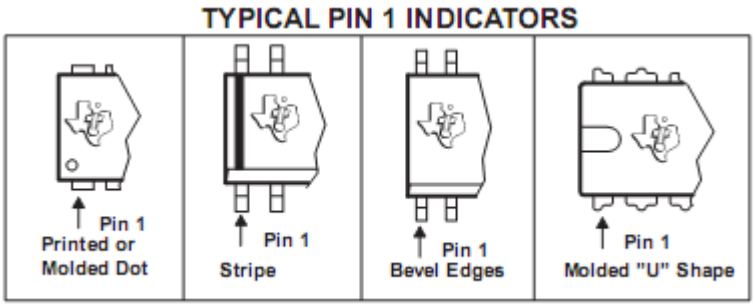
Install Resistors R1-R14
Note: orientation is in "Notes" column below.

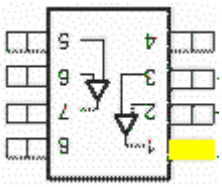
Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	R01	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R02	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W
[__]	R03	49.9	yellow-white-white-gold-brown	Resistor 1%	1	S-N
[__]	R04	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R05	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R06	49.9	yellow-white-white-gold-brown	Resistor 1%	1	E-W
[__]	R07	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R08	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W
[__]	R09	49.9	yellow-white-white-gold-brown	Resistor 1%	1	E-W
[__]	R10	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R11	10 k	brown-black-black-red-brown	Resistor 1%	1	S-N
[__]	R12	49.9	yellow-white-white-gold-brown	Resistor 1%	1	S-N
[__]	R13	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	S-N
[__]	R14	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E

Install the 2 SMT Op-Amps



Note: one of the pin indicators (below) refers to a molded "U" on the chip. Do not confuse this with the "U1" and "U2" annotations in the above picture of the IC placement on the underside of the board.
Thanks to Ross OK5AZ for catching this.





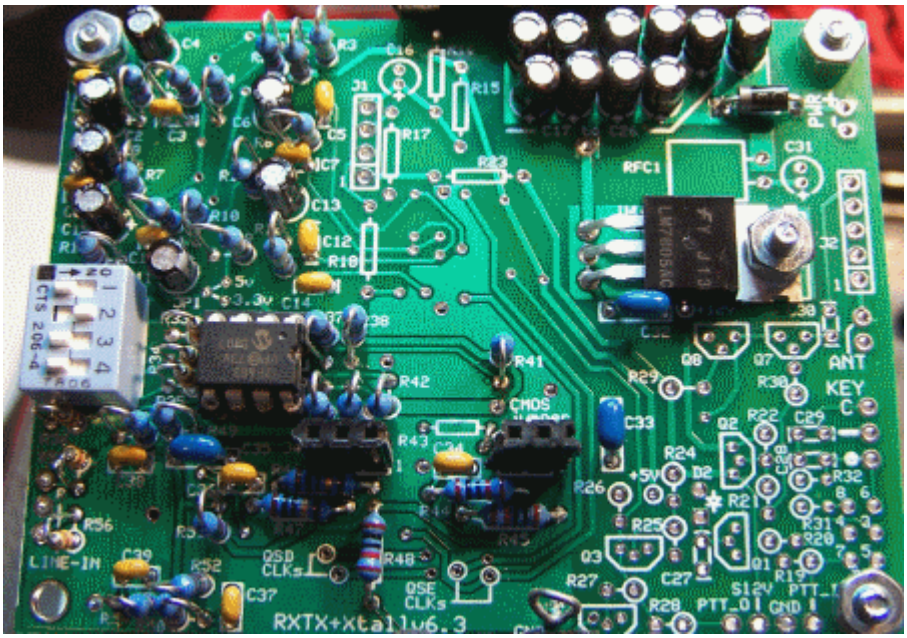
Install U1, U2,

Watch out for solder splashover on any adjacent, open holes

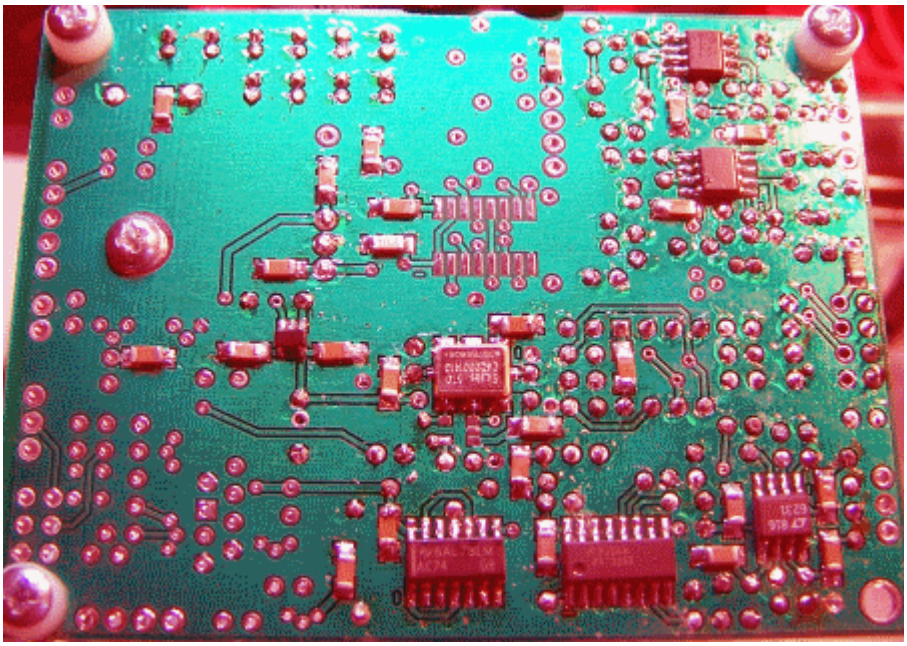
Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	U1	TLV2462		IC SOIC-8 dual Op-Amp	1	(bottom)
[__]	U2	TLV2462		IC SOIC-8 dual Op-Amp	1	(bottom)

Completed Board

Topside



Bottomside



Testing

Current Limited Power Test

- Connect a 100 ohm resistor in series with the power line and apply 12 V dc power
- the current should be less than 120 mA (nominally 100 mA)
- Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.

- **A voltage of around 2 V dc indicates the power rails are not shorted**
- **Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.**

Current Draw

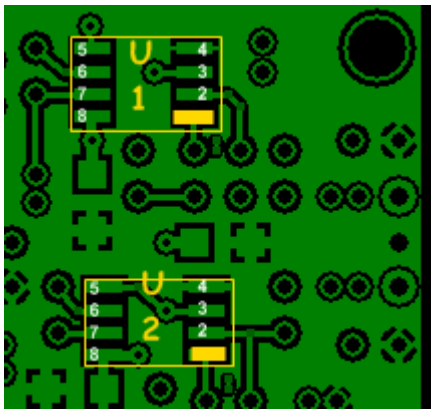
- **Without Limiting resistor the draw should be < 102 mA**
- **Your measurement: _____**

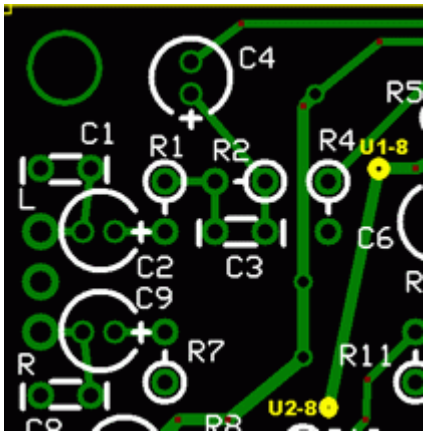
Op-Amp Voltage Divider (R13/R14)

- **R13/R14 form a voltage divider to halve the 5 Vdc rail**
- **measure the voltage WRT ground at the R14 hairpin.**
- **You should see nominaly 2.5 Vdc (actual would range between 2.4 and 2.5 Vdc)**
- **Your Measurement: _____**

Op-Amp Pin Voltages

- **If the voltage divider tests out OK, measure the voltages at the pins of U1 and U2 using the table below**
- **You should measure at the actual pins on the ICs as well as using the convenient resistor hairpin testpoints**





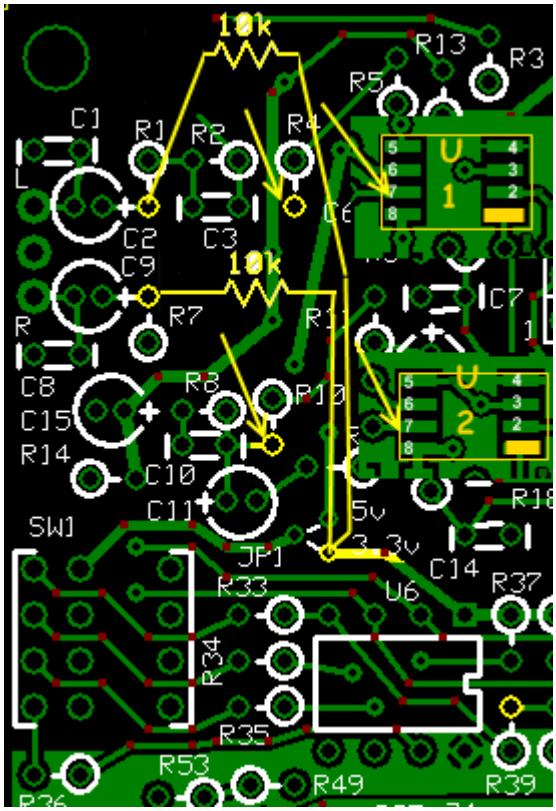
Actual values in the 2.5 nominal measurements will range from 2.4 to 2.5 Vdc

Pin	Nominal Value	Author Result	Your Measurement
1 (R4 hairpin)	½ 5V rail	2.48	
2 (R2 hairpin)	½ 5V rail	2.48	
3 (R14 hairpin)	½ 5V rail	2.48	
4	0 (gnd)	0	
5 (R13 hairpin)	½ 5V rail	2.48	
6 (R5 hairpin)	½ 5V rail	2.48	
7	~2.5 Vdc	½ 5V rail	
8 See testpoint picture above	5V rail	4.96	

U2

Pin	Nominal Value	Author Result	As Measured
1 (R10 hairpin)	½ 5V rail	2.48	
2 (R8 hairpin)	½ 5V rail	2.48	
3 (R14 hairpin)	½ 5V rail	2.48	
4	0 (gnd)	0	
5 (R13 hairpin)	½ 5V rail	2.48	
6 (R11 hairpin)	½ 5V rail	2.48	
7	½ 5V rail	2.48	
8 See testpoint picture above	5V rail	4.96	

Op-Amp Function



This test validates that the OpAmps are actually functioning. Each Opamp IC will have a 0.4 Vdc reduction in the pin 1 voltage and a 0.4 Vdc increase in the voltage at pin 7.

- **Connect a test lead with a spare 10 kOhm resistor in series between R1 hairpin and the 3.3 V test point at JP1 (alternatively you can clip to the R39 or R40 hairpin for a 3.3V source)**
- **Power up the board**
- **Measure the voltage at R4 hairpin. It should be ½ the 5 V rail - 0.4 Vdc (about 2.1 Vdc)**
- **Measure the voltage at pin 7 of U1. It should be ½ the 5 V rail + 0.4 Vdc (about 2.9 Vdc)**

- **Disconnect the lead and resistor from R1 and connect it to bridge between R7 hairpin and the 3.3 V test point (JP1, R39, or R40)**
- **Measure the voltage at R10 hairpin. It should be ½ the 5 V rail - 0.4 Vdc (about 2.1 Vdc)**
- **Measure the voltage at pin 7 of U2. It should be ½ the 5 V rail + 0.4 Vdc (about 2.9 Vdc)**

Test Point	Nominal	Your Measurement
R4 hairpin - R1 bridged	**around 2.1 Vdc**	
U1, Pin 7 - R1 bridged	**around 2.9 Vdc**	
R4 hairpin - R1 unbridged	**½ 5V rail**	
U1, Pin 7 - R1 unbridged	**½ 5V rail**	
R10 hairpin - R7 bridged	**around 2.1 Vdc**	
U2, Pin 7 - R7 bridged	**around 2.9 Vdc**	
R10 hairpin - R7 unbridged	**½ 5V rail**	
U2, Pin 7 - R7 unbridged	**½ 5V rail**	

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - PTT Circuits

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

This and the next stage wrap up some miscellaneous enabling functionality to handle switching between RX and TX.

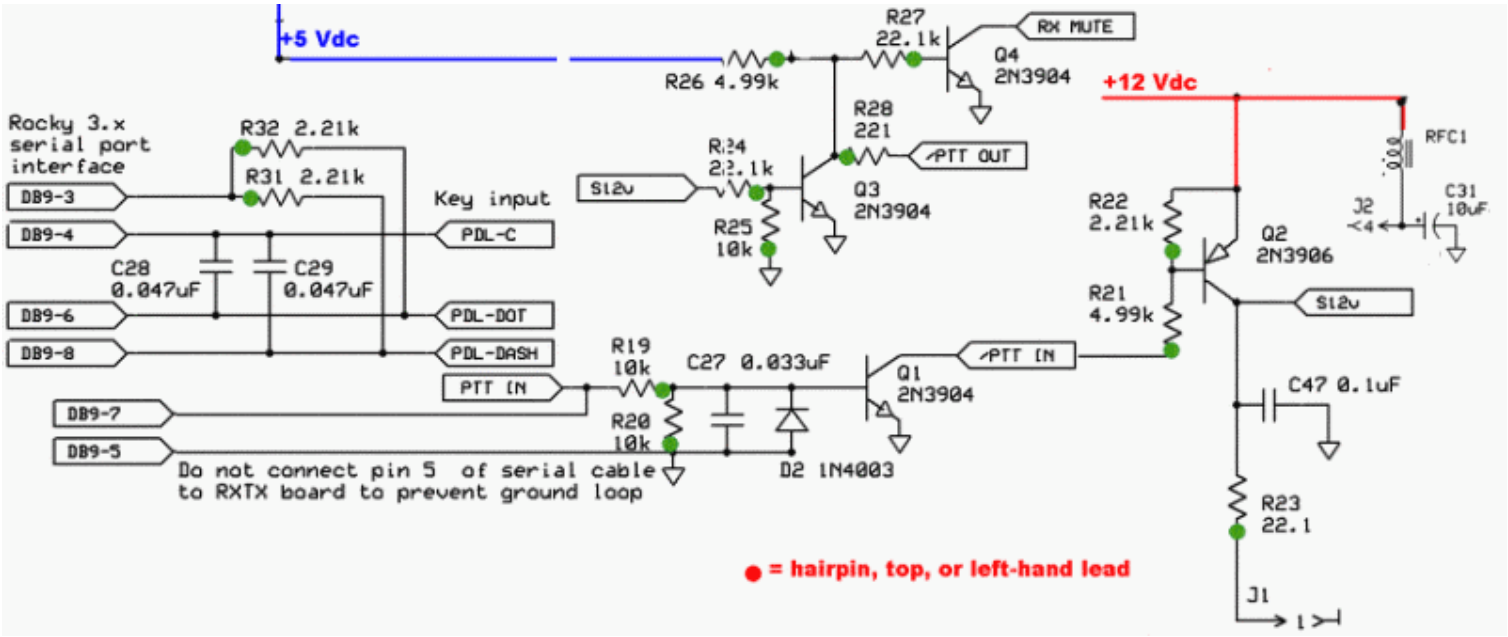
The circuitry for connecting the PTT and Keyer inputs up to Rocky via a serial interface is installed in this stage (minus the DB9 connector, which will be installed in the "External Connections" stage.

The PTT (PTT_I tab on the board) can be activated with +12V from the RS232C signal of the Rocky Interface, OR with +5V from other sources (e.g. a +5V uC signal). If you are using Rocky, you may not need to connect the GND as the GND return may flow through the audio connectors already.

Also available from Tony Parks is a USB I2C interface. That interface's PTT_OUT (Rx = 0V, Tx = 5V) can be connected to the SRv6.x's PTT_IN.

Schematic

(Click for full TX Schematic)



Summary Build Notes

- Install Ceramic Caps C27-C29
- Install Elactrolytic cap C31

- Install Resistors R19-R28, R31-R32
- Install D2, Q1-Q4
- Wind and install RFC1
- Test the Stage

Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C27	0.033 uF	333	ceramic	1	
[__]	C28	0.047 uF	473	ceramic	1	
[__]	C29	0.047 uF	473	ceramic	1	
[__]	C31	10 uF 16V		electrolytic	1	S=+
[__]	RFC1	23 uH		choke 4T #26	1	BN-43-2402 5"
[__]	R19	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W
[__]	R20	10 k	brown-black-black-red-brown	Resistor 1%	1	W-E
[__]	R21	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	N-S
[__]	R22	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	N-S
[__]	R23	22.1	red-red-brown-gold-brown	Resistor 1%	1	FlatH
[__]	R24	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S
[__]	R25	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[__]	R26	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	N-S
[__]	R27	22.1 k	red-red-brown-red-brown	Resistor 1%	1	E-W
[__]	R28	221	red-red-brown-black-brown	Resistor 1%	1	E-W
[__]	R31	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E
[__]	R32	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E
[__]	D2	1N4003		Diode	1	
[__]	Q1	2N3904		Transistor (NPN) TO-92	1	
[__]	Q2	2N390**6**		Transistor (PNP) TO-92	1	
[__]	Q3	2N3904		Transistor (NPN) TO-92	1	
[__]	Q4	2N3904		Transistor (NPN) TO-92	1	

Softrock RXTX V6.3 - Xtall - TX Mixer

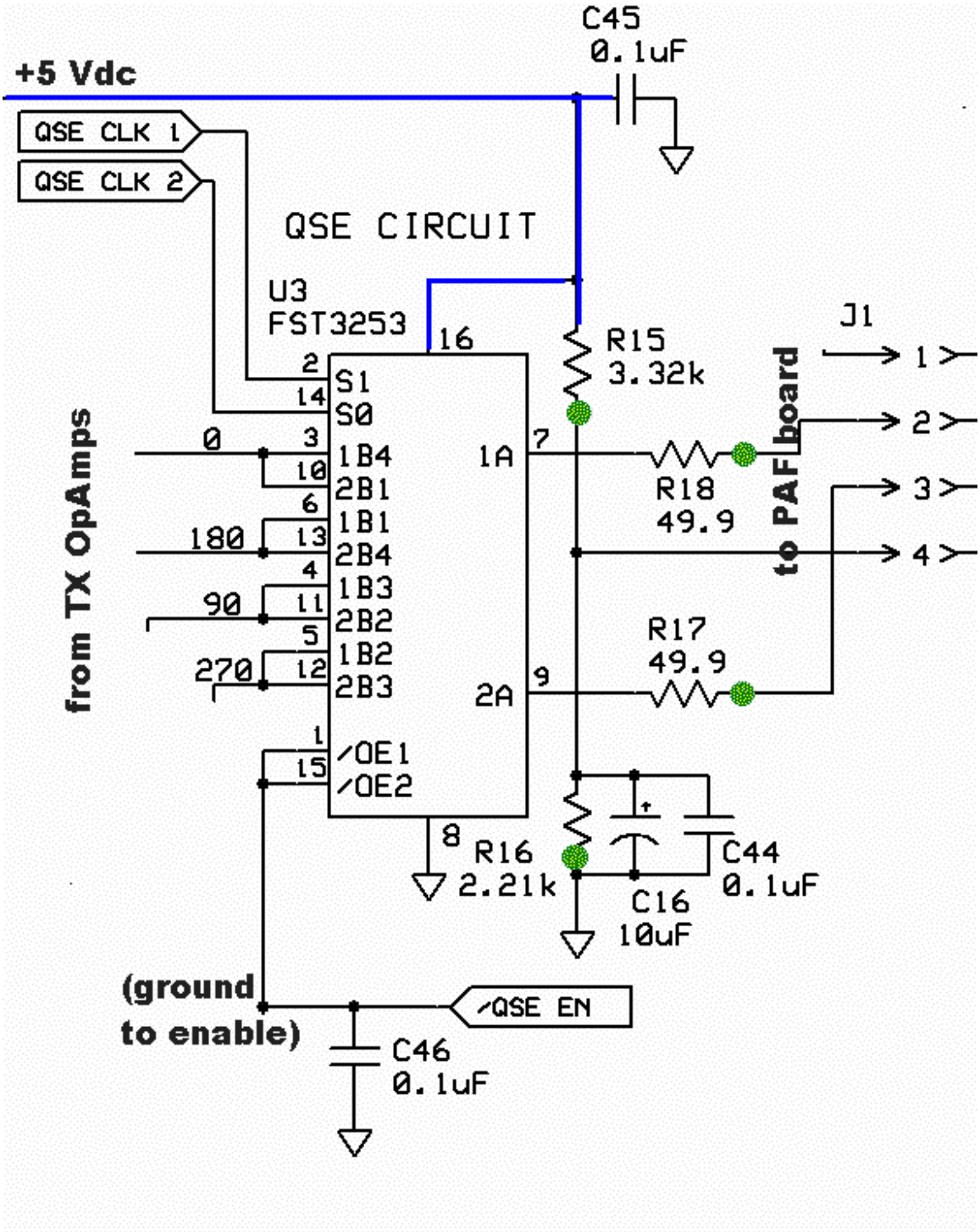
Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs;
TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons
Comments Revisions WB5RVZ SDR Home

Introduction

This stage adds the TX Mixer to the board and provides the modulation of the Dividers' output signals by the 4 I and Q signals from the OpAmps. The result is a double sideband RF waveform that will be coupled into the PA stage.

Schematic

(Click for full TX Schematic)



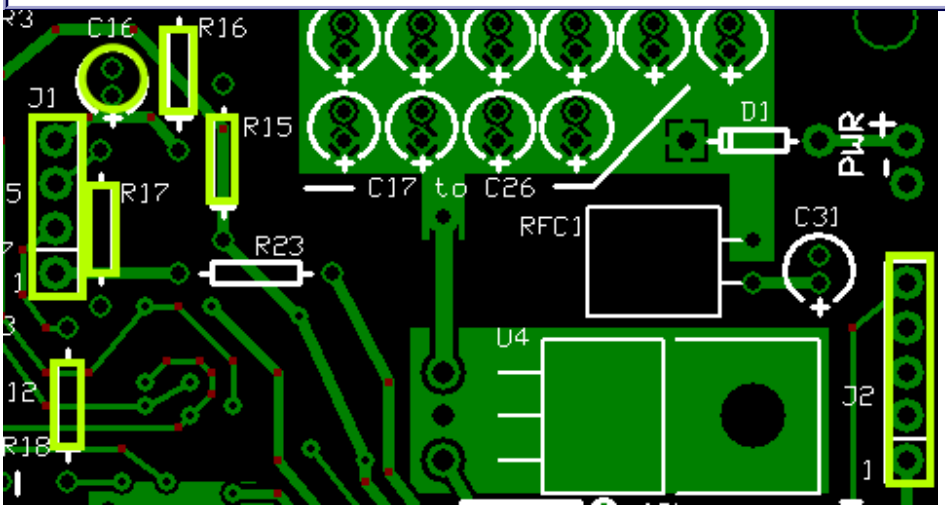
Summary Build Notes

- Install sockets J1 and J2
- Install Resistors R15-R16
- Install electrolytic Cap C16
- Install U3
- Test the Stage

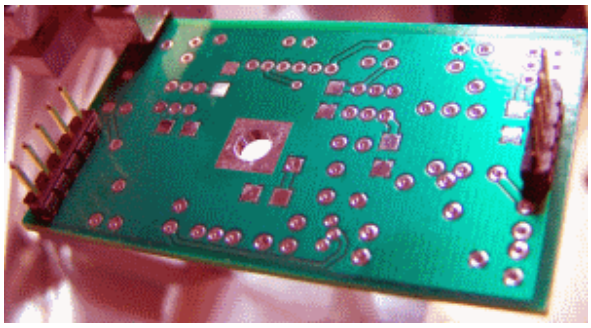
Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C16	10 uF 16V		electrolytic	1	S=+
[__]	J1	4-pin socket		connector (female)	1	
[__]	J2	5-pin socket		connector (female)	1	
[__]	R15	3.32 k	orange-orange-red-brown-brown	Resistor 1%	1	FlatV
[__]	R16	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	FlatV
[__]	R17	49.9	yellow-white-white-gold-brown	Resistor 1%	1	FlatV
[__]	R18	49.9	yellow-white-white-gold-brown	Resistor 1%	1	FlatV
[__]	U3	FST3253		SOIC-16 Dual 4:1 Mux/Demux Bus Switch	1	(bottom)

Detailed Build Notes



Sockets

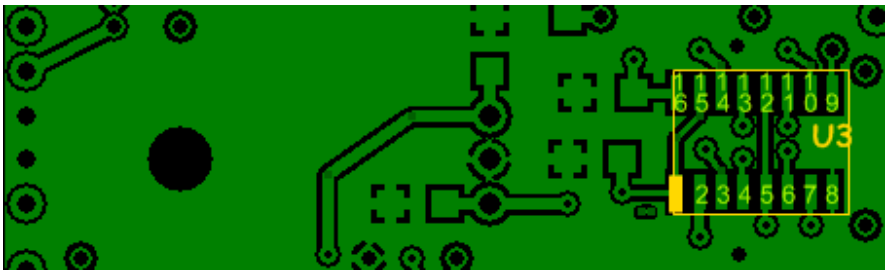


- **From the PAF kit, take the PAF board and plugs P201 and P202**
- **Install the plugs to the bottom side of the PAF board with the short leads of each plug inserted into the holes and protruding from the bottom to the top and the long leads protuding from the bottom of the PAF board.**
- **Using the PAF board and its plugs as an alignment jig, plug it into the sockets J1 and J2**

- **Mount and install the sockets J1 and J2 onto the topside of the Main Board**
- **Remove the PAF board and set aside until later**

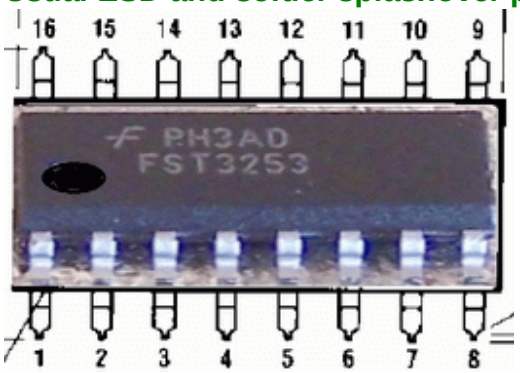
Resistors and Capacitor

- **Install Resistors R15-R18**
  Note they are all oriented flat, vertical.
- **Install electrolytic capacitor C16**



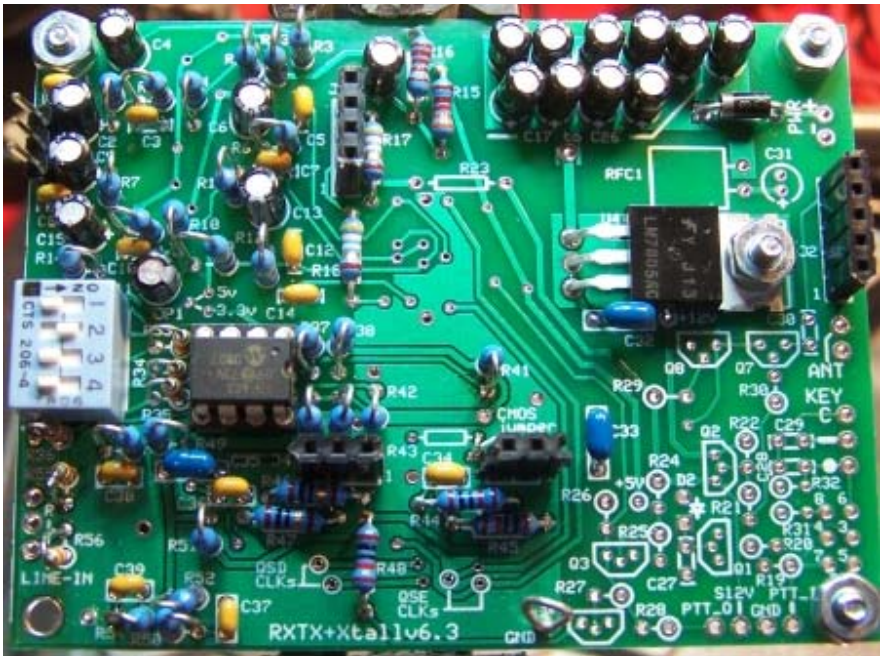
Mixer SMT IC

Install The FST 3253 TX Mixer, U3
Usual ESD and solder splashover precautions apply.

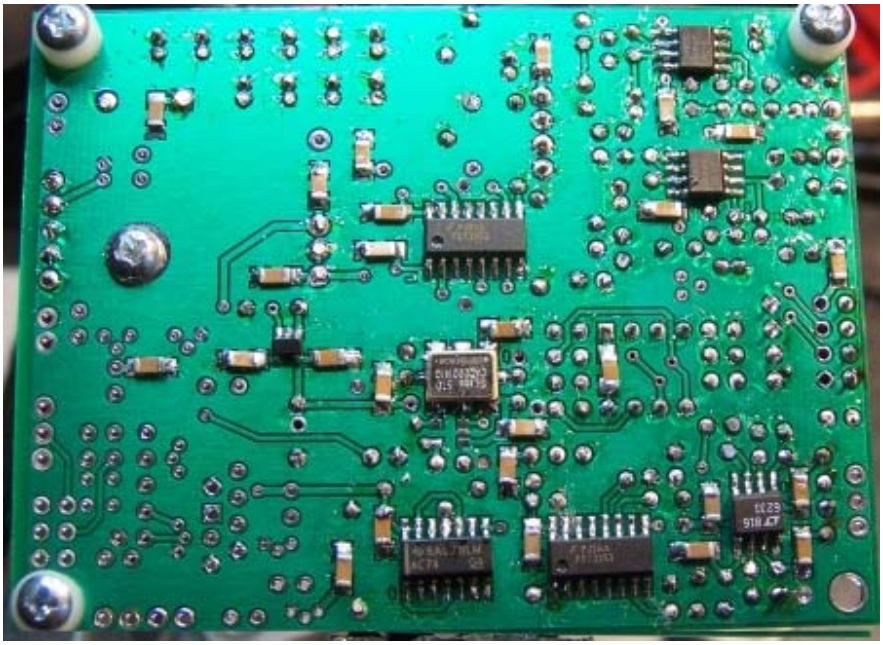


Completed Board

Topside



Bottomside



Testing

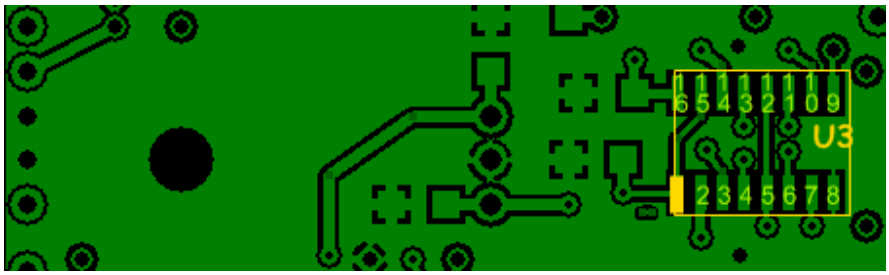
Current Limited Power Test

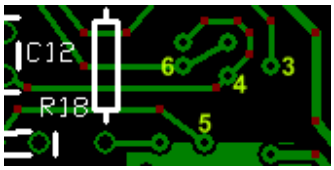
- Connect a 100 ohm resistor in series with the power line and apply 12 V dc power
- the current should be less than 120 mA (nominally 105 mA)
- Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.
- A voltage of around 2 V dc indicates the power rails are not shorted
- Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.

Current Draw

- **Without limiting resistor, you should get < 103 mA**
- **Your measurement: _____**

Mixer Pin Voltages





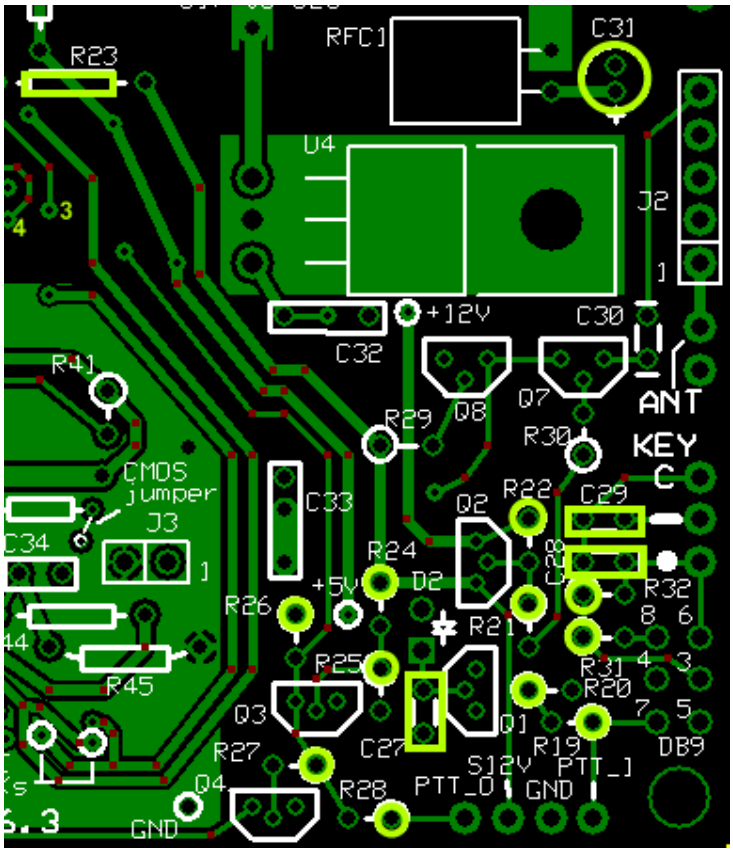
- **Temporarily ground pin 1 of U3 by jumpering the hole for the hairpin lead of R26 to the ground lead.**
- **Jumper pins 2, 3, and 4 of jack J1 (this establishes the correct dc level for pins 7 and 9 of the mixer)**
- **Measure the voltages at the mixer pins as indicated below:**

Pin	Nominal Value	Author Results	Your Measurement
1&15 (hole for R26 hairpin)	~0 Vdc		
8	0		
16	5 V rail		
2 & 14 (QSE CLK 1 & 2)	½ 5V rail		
7(R18 hairpin)	around 2 volts		
9 (R17 hairpin)	around 2 volts		
3 (see picture above right)	around 2 volts		
4 (see picture above right)	around 2 volts		
5 (see picture above right)	around 2 volts		
6 (see picture above right)	around 2 volts		

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Detailed Build Notes

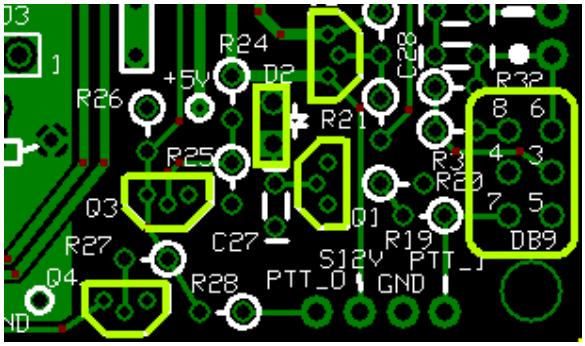
Install the Capacitors and Resistors



Double check the resistor values. This stage has a potentially confusing array of 22.1, 221, 2.21k, 22.1k resistors. It is very easy to get them mixed up.

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[ ]	C27	0.033 uF	333	ceramic	1	
[ ]	C28	0.047 uF	473	ceramic	1	
[ ]	C29	0.047 uF	473	ceramic	1	
[ ]	C31	10 uF 16V		electrolytic	1	S=+
[ ]	R23	22.1	red-red-brown-gold-brown	Resistor 1%	1	FlatH
[ ]	R28	221	red-red-brown-black-brown	Resistor 1%	1	E-W
[ ]	R22	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	N-S
[ ]	R31	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E
[ ]	R32	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	W-E
[ ]	R21	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	N-S
[ ]	R26	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	N-S
[ ]	R19	10 k	brown-black-black-red-brown	Resistor 1%	1	E-W
[ ]	R20	10 k	brown-black-black-red-brown	Resistor 1%	1	W-E
[ ]	R25	10 k	brown-black-black-red-brown	Resistor 1%	1	N-S
[ ]	R24	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S
[ ]	R27	22.1 k	red-red-brown-red-brown	Resistor 1%	1	E-W

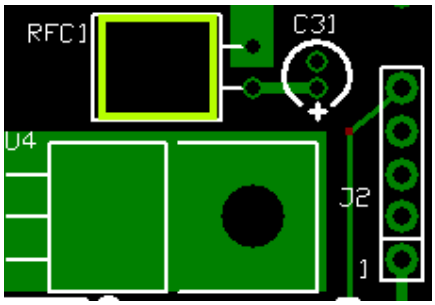
Install Semiconductors

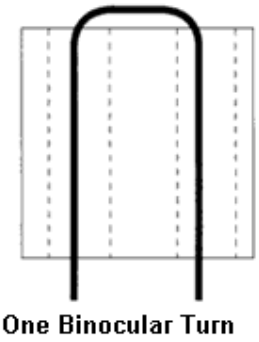


- When mounting D2, mount it hairpin style so the lead going to the square pad is the cathode (the end with the line) 

- Be sure to distinguish between the 2N3904 and the 2N3906 (the markings look very similar).

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	D2	1N4003		Diode	1	N-S
[__]	Q1	2N3904		Transistor (NPN) TO-92	1	
[__]	Q2	2N3906		Transistor (PNP) TO-92	1	
[__]	Q3	2N3904		Transistor (NPN) TO-92	1	
[__]	Q4	2N3904		Transistor (NPN) TO-92	1	



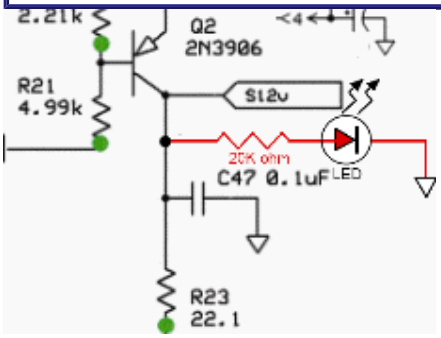


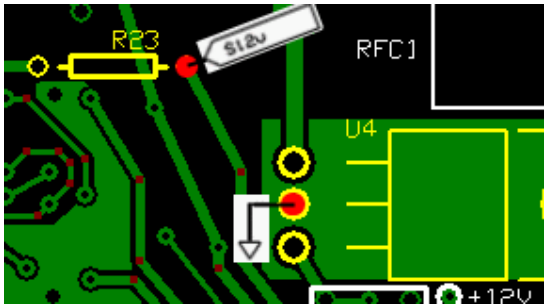
Wind and Install the RFC Choke

- RFC1 needs 4 turns (5") of #26 wire.
- Before winding, take a small drill bit and twirl it in the core holes to smooth/remove any burrs that might otherwise short the coil.
- Remember, when winding a binocular core like the BN-43-2402, each pass where the wire ends up at the same side where it started the pass counts as a turn.
- Use fine grit emery cloth to remove the enamel from the magnet wire up to within 1/8 inch of the core
- Mount the choke so that it lays horizontally flat in the designated space.

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	RFC1	23 uH		choke 4T #26	1	BN-43-2402 5"

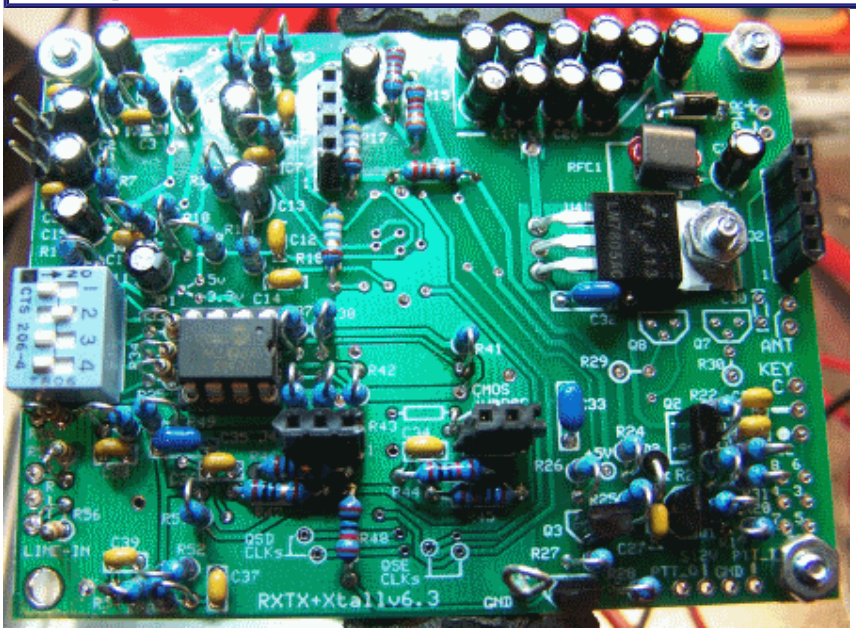
WC5MC TX LED Modification





Charles, WC5MC has a nifty little mod (see his documentation) which adds an LED indicator that lights up when power is applied to the PA/Filter (i.e., the rig's PTT-I goes high and enables the TX mode). It involved dead-bugging a 20 k resistor and an LED between the S12V line and circuit ground.

Completed Board



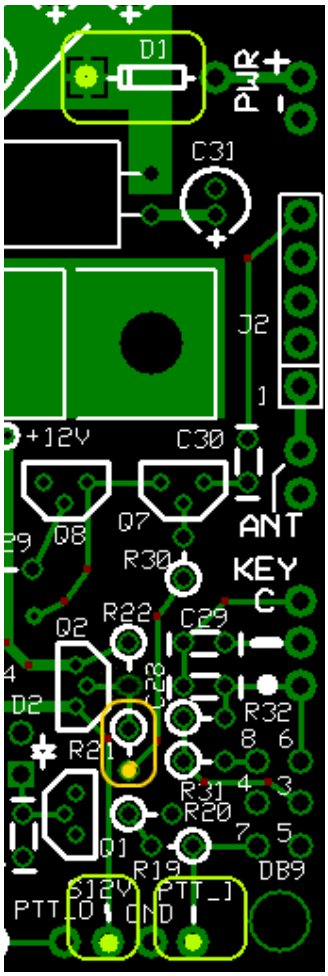
Testing

Current Limited Power Test

- **Connect a 100 ohm resistor in series with the power line and apply 12 V dc power**
- **the current should be less than 120 mA**
- **Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.**
- **A voltage of around 2 V dc indicates the power rails are not shorted**
- **Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.**

Current Draw

- **Without current limiting resistor you should see < 103 mA**
- **Your Measurement: _____**



Switching

- **Before powering up, attach a clip lead between the left-hand (cathode) lead of D1 and the "PTT-I" (this sets PTT_IN = 12 Vdc, ON)**

  Be careful. Do not apply 12Vdc to the terminal marked "PTT-O" - it causes chips to fry!

- **Apply power**
  - **Measure the voltage at the S12V pad. You should get a high signal (e.g., 10-12 Vdc). Your measurement: _____**
  - **Measure the voltage at R21 hairpin (/PTT-I). This should get a low signal, ~0 Vdc. Your Measurement: _____**
- **Unclip the lead at the D1 cathode (this sets PTT OFF)**
  - **Measure the voltage at the S12V pad again. You should get a low signal, ~0 Vdc. Your Measurement: _____**

- **Measure the voltage at R21 hairpin (/PTT-I). This should get a high signal, well above 0 Vdc (e.g., 10-12 Vdc).**
  Your Measurement: _____

RFC1 Continuity Test

- **Apply power to the board**
- **Measure the voltage wrt ground at Pin 4 of J2 (this is the lower end of the RF Choke**
- **You should get the value that is on the 12 Vdc rail (author's rail = ~11.07 Vdc).**
  Your Measurement: _____
- **If you do not get the expected value, this may be an indication that the RFC's leads were not properly soldered.**

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - RX Antenna Switching Circuit

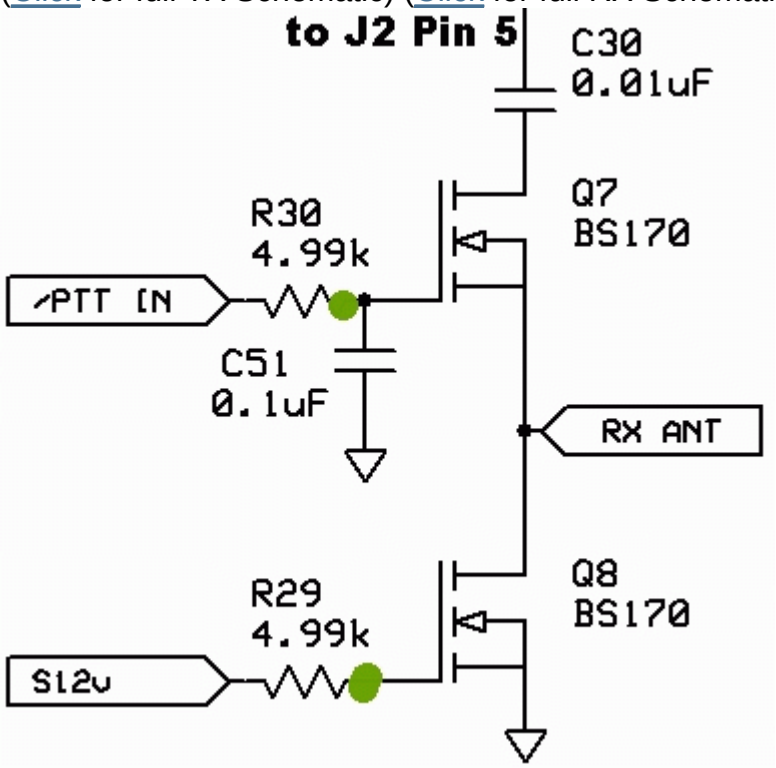
Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

This stage handles the muting of the RX section when I PTT goes high. When RX Mute is High, the RX Mixer is disabled; when RX Mute goes low (the normal power up value), the RX Mixer is enabled. The circuit also handles the switching of the antenna path from the PAF board, via J2 Pin 5 into the RX through the two FETs (Q7 and Q8)

Schematic

(Click for full TX Schematic) (Click for full RX Schematic)



Summary Build Notes

- Install Ceramic cap C30
- Install Resistors R29-R30

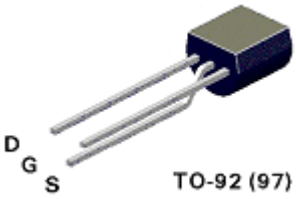
- Install Q7 and Q8
- Test the Stage

Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C30	0.01 uF	103	ceramic	1	
[__]	R29	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	W-E
[__]	R30	4.99 k	yellow-white-white-brown-brown	Resistor 1%	1	S-N
[__]	Q7	BS170		TO-92 Transistor (N-Channel, FET)	1	
[__]	Q8	BS170		TO-92 Transistor (N-Channel, FET)	1	

Detailed Build Notes

- **Install C30, R29-R30, and Q7-Q8**



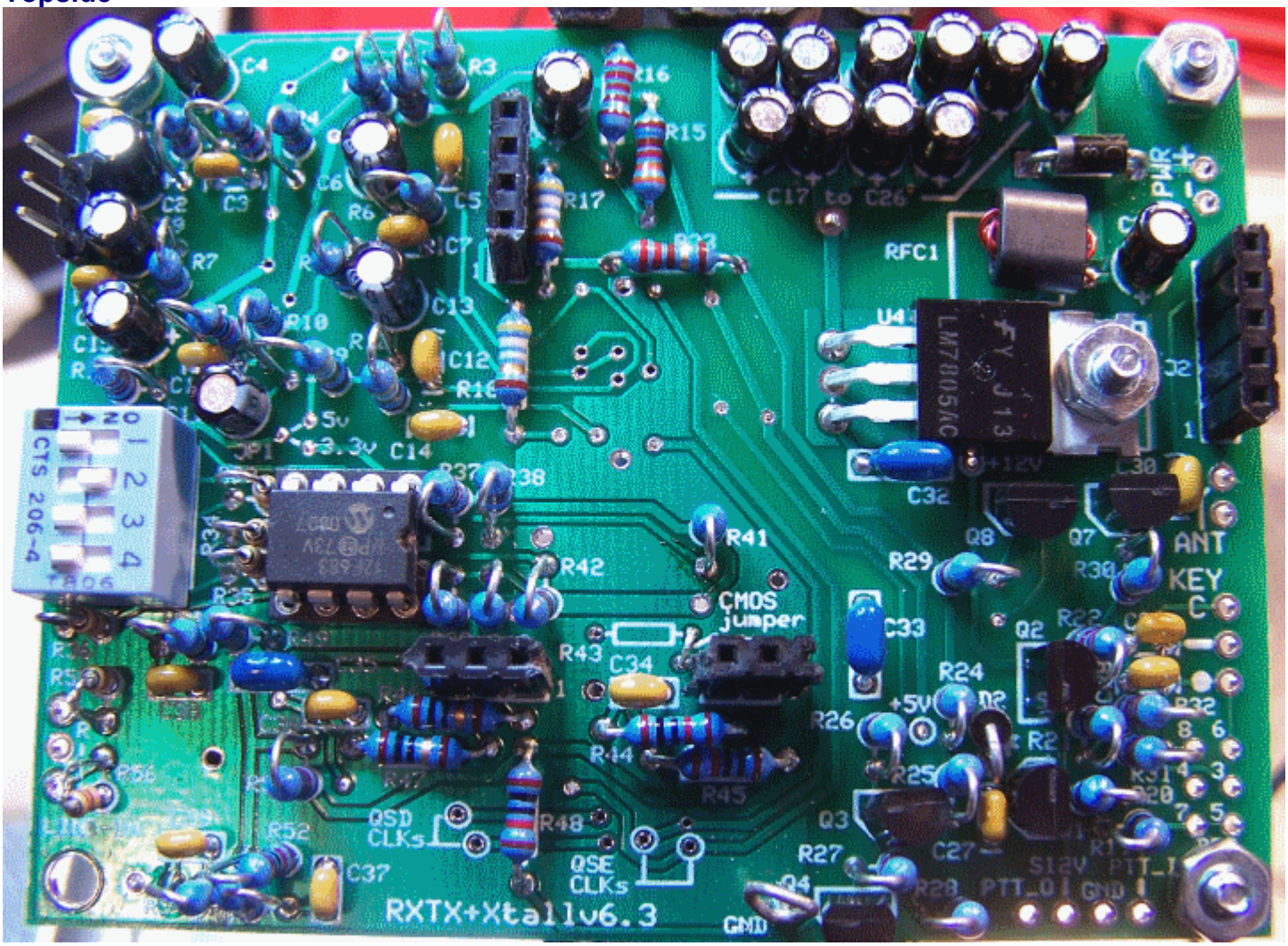
- **Exercise ESD precautions with the BS170 transistors**

Main Board Completed

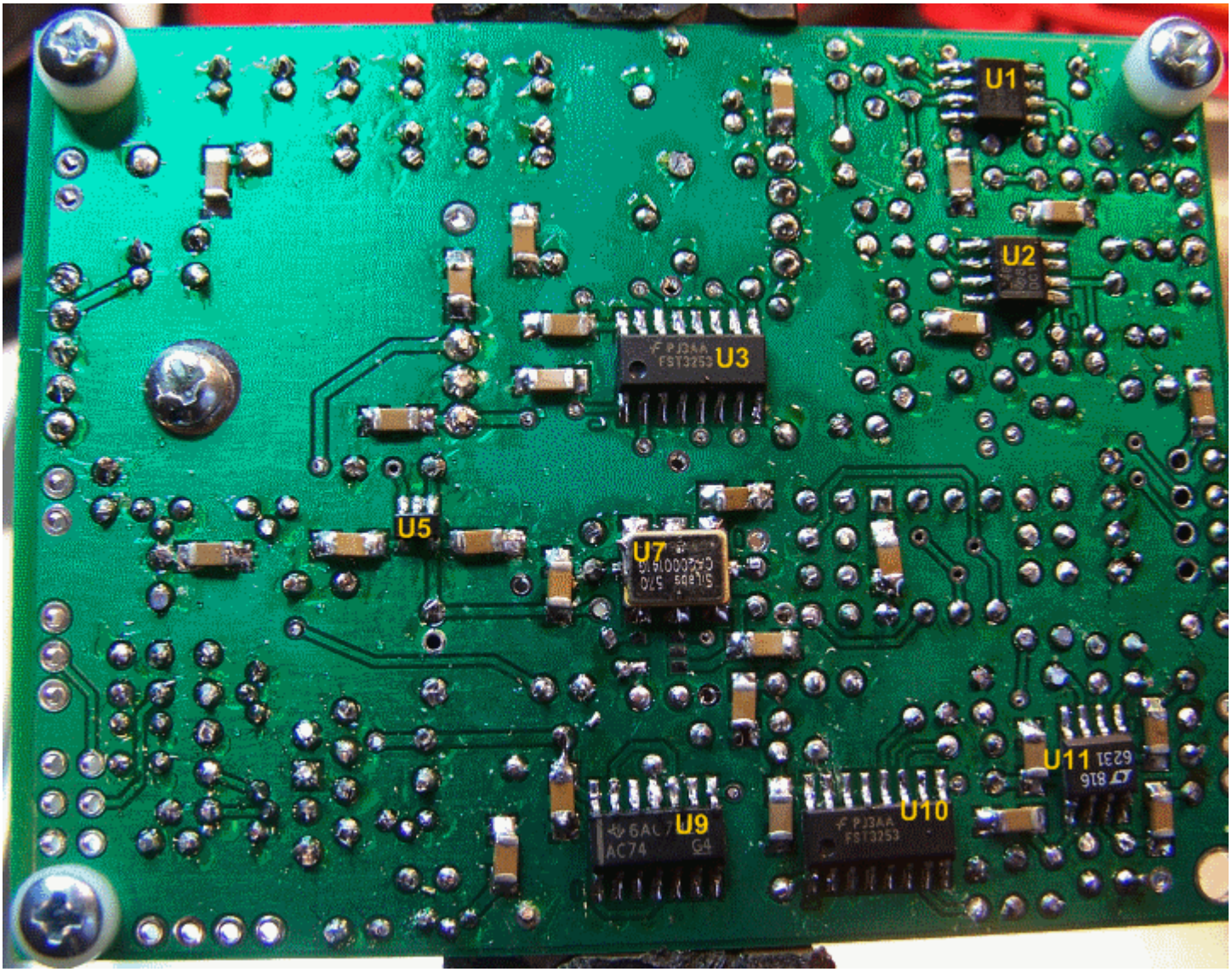
Congratulations. You have completed the main board assembly. Now it's on to the PAF board (we will use the 80/40m version) and those dreaded inductors!

By the way, if you notice you have one resistor left over out of the main board resistors, then it is OK (providing you were building the CMOS version). That left over resistor, in the CMOS version, is the 100 ohm R43 - omitted in the CMOS version.

Topside


C4
R3
C16
R15
C2
C3
C6
C5
R17
C17 to C26
PWR
R6
C7
RFC1
R7
C13
U4
LM7805AC
R10
C12
R16
J2
5v
3.3v
C14
CTS 206-4
C32
+12V
L38
R41
Q8
Q7
ANT
R42
R29
R30
KEY
CMOS
Jumper
C33
R43
C34
Q2
R24
+5V
D2
R26
R44
R45
R25
R32
R52
QSD
CLKs
R48
Q3
C37
QSE
CLKs
R27
C27
S12V
PTT_I
R28
PTT_O
GND
RXTX+Xtallv6.3
GND

Bottomside



Testing

Current Limited Power Test

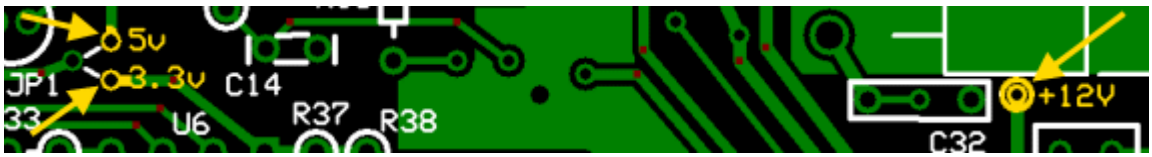
- Connect a 100 ohm resistor in series with the power line and apply 12 V dc power
- the current should be relatively low (around 120 mA or less)
- Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.
- A voltage of around 2 V dc indicates the power rails are not shorted
- Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.

Current Draw

- current draw without limiting resistor should be < 105 mA

- **Your Measurement: _____**

Power Rail Resistances

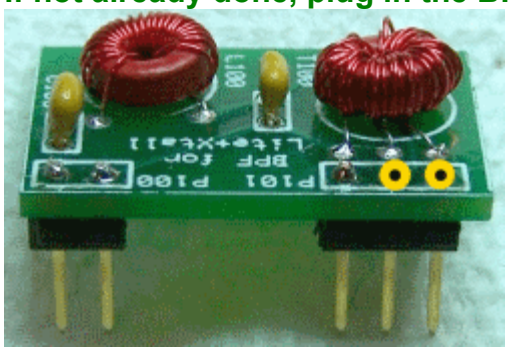


Set SW1 so that one of its dip switches is on (author used the 40m setting for 7.046 MHz, "0100"). Measure the resistance, WRT ground, of the three power rails:

- **+12 V testpoint should read quite high, in the meg ohms.**
  Author measured about 7 M ohm
  Your measurement: _____
- **+5 V testpoint should read about 950 ohms.**
  Author measured 949 ohms
  Your measurement: _____
- **+3.3 V testpoint should read 9 - 10 k ohms.**
  Author measured 9.2 kOhms
  Your measurement: _____
  This resistance value will vary, depending upon how many of the switches on SW1 are on. If none are on, the reading is ~100K. If more than one are on, the reading will be proportionately less.
  Thanks to Jim WA4YWM for adding this!

Resistance at BPF Transformer Secondary Winding

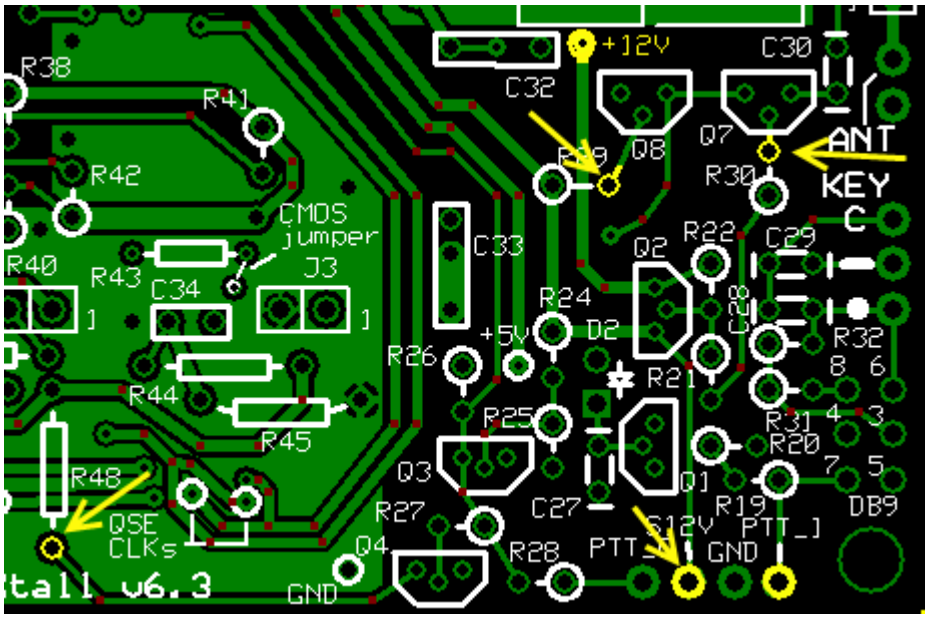
If not already done, plug in the BPF Board (following results were with 80/40 BPF)



Measure the resistance, WRT ground, of the secondary windings of T100-#:

- **Pin 2 of P101 should read abount 700-750 ohms.**
  Author measured 740 ohm
  Your measurement: _____
- **Pin 3 of P101 should read abount 700-750 ohms.**
  Author measured 740 ohm
  Your measurement: _____

RX Muting and RX Antenna Switching



- **set PTT-I to high by connecting the PTT-I pad to the 12 V test point (or to the left-hand lead of D1) with a clip lead (as in PTT testing)**
  - **Measure the voltage WRT ground of the RX Mute signal at R48's bottom lead. You should get a high signal (~5 Vdc).**
    Your Measurement: _____
  - **Measure the voltage WRT ground at the S12V pad. You should get approximately 11 -12 Vdc.**
    Your Measurement: _____
  - **Measure the voltage WRT ground at the hairpin of R30 (gate of Q7). You should get ~0 V.**
    Your Measurement: _____
  - **Measure the voltage WRT ground at the hairpin of R29 (gate of Q8). You should get ~12 V.**
    Your Measurement: _____
- **set PTT-I to low by disconnecting the lead between PTT-I pad the 12 V source**
  - **Measure the voltage WRT ground of the RX Mute signal at R48's bottom lead. You should get a low signal (~50 mVdc).**
    Your Measurement: _____
  - **Measure the voltage WRT ground at the S12V pad. You should get ~0 Vdc.**
    Your Measurement: _____
  - **Measure the voltage WRT ground at the hairpin of R30 (gate of Q7). You should get ~12 V.**
    Your Measurement: _____

- **Measure the voltage WRT ground at the hairpin of R29 (gate of Q8). You should get ~0 V.**
  Your Measurement: _____

RX Test in Rocky

An additional test is to run Rocky, feeding the Ring and Tip outputs to the Line In inputs of your PC's sound card.

At this stage, you can test the receiver part of the rig using your ham transmitter (or some other RF source)

- **Assuming you have built the 80/40 BPF board, plug it into the jacks (J3 and J4) on the mother board**
- **Tack solder a stereo cable for the ring, tip, and common audio output connections:**
- **Plug the other end of the stereo cable into your PCs STEREO input. Note: it MUST BE STEREO; most laptops, unfortunately, do not have a STEREO line-in jack and their MIC inputs are very often just MONO.**
- **Use clip leads to connect pin 1 to pin 5 on J2**
- **insert a small wire lead into the "ANT" terminal to pick up the signal**
- **If you already have not done so, download and install Rocky**
- **Run Rocky and click on the `View > Settings` menu**
- **In the "settings" menu, click on the "DSP" tab**
- **In the "DSP" tab's "Local Oscillator" section, click on the button marked "Single Band" and type in the desired center frequency (7046000). This sets Rocky's center frequency at 7.046 MHz.**
- **Click on the "Audio" Tab and select your sound card (if it is not already selected) in the "I/Q Input Device" dropdown box.**

- **Click on OK to close the "Settings" Menu**
- **Using your ham transceiver (or other signal source), transmit a low power RF signal (e.g. 7.059 MHz), injected at the ANT terminal**
- **Power up the board and click the `File > Start Radio` menu choice.**
- **You should see the Rocky spectrum display resembling the image above.**
- **If your signal source can sweep the frequency, observe Rocky's spectrum display as the generator sweeps through the "chunk" of bandwidth centered on the center frequency.**
- **If you get "mirror images" of the signal, instead of the expected results, check out the image rejection troubleshooting hints.**

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - PA Filter Plug-In (s)

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

This is the final (no pun intended) stage of the build, where the output signal from the Mixer (QSE) stage is amplified and delivered to the antenna. When you have completed this stage, you are ready to set up the radio for actual tranceiving use.

This is the largest and most complicated stage in the entire build. Because of this, there are several intra-build test activities to complete during the build, mostly checking for correct installation of the inductors

There are some tricky maneuvers in this stage, including, but not limited to, the following gotchas (using the 80/40m PAF board as an example):

- Six inductors to wind and install (including the 34 (plus 2x17)turn T200 and the 33 turn L200-2)
- Two binocular inductors to wind and mount that have been the source of many problems
- Some careful bending of the leads of and mounting of Q201, Q202, and Q203
- Installing the heat sinks on the three transistor array and the Q200 (2N2222)
- installing some resistors (flat) that must be carefully placed so as not to interfere with the placement of Q200 and its heat sink

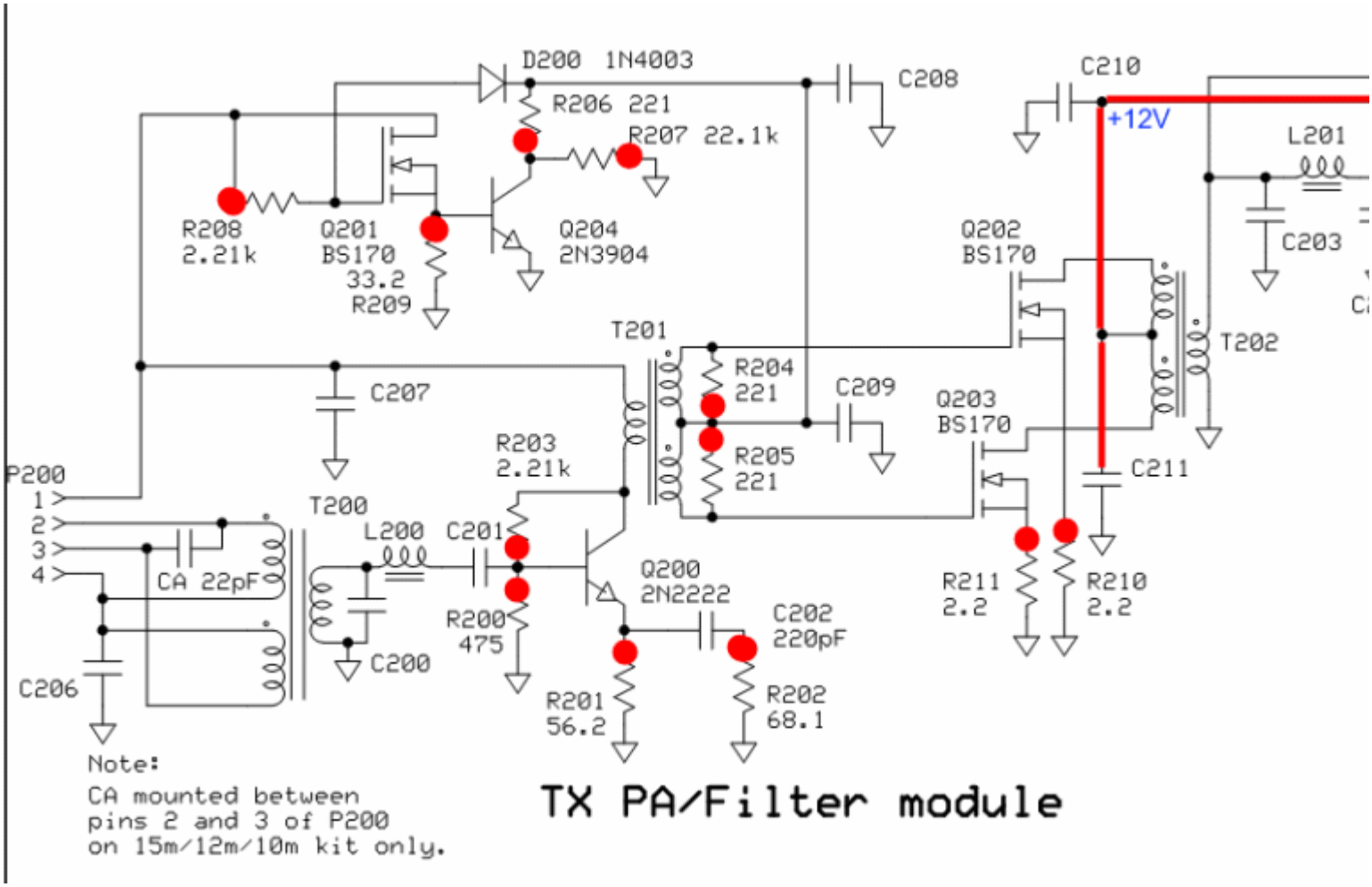
The build instructions for this main PAF stage use the BOM values for the 80/40m PAF, which the author built as part of this documentation. If you are building a PAF board for a different band(s), you should refer to the Bill of Materials for that other band(s) and substitute their values herein.

The other bands' BOMs are:

- BF/PAF-1: the 160 m band
- BF/PAF-3: the 30/20/17 m band
- BF/PAF-4: the 15/12/10 m band

Schematic

(Click for full TX Schematic)



Summary Build Notes

- Install all SMT caps (all are 0.1 uF). Test for shorts
- Install flat components:R200, R201, R203, R210, R211; D200
- Install Q201-Q203 and heat sink stack
- Wind and Install, in order, T201, T202, T200, L200, L201, L202. Continuity test windings and solder joints
- Install ceramic cap C202 and band-specific ceramic caps (C200, C201, C203-C205)
- Install Resistors R204-R209 and band-specific resistor (R202)
- Install Q204 and Q200 (with nylon washer and heat sink)
- If operation is planned for 80 or 30m, you must build and use the additional external Low-pass filter for the appropriate band
- Note: Capacitor Ca (22 pF) is only applicable to the 15/12/10 m PAF board.

- Test the Stage

Bill of Materials

This stage's BOM is limited to a single PAF board, the 80/40m board (PAF-2).

There are additional bills of material for the other PAF boards:

- BF/PAF-1: the 160 m band
- BF/PAF-3: the 30/20/17 m band
- BF/PAF-4: the 15/12/10 m band

Bill of materials for 80/40m PA/Filter

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	C206-2	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-2	PAF-2
[___]	C207-2	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-2	PAF-2
[___]	C208-2	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-2	PAF-2
[___]	C209-2	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-2	PAF-2
[___]	C210-2	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-2	PAF-2
[___]	C211-2	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-2	PAF-2
[___]	C200-2	220 pF	221	ceramic	1	PAF-2	PAF-2
[___]	C201-2	220 pF	221	ceramic	1	PAF-2	PAF-2
[___]	C202-2	omit 80/40 (rev 11/10/2008)	221	ceramic	1	PAF-2	PAF-2
[___]	C203-2	470 pF	471	ceramic	1	PAF-2	PAF-2
[___]	C205-2	470 pF	471	ceramic	1	PAF-2	PAF-2
[___]	C204-2	820 pF	821	ceramic	1	PAF-2	PAF-2
[___]	P200-2	4-pin header		connector (male)	1	PAF-2	PAF-2
[___]	P201-2	5-pin header		connector (male)	1	PAF-2	PAF-2
[___]	BN-43-2402	BN-43-2402 core	BN-43-2402	binocular core	2		PAF-2
[___]	T30-2 (red)	T30-2 (red)	red	toroid core	2		PAF-2
[___]	T37-2 (red)	T37-2 (red)	red	toroid core	2		PAF-2

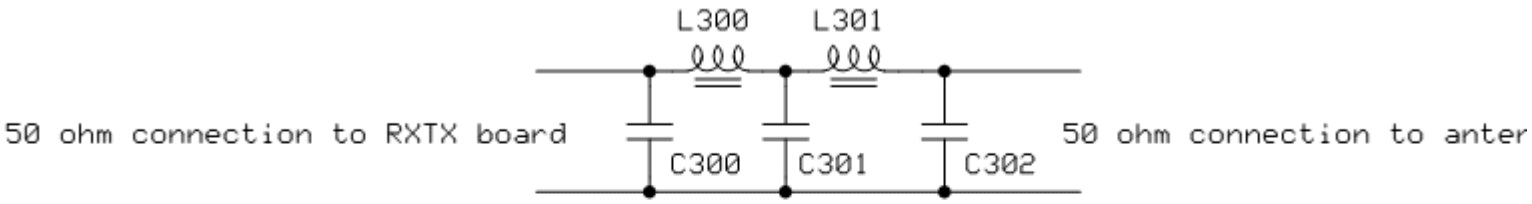
[___]	#4 nylon	#4 nylon washer		hardware	1	for Q200	PAF-2
[___]	#6 lock washer	#6 lock washer		hardware	1	1 for each PAF board	PAF-2
[___]	4 pin header	4 pin header		hardware	1	1 for each PAF board	PAF-2
[___]	5 pin header	5 pin header		hardware	1	1 for each PAF board	PAF-2
[___]	6-32 1/2"	6-32 1/2" machine screw		hardware	1	1 for each PAF board	PAF-2
[___]	6-32 nut	6-32 hex nut		hardware	1	1 for each PAF board	PAF-2
[___]	PAF-2	PA/Filter Board		RXTX V6.3 PA/Filter Board	1	PAF-2 80/40m	PAF-2
[___]	TO220 Silpad	Silpad for TO220 heat sink		hardware	1	1 for each PAF board	PAF-2
[___]	TO18 Heat sink	TO18 Heat sink for Q200		hardware	1	1 for each PAF board	PAF-2
[___]	TO220 Heatsink	TO220 Heatsink for Q201-203		hardware	1	1 for each PAF board	PAF-2
[___]	R210-2	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-2
[___]	R211-2	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-2
[___]	R209-2	33.2	orange-orange-red-gold-brown	Resistor 1%	1	N-S	PAF-2
[___]	R201-2	56.2	green-blue-red-gold-brown	Resistor 1%	1	FlatH	PAF-2
[___]	R204-2	221	red-red-brown-black-brown	Resistor 1%	1	E-W	PAF-2
[___]	R205-2	221	red-red-brown-black-brown	Resistor 1%	1	E-W	PAF-2
[___]	R206-2	221	red-red-brown-black-brown	Resistor 1%	1	N-S	PAF-2
[___]	R200-2	475	yellow-violet-green	Resistor 1%	1	FlatH	PAF-2

			-black-brown				
[___]	R203-2	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	FlatV	PAF-2
[___]	R208-2	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	S-N	PAF-2
[___]	R207-2	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S	PAF-2
[___]	R202-2	omit 80/40	blue-grey-brown-gold-brown	Resistor 1%	0	S-N (Omit for 80/40m)	PAF-2
[___]	D200-2	1N4003		Diode	1	FlatV	PAF-2
[___]	Q200-2	2N2222A		Transistor (NPN) TO-18 can	1	PAF-2	PAF-2
[___]	Q204-2	2N3904		Transistor (NPN) TO-92	1	PAF-2	PAF-2
[___]	Q201-2	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-2	PAF-2
[___]	Q202-2	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-2	PAF-2
[___]	Q203-2	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-2	PAF-2

Special External Low Pass Filter for 80m Operation

If you plan to transmit on 80m (or 30m if you are building the 30.20.17m board), you will need to build the external 80m LowPass filter to connect between the board and your antenna. The schematic and BOM are listed below:

Schematic



	C300	C301	C302	L300 and L301
80m	390pF	1000pF	390pF	2.5uH,25T #26, (15 in.), T37-2 core
30m	100pF	330pF	100pF	0.97uH,18T #26, (12 in.), T37-6 core

Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C300-2	390 pF	391	ceramic	1	BPF-80/40
[__]	C301-2	1000 pF	102	ceramic	1	BPF-80/40
[__]	C302-2	390 pF	391	ceramic	1	BPF-80/40
[__]	L300-2	2.5 uH	red	T37-2 (red) #26	1	25 T #26 (15")
[__]	L301-2	2.5 uH	red	T37-2 (red) #26	1	25 T #26 (15")

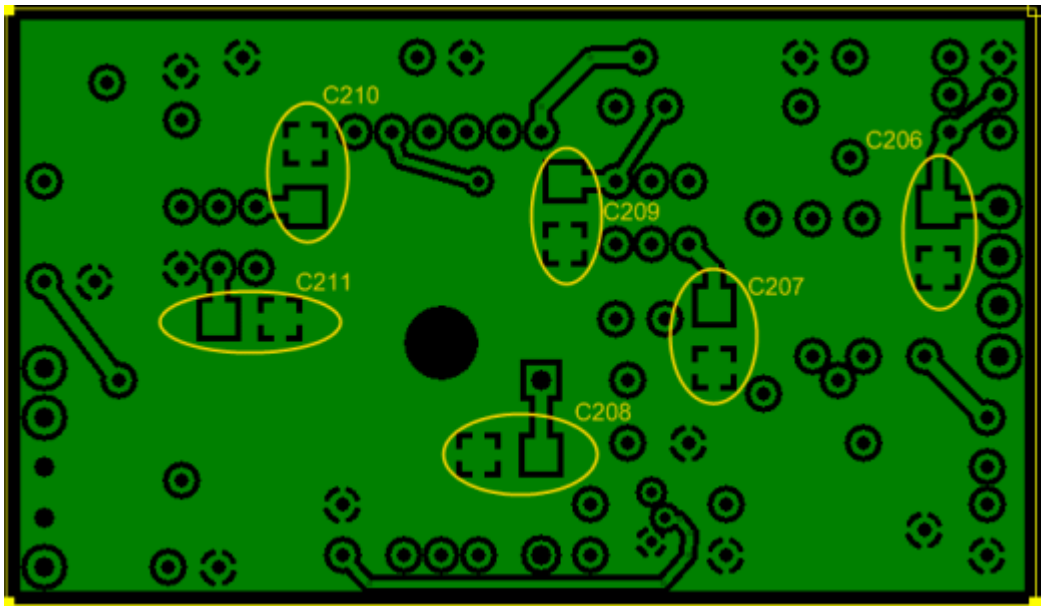
Detailed Build Notes

The build instructions for this main PAF stage use the BOM values for the 80/40m PAF, which the author built as part of this documentation. If you are building a PAF board for a different band(s), you should refer to the Bill of Materials for that other band(s) and substitute their values herein.

The other bands' BOMs are:

- **BF/PAF-1: the 160 m band**
- **BF/PAF-3: the 30/20/17 m band**
- **BF/PAF-4: the 15/12/10 m band**

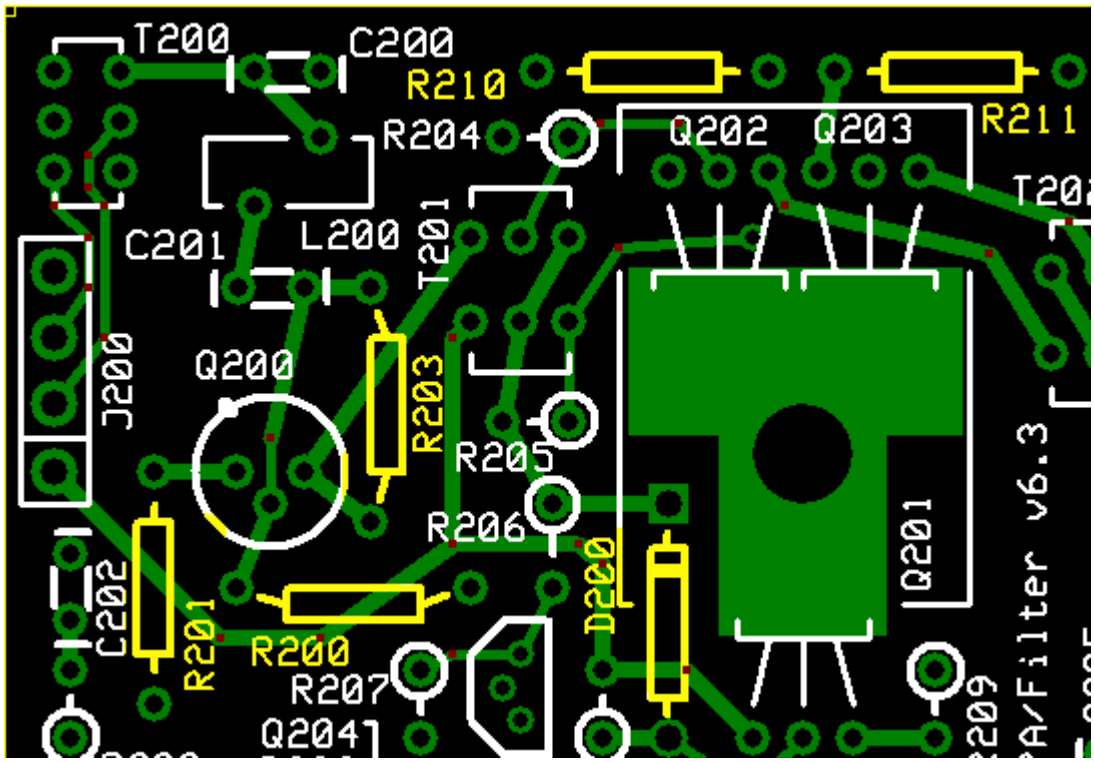
Install SMT Capacitors



All 6 are 0.1 uF 1206 caps found in the strip with the black stripe drawn on it.

After installing the six SMT caps, check each cap to ensure no shorts to ground exist across the cap.

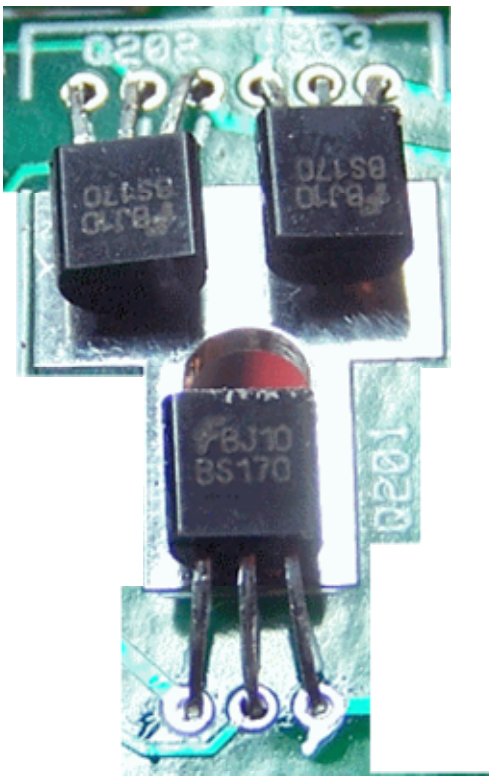
Install the Flat Orientation Resistors and diodes



Take care to not encroach upon the space required for mounting Q200

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	R210-2	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH
[__]	R211-2	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH
[__]	R201-2	56.2	green-blue-red-gold-brown	Resistor 1%	1	FlatH
[__]	R200-2	475	yellow-violet-green-black-brown	Resistor 1%	1	FlatH
[__]	R203-2	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	FlatV
[__]	D200-2	1N4003		Diode	1	FlatV

FET Transistor/Heatsink Stack



- Transistors Q201, Q202 and Q203 are mounted with their flat side facing upward so that the entire flat side of each transistor will be under an aluminum TO220 heat sink.
  - Bend the leads of Q201, Q202 and Q203 at right angles away from the flat side of each transistor at a distance from the plastic body of each transistor so that its case end is very close to the heat sink mounting hole in the board.
  - When a transistor is properly placed solder one of its leads from the top side of the board to tack the transistor in position.

    Remember, just tack 1 lead of each FET

Inductors

- **After Q201, Q202 and Q203 are tacked in place with their flat sides facing upward, mount the heat sink with the Sil-Pad between the flat sides of the transistors and the bottom surface of the heat sink.**
- **The heat sink stack up should be as follows: from the bottom of the circuit board:**

1.
    1. **the ½ inch long 6-32 Phillips machine screw,**
    2. **the circuit board,**
    3. **the transistors with flat faces upward,**
    4. **the TO220 Sil-Pad,**
    5. **the TO220 heat sink with fins upward,**
    6. **the #6 star washer,**
    7. **and the 6-32 hex nut.**

- **Tighten the 6-32 hardware carefully to firmly compress the stack while holding the heat sink in alignment with the rectangular markings on the circuit board. Be careful that the tightening of the #6 hardware does not cause a twisting motion of the transistors.**
- **When the transistors are firmly clamped between the board and heat sink with good alignment, complete the soldering of the transistor leads and trim the lead flush to the bottom of the board.**

Winding Inductors

To learn how to wind coils and transformers, please read the tips from the experts and The Common Construction Techniques Guidelines. Then view the excellent videos on KC0WOXs Website to solidify your understanding of the task.

This inductors section contains a number of in-line tests to validate the integrity of the windings and the solder joints on the leads after mounting.

Each PAF board uses different toroid and binocular core types. The toroidal core types for the different PAF boards are shown in the following table:

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	T37-2 (red)	T37-2 (red)	red	toroid core	4		PAF-1
[___]	T30-2 (red)	T30-2 (red)	red	toroid core	2		PAF-2
[___]	T37-2 (red)	T37-2 (red)	red	toroid core	2		PAF-2
[___]	T30-6 (yellow)	T30-6 (yellow)	yellow	toroid core	2		PAF-3
[___]	T37-6 (yellow)	T37-6 (yellow)	yellow	toroid core	2		PAF-3
[___]	T30-6 (yellow)	T30-6 (yellow)	yellow	toroid core	2		PAF-4
[___]	T37-6 (yellow)	T37-6 (yellow)	yellow	toroid core	2		PAF-4

The binocular core types for the different boards are shown in the following table:

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit

.	BN-43-2402	BN-43-2402 core		binocular core	2		PAF-1
.	BN-43-2402	BN-43-2402 core		binocular core	2		PAF-2
.	BN-**61**-2402	BN-61-2402 core		binocular core	2		PAF-3
.	BN-**61**-2402	BN-61-2402 core		binocular core	2		PAF-4

Turn counts: remember that, for a toroid core, each pass through the center counts as a turn.

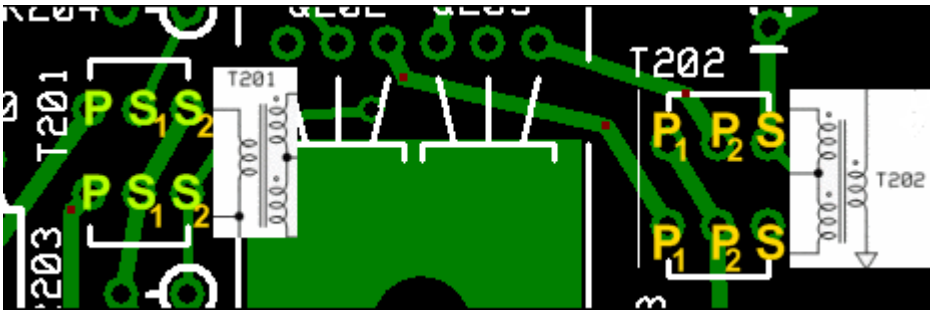
For a binocular core, each pass where the wire ends up at the same side where it started the pass counts as a turn.

Transformers will have either one primary and two secondaries or two primaries and one secondary. When mounting a transformer to the board, feed the wires into the holes as they are marked in the picture below

Install P200 and P201

If you have not already done so, mount the header pins for P200 and P201 with the long pins facing out from the underside of the board.

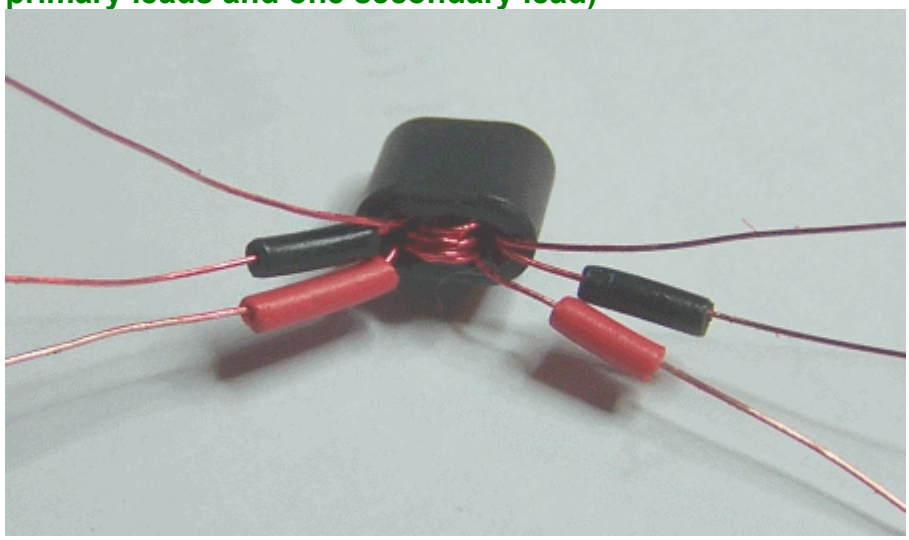
T201 and T202



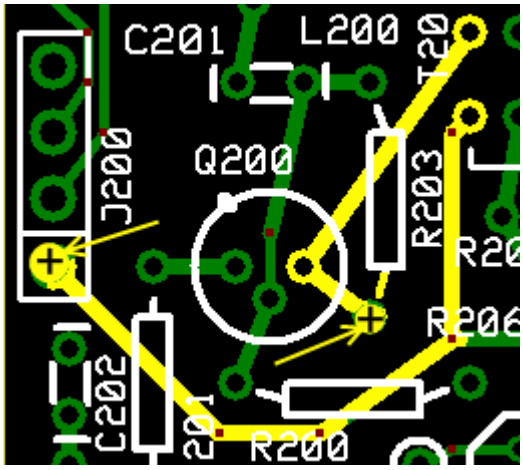
T201

Circuit Designation	Component	(Color) Code	Type	Windings
PAF-1 T201-1			**BN-43-2402**	**primary 6T of #30 (10 in.); secondaries 3T bifilar of #30 (2x 5 in.)**
PAF-2 T201-2			**BN-43-2402**	**primary 6T of #30 (10 in.); secondaries 3T bifilar of #30 (2x 5 in.)**
PAF-3 T201-3			**BN-61-2402**	**primary 6T of #30 (10 in.); secondaries 3T bifilar of #30 (2x 5 in.)**
PAF-4 T201-4			**BN-61-2402**	**primary 5T of #30 (10 in.); secondaries 3T bifilar of #30 (2x 5 in.)**

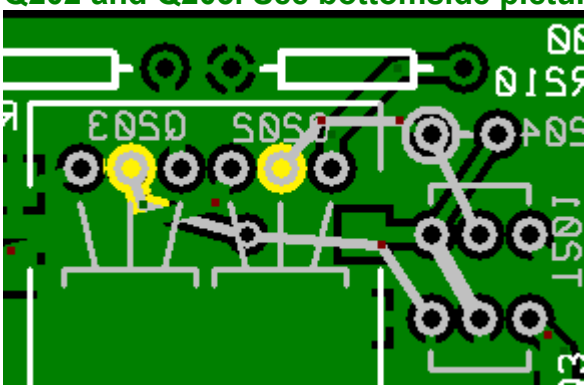
- **T201 (Binocular core): Wind and mount T201 using #30 wire.**
- **Exercise care in winding the binocular cores to direct the wire into each core hole so that the hard material of the core does not scrape off portions of the wire's enamel insulation. (It may be advisable to lightly spin with one's fingers a small drill bit in each of the binocular core hole openings to remove sharp edges that may cut through the enamel insulation of a wire.)**
  - **Be sure to use the correct type of binocular core (refer to table above for core type, number of turns, and wire length)**
  - **Note the mounting hole pattern on the circuit board for T201 and plan the direction of core winding to provide the best orientation of each inductor lead. The leads from the binocular core should be such that each side (hole) of the core has 3 leads coming out: one primary lead and 2 secondary leads(or 2 primary leads and one secondary lead)**



  - **Wind the primary first, then the bifilar secondaries.**
  - **(A small sewing needle has been proven to be a great aid in winding these binocular cores, however, you should take great care to keep the needle from removing any insulation on the wires in the windings)**
  - **Before mounting, test to ensure there are no shorts between the primary and secondary windings.**



- **Once mounted, test the primary winding continuity between J200 pin 1 and the bottom lead of R203**
- **Test the secondary windings' continuity between the gate pins of Q202 and Q203. See bottomside picture below:**



- **Ensure the primary winding is isolated from the secondary by checking the resistance between Pin 1 of P200 and the gate of Q203. You should see at least 20 k Ohm if the windings are OK. Zero ohms would indicate the windings are shorted together.**

T202

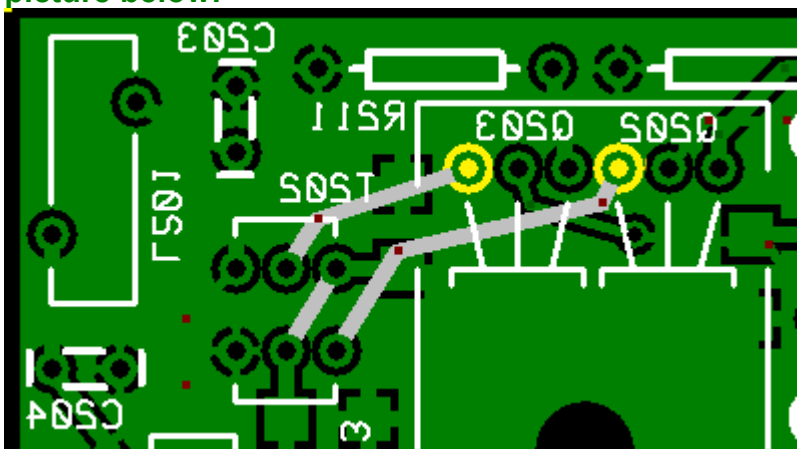
Circuit Designation	Component	(Color) Code	Type	Windings
PAF-1 T202-1			BN-43-2402	primaries 4T bifilar of #30 (2x 6 in.); secondary 5T of #30 (9 in.)
PAF-2 T202-2			BN-43-2402	primaries 4T bifilar of #30 (2x 6 in.); secondary 5T of #30 (9 in.)
PAF-3 T202-3			BN-61-2402	primaries 4T bifilar of #30 (2x 6 in.);

					secondary 5T of #30 (9 in.)
PAF-4	T202-4			BN-61 -2402	primaries 3T bifilar of #30 (2x 6 in.); secondary 5T of #30 (9 in.)

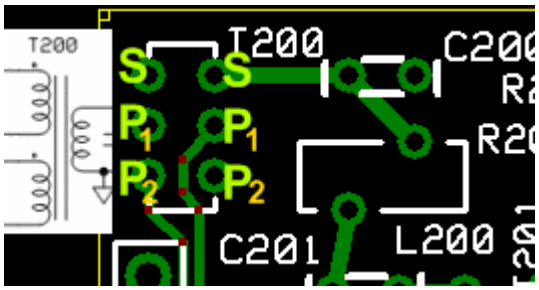
- T202 (Binocular core): Wind and mount T202 using #30 wire.
  - Wind the secondary first, then the bifilar primaries.
  - (A small sewing needle has been proven to be a great aid in winding these binocular cores, however, you should take great care to keep the needle from removing any insulation on the wires in the windings
  - Be sure to use the correct type of binocular core (refer to table above for core tyBe sure to use the correct type of binocular core (refer to table above for core type, number of turns, and wire length)
- Note the mounting hole pattern on the circuit board for T202 and plan the direction of core winding to provide the best orientation of each inductor lead.
- Before mounting, test to ensure there are no shorts between the primary and secondary windings.
- Test the primary leads by checking for continuity between P201 Pin 5 and P201 Pin 3 (ground).
- Validate that the primary windings are isolated from the secondary winding by checking the resistance between pins 4 and 5 of P201. You should see at least 20 k Ohm if the windings are OK. A zero ohm reading indicates a possible short between the windings

, calling for repairs to the transformer.

- Test the continuity of the two secondary windings - see bottomside picture below:



T200 and L200



T200

Circuit Designation	Component	(Color) Code	Type	Windings
PAF-1	T200-1	7.1 uH	red	T37-2 #30	primaries 21T bifilar #30 (2x 13in.); secondary 7.1 uH 42T #30 (24 in.)
PAF-2	T200-2	5.0 uH	red	T30-2 (red) #30	primaries 17T bifilar #30 (2x 10in.); secondary 5.0 uH 34T #30 (19 in.)
PAF-3	T200-3	1.74 uH	yellow	T30-6 #30	primaries 11T bifilar #30 (2x 8in.); secondary 1.74 uH 22T #30 (14 in.)
PAF-4	T200-4	0.81 uH	yellow	T30-6 #30	primaries 8T bifilar #30 (2x 6in.); secondary 0.81 uH 15T #30 (11 in.)

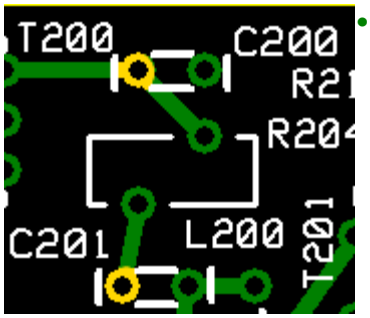
-
  - From the PAF kit, take the PAF board and plugs P201 and P202
  - Install the plugs to the bottom side of the PAF board with the short leads of each plug inserted into the holes and protruding from the bottom to the top and the long leads protuding from the bottom of the PAF board.
- T200: wind and mount T200
  - See table above for core type, number of turns, and wire length
  - Wind the secondary first (secondary winding uses #30 wire)
  - Then wind the primaries (primary windings are each bifilar using #30 wire)
  - Note the mounting hole pattern on the circuit board for T200 and plan the direction of core winding to provide the best orientation of each inductor lead.
  - A correctly wound T200 will have three leads coming out of each side of the core: two primary leads (the bifilar windings) and one secondary lead. The 3 leads on one side of the core should go into the corresponding "S" (secondary) and "P" holes in the left-hand column of holes for T200 in the picture above. The three leads from the other side should go into the corresponding holes in the right-hand column of holes for T200.

- After mounting, validate the soldering of the primaries leads by checking for continuity between pins 2 and 3 of P200.
- Validate the soldering of the secondary leads by checking for continuity between the left hole of C200 and ground.

L200

Circuit Designation	Component	(Color) Code	Type	Windings
PAF-1 L200-1	30 uH	red	T37-2 (red) #30	86 T #30 (46")
PAF-2 L200-2	4.7 uH	red	T30-2 (red) #30	33 T #30 (17")
PAF-3 L200-3	1.6 uH	yellow	T30-6 #30	21 #30 (14")
PAF-4 L200-4	2.1 uH	yellow	T30-6 #30	24 #30 (15")

- L200: wind and mount L200 using #30 wire
  - See table above for core type, number of turns, and wire length
  - If you are building the 160m kit, you may encounter problems trying to fit turns of #30 wire onto the Toroid.
  - If you run out of space, distribute the remaining turns over the top of the preceding turns.
- Note the mounting hole pattern on the circuit board for L200 and plan the direction of core winding to provide the best orientation of each inductor lead.

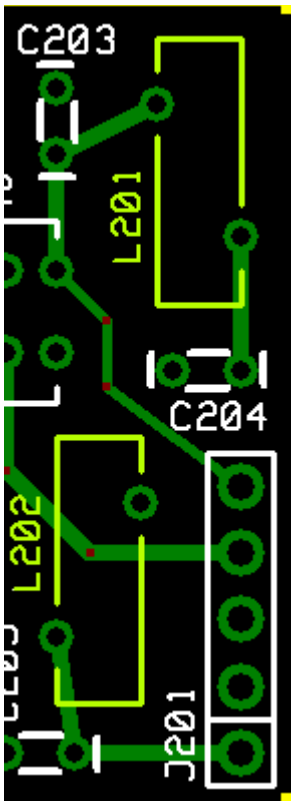


Test L200 continuity between the left lead points of C200 and C201

Inductors L201 and L202

L201 and L202 - both are identical

Circuit Designation	Component	(Color) Code	Type	Windings
PAF-1 L201-1	3.4 uH	red	T37-2 (red) #26	29 T #26 (17")
PAF-2 L201-2	1.4 uH	red	T37-2 (red) #26	19 T #26 (13")

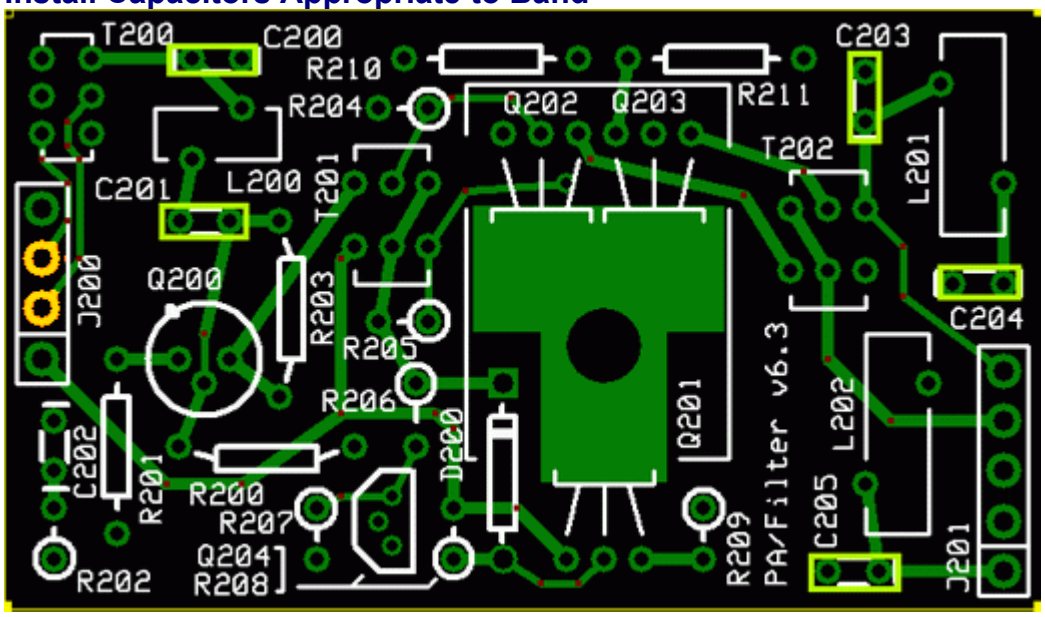


PAF-3	L201-3	.6 uH	yellow	T37-6 (yellow) #26	14T #26 (10")
PAF-4	L201-4	.36 uH	yellow	T37-6 (yellow) #26	11T #26 (9")

- L201 and L202 (toroid): wind and mount each coil using #26 wire
- See table above for core type, number of turns, and wire length
- Note the mounting hole pattern on the See table above for core type, number of turns, and wire length
- Note the mounting hole pattern on the circuit board for each inductor and plan the direction of core winding to provide the best orientation of each inductor lead.
- After installing both coils, test for continuity between P201 pin 1 and P201 Pin 2. This validates the soldering on L201, L202, and the secondary of T202.

Remaining Passive Components

Install Capacitors Appropriate to Band

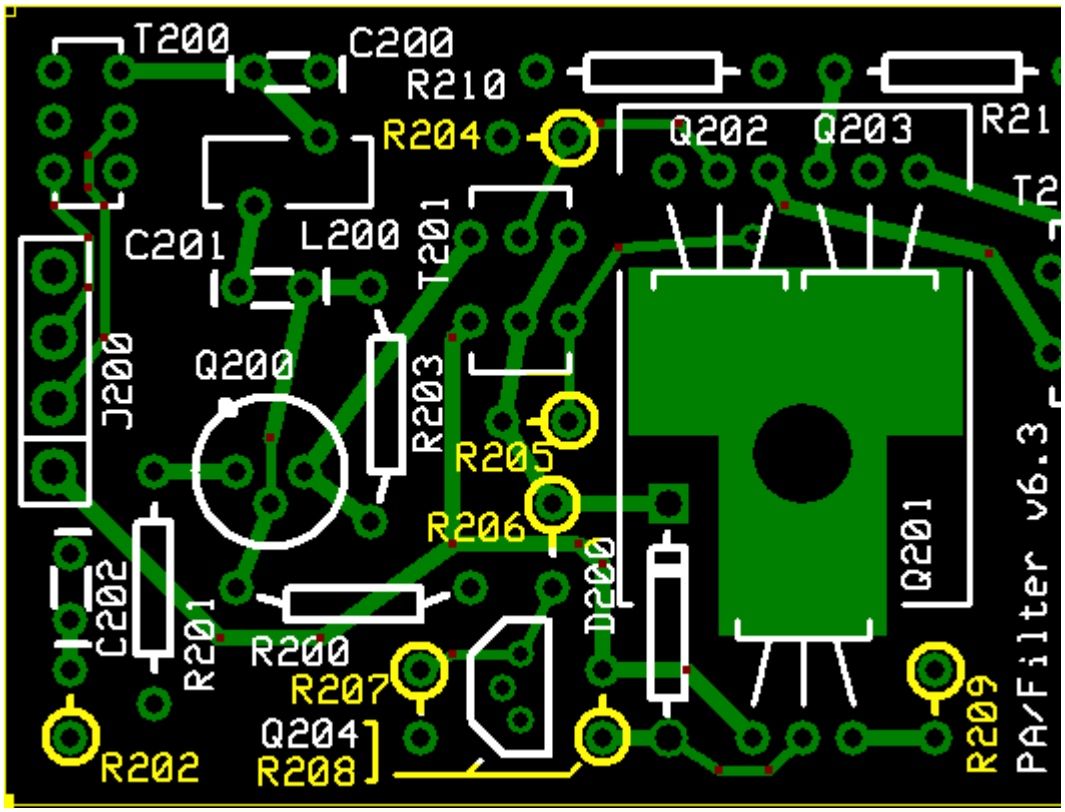


Bands	C200	C201	C203, C205	C204	C206 through C211
160m	1000pF	270pF	2200pF	4700pF	0.1uF size 1206
80m, 40m	220pF	220pF	470pF	820pF	0.1uF size 1206
30m, 20m, 17m	82pF	82pF	150pF	330pF	0.1uF size 1206
15m, 12m, 10m	47pF	22pF	100pF	180pF	0.01uF size 1206

- **Install the ceramic caps C200-C205 to topside (note: C202-# is ommitted for the 160 and 80/40 bands and is 220 pF for the higher bands. The other caps are band-specific - see chart, above)**
- **Note: the capacitor Ca (22 uF) is installed across the pins 2 and 3 of P200 for the 15_12_10 m board only.**

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	C200-2	see chart		ceramic	1	PAF-2	PAF-2
[___]	C201-2	see chart		ceramic	1	PAF-2	PAF-2
[___]	C202-2	omit for 80/40	221	ceramic	1	omit for PAF-2	PAF-2
[___]	C203-2	see chart		ceramic	1	PAF-2	PAF-2
[___]	C205-2	see chart		ceramic	1	PAF-2	PAF-2
[___]	C204-2	see chart		ceramic	1	PAF-2	PAF-2
[___]	CA-2	22 pF	22J	ceramic	1	(15-12-10m board only)	PAF-4

Install Hairpin Orientation Resistors



Bands	R202	R204, R205
160m	omit	221 1%
80m, 40m	omit	221 1%
30m, 20m, 17m	~~omit~~ USE	~~100~~ 221 1%
15m, 12m, 10m	use	~~220~~ 1% 221 1%

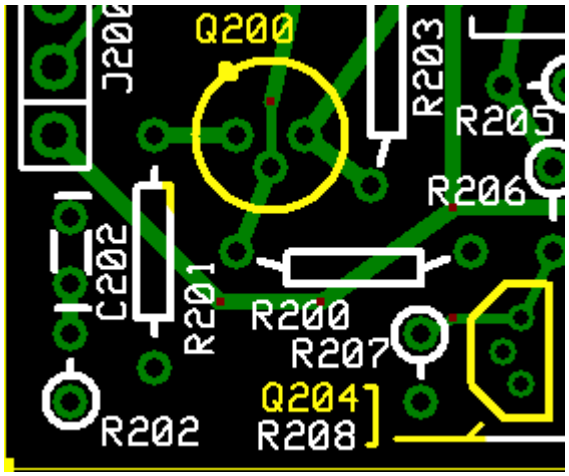
- **Most of the resistors are independent of the band**
- **R202, R204, and R205 are band-specific (see chart above: note, modified for 11/10/08 change)**
- **Note that R202 is only used in the 15/12/10 meter board (PAF-4)**

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	R209-2	33.2	orange-orange-red-gold-brown	Resistor 1%	1	N-S
[__]	R204-2	see chart		Resistor 1%	1	E-W
[__]	R205-2	see chart		Resistor 1%	1	E-W
[__]	R206-2	221	red-red-brown-black-brown	Resistor 1%	1	N-S
[__]	R208-2	2.21 k	red-red-brown-brown-brown	Resistor 1%	1	S-N

[__]	R207-2	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S
[__]	R202-2	see chart		Resistor 1%	0	S-N

Remaining Transistors

Transistors Q204 and Q200



- Install transistor Q204 (2N3904)
- Install driver transistor Q200 (2N2222A).

  Be sure to use the nylon washer in mounting this transistor. This is necessary in order to keep the metal case off of the board and avoid shorts between the leads of the transistor.

  - Press the TO-18 heat sink onto Q200 by placing the top of the heat sink (the wide, flat "hat") on a hard flat surface and then pressing uniformly on the lower rim of the transistor to fully insert it into the heat sink.
  - A *#4 nylon washer* is included in the kit as a spacer between the bottom of the transistor and the circuit board.
    - Slip the leads of the transistor through the nylon washer's hole
    - Snug the transistor to the circuit board.
  - Exercise care to make sure the emitter lead of Q200 by the metal tab on the transistor case goes to the hole closest to the silkscreen emitter mark on the circuit board.
  - solder the three leads

External Low-Pass Filters

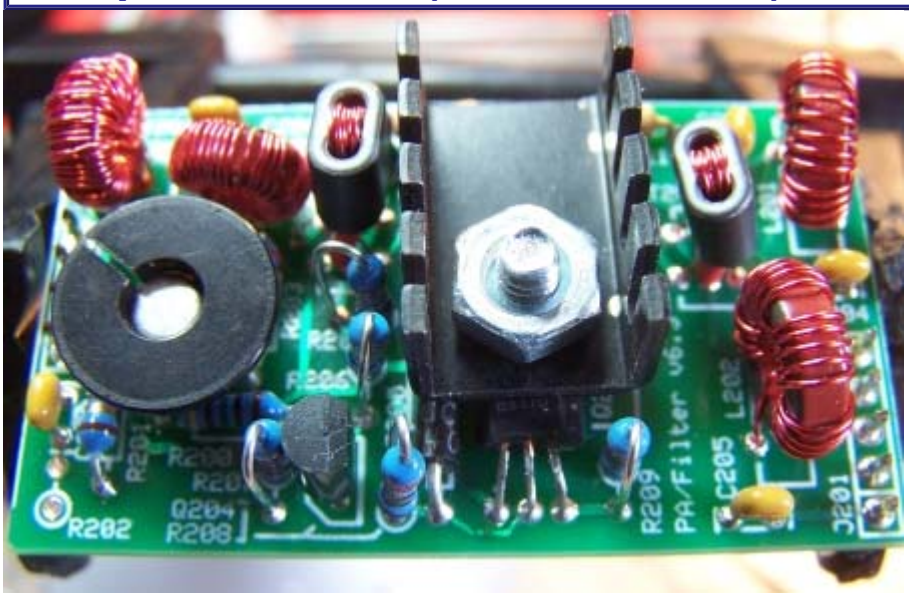
To satisfy fully the FCC regulations when using this transceiver for transmissions in the 80m or 30m bands, you must build and use between the RXTX board and the transmitting antenna an external low-pass filter.

The filter design and bill of materials are specified at the beginning of this page. (Change to design, 9-14-2008).

The 80m LP filter components are needed for 80m operation to have the 80m 2nd harmonic signal fully meet the FCC requirements. The components should be mounted external to the RXTX boards in the 50 ohm 80m antenna coax coming to the RXTX board.

If have the 80/40m PAF or the 30/20/17m PAF and you do not plan to operate in the 80m or in the 30m bands, then you do not need to build and install the outboard LPF.

Completed Board (PAF-2: 80/40m)



Testing

Power Rail Resistances

- **Plug the PAF board into Jacks J1/J2 and the BPF board into jacks J3/J4**
- **+12 V testpoint should be very high (> 1 M Ohm) WRT ground.**
  Your Measurement: _____

Current Limited Power Test

- **Connect a 100 ohm resistor in series with the power line and apply 12 V dc power**
- **the current should be less than 120 mA**
- **Measure the voltage WRT ground at the +5 V and at the 3.3 Vdc testpoints.**
- **A voltage of around 2 V dc indicates the power rails are not shorted**
- **Remove the current-limiting resistor. Subsequent tests in this stage are with the current-limiting resistor OUT of the circuit.**

Current Draw (Power drain)

- **without limiting resistor you should see < 100 mA.**
  Your Measurement: _____

PTT Current Draw

PTT input function may be verified by connecting PTT input line, (I PTT), to 12 volts. (Exercise care in connecting 12 volts to the PTT input line because a connection of 12 volts to the PTT output line, (PTT O), can damage U3.)

- **Before powering up, attach a clip lead between a 12 volt point[1] and the "PTT-I" (this sets PTT_IN = 12 Vdc, ON)**
  Be careful. Do not apply 12Vdc to the terminal marked "PTT-O" - it causes chips to fry!

- **Apply power**
- **Measure current draw (should be less than 200 mA (1.92 W)).**
  Your Measurement: _____

PA Standing Current

PA standing current is checked by connecting PTT-in to 12 volts and measuring the voltage across resistors R210 and R211. The DC voltage across each resistor should be 55 mVDC +/- 10mVDC.

- **Before powering up, attach a clip lead between a 12 V point[1] and the "PTT-I" (this sets PTT_IN = 12 Vdc, ON)**
  Be careful. Do not apply 12Vdc to the terminal marked "PTT-O" - it causes chips to fry!

- **Apply power**
- **Measure the dc voltage across R210 (nominal is ~55 mVdc +/- 10 mVdc).**
  Your Measurement: _____
- **Measure the dc voltage across R211 (nominal is ~55 mVdc +/- 10 mVdc).**
  Your Measurement: _____
- **Measure the dc voltage (forward bias) at the junction of R204 and R205 (nominal is ~2.2 Vdc).**
  Your Measurement: _____

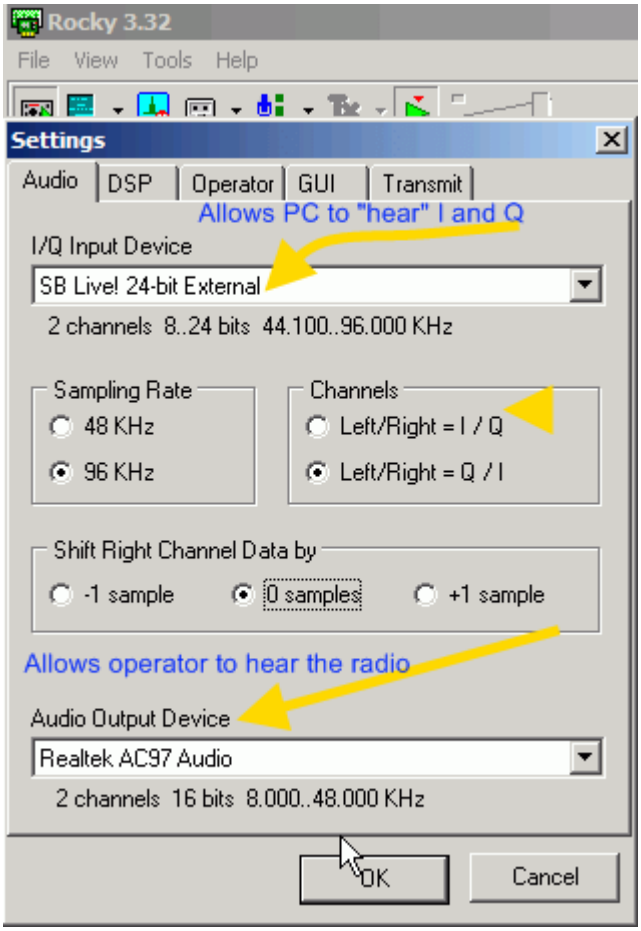
[1]12 volts can be obtained at the power in lead or at pin 4 P201

Receiver Test

This test will use the Rocky SDR program and will test the receiver with the local oscillator switch set to 0100 (center frequency of 7.046 MHz)

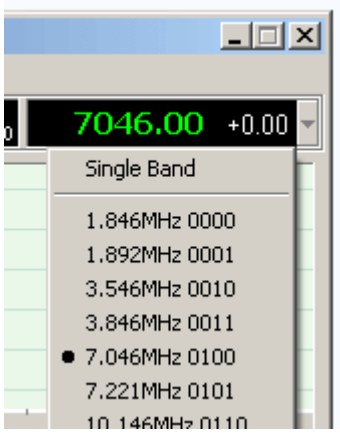
The RX antenna connection on the v6.3 board is through the TX LP filter. Thus an appropriate PA/Filter board needs to be plugged on top of the RXTX board, or if no PA/Filter board is plugged in, a jumper needs to be placed between pins 1 and 5 of J2 on the RXTX board.

- **Connect the line-in cable to a soundcard line-in jack (or Mic-In if no Line-In)**
- **Connect a 50 ohm antenna through a coaxial cable to the board**
- **plug in the proper BPF board (or short pins 1 and 5 of J2)**
- **Connect DC power to the board.**
- **Set up Rocky for receiving. In *view settings*, on the "Audio" tab:**
  - ***IQ Input Device*: select your sound card as the IQ Output Device**
  - ***sampling rate*: select your desired sampling rate**
  - ***Shift Right Channel Data by*: select the appropriate number of samples to shift the right channel (if you are not sure, start out with a shift of zero samples)**
  - ***Audio Output Device*select the sound card to be used for the human-audible output of the SDR**
  - **The example below shows the author's settings. It selects the Soundblaster Live 24 bit USB external soundcard for the IQ heavy lifting and the on-board soundcard for the audible results.**



- **If you have not already done so, set up Rocky's *.ini* file to program Rocky for the center frequencies corresponding to the settings of SW1.**

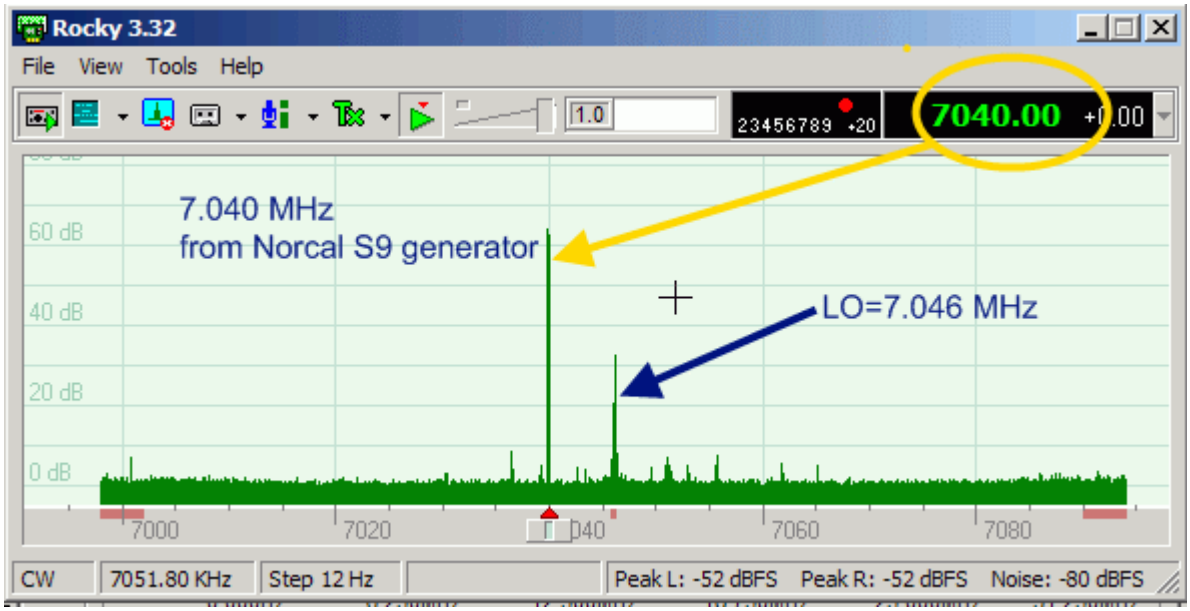
- **Start Rocky (*File/Start Radio*) and power up the board**
- **Select the desired center frequency (our example = 7.046 MHz)**



- **Connect the Antenna to a signal source and generate a signal at about 7.040 MHz:**
  - **(the author has used the Norcal S9 Signal Generator, which generates a 50 uV crystal-controlled signal at 7.040 MHz).**

- **You can use your transceiver as a signal source by loosely coupling the Softrock's antenna to the QRP output of the transceiver into a dummy load.**

- **You should see signals in Rocky's default spectrum view:**



- **In addition, you can loosely couple the antenna input to a signal generator and sweep the frequencies around the center frequency. In this instance, you should see the signal march across Rocky's spectrum display. It's actually pretty neat, even psychodelic, in a geeky sort of way.**
- **If you see an image that is a mirror image of the signal, refer to the image rejection hints on this site.**

RF Output

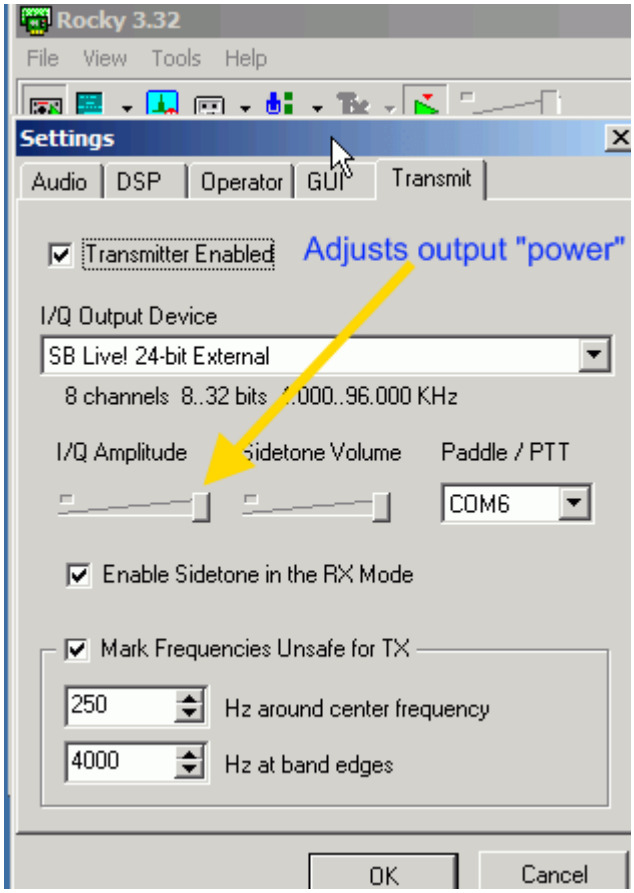
A quadrature audio source can be used for initial testing of the transmit function. Quadrature audio can be provided from a PC soundcard line-out if a program such as IQ GEN by DL6IAK or Rocky is installed on the PC.

Note: on the author's PC, IQ Gen was unable to produce the required 2.4 V p-p signals needed to drive the transmitter to its full 1 W output. However, it still serves as a means to produce an adjustable level of I and Q signals for initial tests.

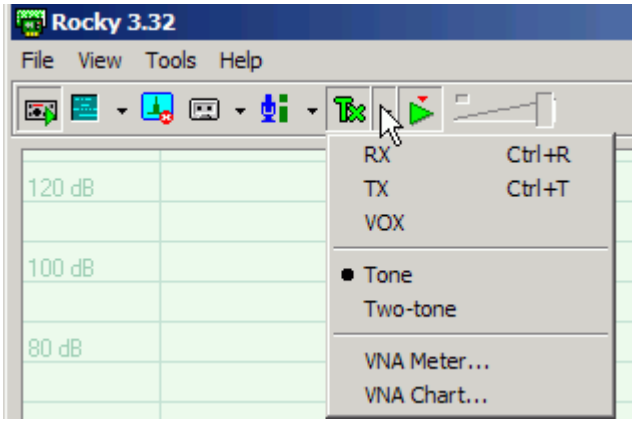
TX Output Test

PA Output Test - No Scope

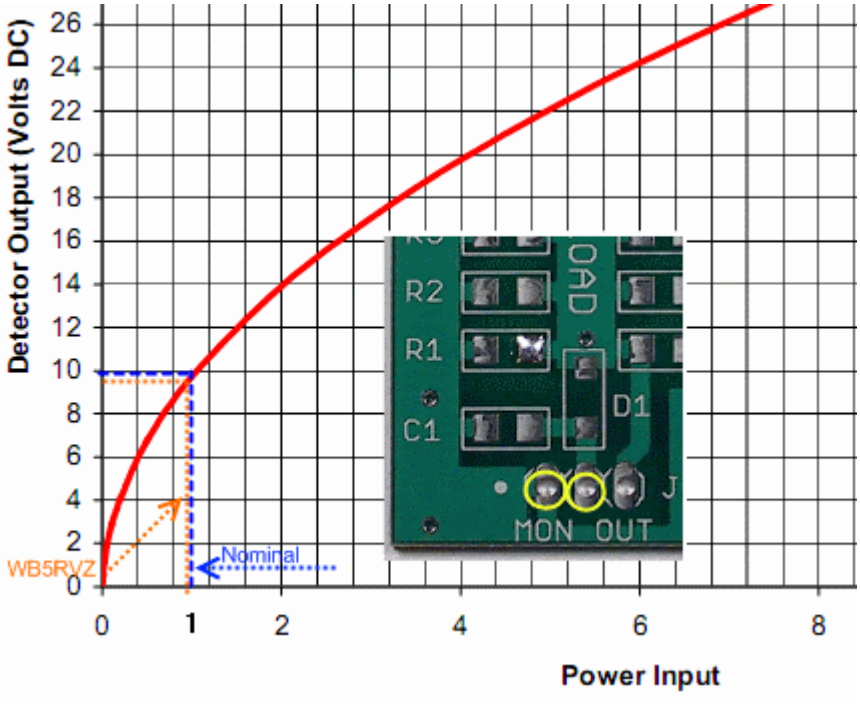
- **Use the same Rocky setup from above**
- **Set up Rocky to transmit (i.e., send out I and Q signals) .**



- **Connect the soundcard's Line Out to the "L" and "R" pads on the board**
- **Connect your antenna terminals to a 50 ohm load - for illustration we are using the Norcal Dummy Load**
- **Power up the RXTX with PTT-I at 12 V**
- **During testing, take care not to leave the Softrock at PTT=high for any length of time - the heat sink and the PA FETs will get uncomfortable hot if you do!**
- **Set the center frequency of Rocky accordingly and, using your mouse, select a frequency on the spectrun display approximetaly 15 kHz above the center frequency (7.061 MHz when SW1 is set for a center frequency of 7.046 MHz. Click on the "TX" button at the top of the screen, select "Tone" to get a single sine wave out of the PC's sound card (I and Q) outputs.**



- **Check for DC voltage at the 50 ohm dummy load's DC output as RoCheck for DC voltage at the 50 ohm dummy load's DC output as Rocky's *IQ Amplitude* audio level slider is increased towards max**



- **The DC voltage at the 50 ohm load should go to ~10 Vdc, (1 watt output), when the quadrature audio inputs are each at their max.**
  Author's initial test measured 9.8 Vdc (using a pack of 8 AA cells), which interpolates to slightly over 900 mW. The voltage measured when using a 12V gel cell for power was 10.7 Vdc, just a tad over 1 W.
  Your measurement _____
- **Simon N0EPW has observed that if the output power is about 1/2 what it should be, You should check the installation of T201 or T202. He found this out the hard way. Of course the first tranformer he removed was the good one :-(**

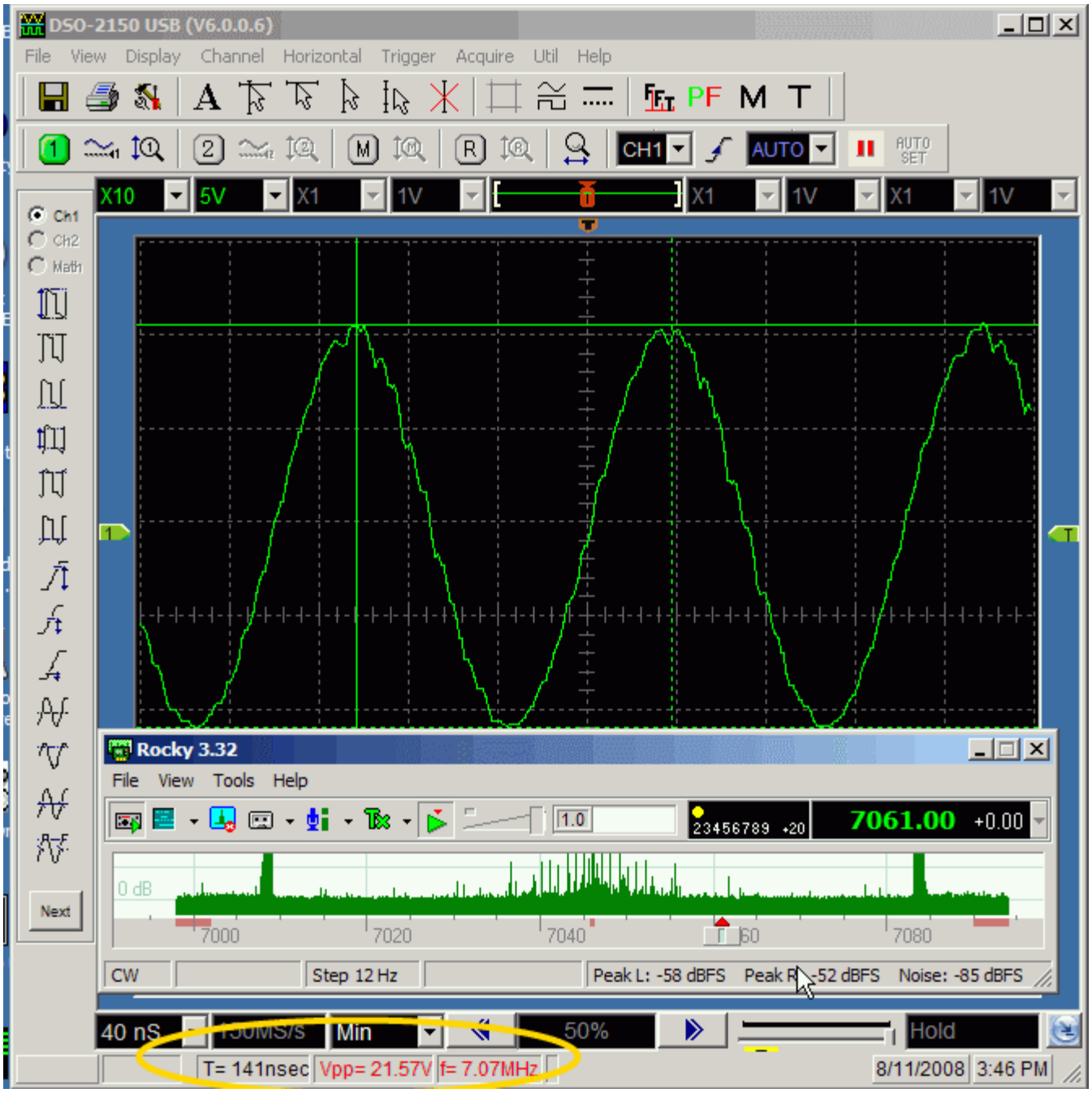
In the test setup above, tune an external radio to the TX output frequency (approximetaly 15 kHz above the Softrock's center frequency, i.e., 7.061 MHz when SW1

is set for a center frequency of 7.046 MHz.). Loosely couple the receiver to the dummy load. You should see/hear the signal on the receiver.

PA Output Test - Scope

(Usual caveats as to author's scope's accuracy and stability apply here)

- **Use the same Rocky setup from above with the board powered up and PTT-I high**
- **Click on Rocky's "TX" button and transmit a tone**
- **check for RF output across the 50 ohm load as Rocky's *IQ Amplitude* audio level is increased towards max**
- **The RF voltage across theThe RF voltage across the 50 ohm load should go to ~20V p-p, (1 watt output), when the quadrature audio inputs are each at 2.4V p-p.. Author's initial measurement 19.35 V p-p using the 8 AA cells; using the 12 V gel cell, the output was 21.6 V p-p**
  Your Measurement: _____
- **The RF output waveform across the 50 ohm load should appear as a clean looking sine wave when viewed with a scope. The frequency of the RF voltage should be equal to the center frequency + or - 15 kHz where the + or - frequency offset depends on the line-out signal phase relationship between the two line-out channels.**
- **The example shown below has the correct wave form and frequency, but the V p-pand frequency are approximate (however this may well be due to the calibration and accuracy of the author's cheapo scope).**
- **The power output is derived using the following formula:**
  $[(V_{pk})^2 * 0.125] / 50$
  $= [(21.5)^2 * 0.125] / 50$
  = 1.16 W (1156 mW)



TX I/Q Balancing

Balance the I and Q outputs of Rocky (phase and gain) for the cleanest image rejection during transmit.

While not actually a "test procedure", the process of TX I/Q Balancing is a last step to enabling a fully functional, optimized TX for the RXTX V6.3 (this applies to use of the RXTX V6.3 with the Rocky software).

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - 160m Boards

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

Below is the bill of materials for the BPF and PA/Filter boards for the 160m band.

Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	BPF-Board-1	BPF Board for 160m		Lite+Xtall V 6.3 BPF Board	1	BPF-160	BPF-1
[___]	C100-1	390 pF	391	ceramic	1	BPF-1	BPF-1
[___]	C101-1	5600 pF	562	ceramic	1	BPF-1	BPF-1
[___]	P100-1	2-pin header		connector (male)	1	BPF-1	BPF-1
[___]	P101-1	3 pin header		connector (male)	1	BPF-1	BPF-1
[___]	T30-2 (red)	T30-2 (red)	red	toroid core	2		BPF-1
[___]	#4 nylon	#4 nylon washer		hardware	1	for Q200	
[___]	#6 lock washer	#6 lock washer		hardware	1	1 for each PAF board	PAF-1
[___]	4 pin header	4 pin header		hardware	1	1 for each PAF board	PAF-1
[___]	5 pin header	5 pin header		hardware	1	1 for each PAF board	PAF-1
[___]	6-32 1/2"	6-32 1/2" machine screw		hardware	1	1 for each PAF board	PAF-1
[___]	6-32 nut	6-32 hex nut		hardware	1	1 for each PAF board	PAF-1
[___]	BN-43-2402	BN-43-2402 core	BN-43-2402	binocular core	2		PAF-1

[___]	C200-1	1000 pF	102	ceramic	1	PAF-1	PAF-1
[___]	C201-1	270 pF	271	ceramic	1	PAF-1	PAF-1
[___]	C202-1				1	not used	PAF-1
[___]	C203-1	2200 pF	222	ceramic	1	PAF-1	PAF-1
[___]	C204-1	4700 pF	472	ceramic	1	PAF-1	PAF-1
[___]	C205-1	2200 pF	222	ceramic	1	PAF-1	PAF-1
[___]	C206-1	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-1
[___]	C207-1	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-1
[___]	C208-1	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-1
[___]	C209-1	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-1
[___]	C210-1	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-1
[___]	C211-1	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-1
[___]	D200-1	1N4003		Diode	1	FlatV	PAF-1
[___]	P200-1	4-pin header		connector (male)	1	PAF-1	PAF-1
[___]	P201-1	5-pin header		connector (male)	1	PAF-1	PAF-1
[___]	PAF-1	PA/Filter Board		RXTX V6.3 PA/Filter Board	1	PAF-1 160m	PAF-1
[___]	Q200-1	2N2222A		Transistor (NPN) TO-18 can	1	PAF-1	PAF-1
[___]	Q201-1	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-1	PAF-1
[___]	Q202-1	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-1	PAF-1
[___]	Q203-1	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-1	PAF-1
[___]	Q204-1	2N3904		Transistor (NPN) TO-92	1	PAF-1	PAF-1
[___]	R200-1	475	yellow-violet-green-black-brown	Resistor 1%	1	FlatH	PAF-1

[___]	R201-1	56.2	green-blue-red-gold-brown	Resistor 1%	1	FlatH	PAF-1
[___]	R202-1	omit 160	blue-grey-brown-gold-brown	Resistor 1%	0	S-N (Omit for 160m)	PAF-1
[___]	R203-1	2.21 k	red-red-brown-red-brown	Resistor 1%	1	FlatV	PAF-1
[___]	R204-1	221	red-red-brown-black-brown	Resistor 1%	1	E-W	PAF-1
[___]	R205-1	221	red-red-brown-black-brown	Resistor 1%	1	E-W	PAF-1
[___]	R206-1	221	red-red-brown-black-brown	Resistor 1%	1	N-S	PAF-1
[___]	R207-1	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S	PAF-1
[___]	R208-1	2.21 k	red-red-brown-red-brown	Resistor 1%	1	S-N	PAF-1
[___]	R209-1	33.2	orange-orange-red-gold-brown	Resistor 1%	1	N-S	PAF-1
[___]	R210-1	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-1
[___]	R211-1	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-1
[___]	T37-2 (red)	T37-2 (red)	red	toroid core	4		PAF-1
[___]	TO18 Heat sink	TO18 Heat sink for Q200		hardware	1	1 for each PAF board	PAF-1
[___]	TO220 Heatsink	TO220 Heatsink for Q201-203		hardware	1	1 for each PAF board	PAF-1
[___]	TO220 Silpad	Silpad for TO220 heat sink		hardware	1	1 for each PAF board	PAF-1

Inductor Winding Data

Circuit Designation	Component	(Color) Code	Type	Windings
PAF-1 L200-1	30 uH	red	T37-2 (red) #30	86 T #30 (46")
PAF-1 L201-1	3.4 uH	red	T37-2 (red) #26	29 T #26 (17")
PAF-1 L202-1	3.4 uH	red	T37-2 (red) #26	29 T (17")
PAF-1 T200-1	7.1 uH	red	T37-2 #30	primaries 21T bifilar #30 (2x 13in.); secondary 7.1 uH 42T #30 (24 in.)
PAF-1 T201-1	46.08 uH		BN-43-2402	primary 6T of #30 (10 in.); secondaries 3T bifilar of #30 (2x 5 in.)
PAF-1 T202-1	36 uH		BN-43-2402	primaries 4T bifilar of #30 (2x 6 in.); secondary 5T of #30 (9 in.)

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - 30/20/17m Boards

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

Below is the bill of materials for the BPF and PA/Filter boards for the 30/20/17m band.

Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	BPF-Board-3	Board 30/20/17		BPF Board	1	BPF-30/20/17	BPF-3
[___]	C100-3	180 pF	181	ceramic	1	BPF-30/20/17	BPF-3
[___]	C101-3	220 pF	221	ceramic	1	BPF-30/20/17	BPF-3
[___]	P100-3	2-pin header		connector (male)	1	BPF-3	BPF-3
[___]	P101-3	3 pin header		connector (male)	1	BPF-3	BPF-3
[___]	T25-6 (yellow)	T25-6 (yellow)	yellow	toroid core	2		BPF-3
[___]	#4 nylon	#4 nylon washer		hardware	1	for Q200	
[___]	#6 lock washer	#6 lock washer		hardware	1	1 for each PAF board	PAF-3
[___]	4 pin header	4 pin header		hardware	1	1 for each PAF board	PAF-3
[___]	5 pin header	5 pin header		hardware	1	1 for each PAF board	PAF-3
[___]	6-32 1/2"	6-32 1/2" machine screw		hardware	1	1 for each PAF board	PAF-3
[___]	6-32 nut	6-32 hex nut		hardware	1	1 for each PAF board	PAF-3
[___]	BN-61-2402	BN-61-2402 core	BN-61-2402	binocular core	2		PAF-3
[___]	C200-3	82 pF	82	ceramic	1	PAF-1	PAF-3
[___]	C201-3	82 pF	82	ceramic	1	PAF-1	PAF-3
[___]	C202-3	220 pF	221	ceramic	1	PAF-1	PAF-3
[___]	C203-3	150 pF	151	ceramic	1	PAF-1	PAF-3
[___]	C204-3	330 pF	331	ceramic	1	PAF-1	PAF-3
[___]	C205-3	150 pF	151	ceramic	1	PAF-1	PAF-3

[___]	C206-3	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-3
[___]	C207-3	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-3
[___]	C208-3	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-3
[___]	C209-3	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-3
[___]	C210-3	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-3
[___]	C211-3	0.1 uF		SMT 1206 CAP (black marked strip)	1	PAF-1	PAF-3
[___]	D200-3	1N4003		Diode	1	FlatV	PAF-3
[___]	P200-3	4-pin header		connector (male)	1	PAF-3	PAF-3
[___]	P201-3	5-pin header		connector (male)	1	PAF-3	PAF-3
[___]	PAF-3	PA/Filter Board		RXTX V6.3 PA/Filter Board	1	PAF-3 30/20/17m	PAF-3
[___]	Q200-3	2N2222A		Transistor (NPN) TO-18 can	1	PAF-3	PAF-3
[___]	Q200-4	2N2222A		Transistor (NPN) TO-18 can	1	PAF-3	PAF-3
[___]	Q201-3	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-3	PAF-3
[___]	Q201-4	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-3	PAF-3
[___]	Q202-3	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-3	PAF-3
[___]	Q203-3	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-3	PAF-3
[___]	Q204-3	2N3904		Transistor (NPN) TO-92	1	PAF-3	PAF-3

[___]	R200-3	475	yellow-violet-green-black-brown	Resistor 1%	1	FlatH	PAF-3
[___]	R201-3	56.2	green-blue-red-gold-brown	Resistor 1%	1	FlatH	PAF-3
[___]	R202-3	68.1	blue-grey-brown-gold-brown	Resistor 1%	1	S-N S-N	PAF-3
[___]	R203-3	2.21 k	red-red-brown-red-brown	Resistor 1%	1	FlatV	PAF-3
[___]	R204-3	221	red-red-brown-black-brown	Resistor	1	E-W	PAF-3
[___]	R205-3	221	red-red-brown-black-brown	Resistor	1	E-W	PAF-3
[___]	R206-3	221	red-red-brown-black-brown	Resistor 1%	1	N-S	PAF-3
[___]	R207-3	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S	PAF-3
[___]	R208-3	2.21 k	red-red-brown-red-brown	Resistor 1%	1	S-N	PAF-3
[___]	R209-3	33.2	orange-orange-red-gold-brown	Resistor 1%	1	N-S	PAF-3
[___]	R210-3	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-3
[___]	R211-3	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-3
[___]	T30-6 (yellow)	T30-6 (yellow)	yellow	toroid core	2		PAF-3
[___]	T37-6 (yellow)	T37-6 (yellow)	yellow	toroid core	2		PAF-3
[___]	TO18 Heat sink	TO18 Heat sink for Q200		hardware	1	1 for each PAF board	PAF-3

[___]	TO220 Heatsink	TO220 Heatsink for Q201-203		hardware	1	1 for each PAF board	PAF-3
[___]	TO220 Silpad	Silpad for TO220 heat sink		hardware	1	1 for each PAF board	PAF-3

Inductor Winding Data

Circuit	Designation	Component	(Color) Code	Type	Windings
PAF-3	L200-3	1.6 uH	yellow	T30-6 #30	21 #30 (14")
PAF-3	L201-3	.6 uH	yellow	T37-6 (yellow) #26	14T #26 (10")
PAF-3	L202-3	.6uH	yellow	T37-6 (yellow) #26	14T #26 (10")
PAF-3	T200-3	1.74 uH	yellow	T30-6 #30	primaries 11T bifilar #30 (2x 8in.); secondary 1.74 uH 22T #30 (14 in.)
PAF-3	T201-3			BN-61-2402	primary 6T of #30 (10 in.); secondaries 3T bifilar of #30 (2x 5 in.)
PAF-3	T202-3			BN-61-2402	primaries 4T bifilar of #30 (2x 6 in.); secondary 5T of #30 (9 in.)

Special, External LPF for 30m Operation

Check	Designation	Component	(Color) Code	Type	Qty	Notes
[__]	C300-3	100 pF	101	ceramic	1	BPF-30/20/17
[__]	C301-3	330 pF (code 331)	331	ceramic	1	BPF-30/20/17
[__]	C302-3	100 pF	101	ceramic	1	BPF-30/20/17
[__]	L300-3	0.97 uH	yellow	T37-6 (yellow) #26	1	18 T #26 (12")
[__]	L301-3	0.97 uH	yellow	T37-6 (yellow) #26	1	18 T #26 (12")

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - 15/12/10m Boards

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

Below is the bill of materials for the BPF and PA/Filter boards for the 15/12/10m band.

Bill of Materials

Check	Designation	Component	(Color) Code	Type	Qty	Notes	Circuit
[___]	BPF-Board-4	Board 15/12/10		BPF Board	1	BPF-15/12/10	BPF-4
[___]	C100-4	82 pF (code 82)	82	ceramic	1	BPF-15/12/10	BPF-4
[___]	C101-4	330 pF (code 331)	331	ceramic	1	BPF-15/12/10	BPF-4
[___]	P100-4	2-pin header		connector (male)	1	BPF-4	BPF-4
[___]	P101-4	3 pin header		connector (male)	1	BPF-4	BPF-4
[___]	T25-6 (yellow)	T25-6 (yellow)	yellow	toroid core	2		BPF-4
[___]	#4 nylon	#4 nylon washer		hardware	1	for Q200	
[___]	#6 lock washer	#6 lock washer		hardware	1	1 for each PAF board	PAF-4
[___]	4 pin header	4 pin header		hardware	1	1 for each PAF board	PAF-4
[___]	5 pin header	5 pin header		hardware	1	1 for each PAF board	PAF-4
[___]	6-32 1/2"	6-32 1/2" machine screw		hardware	1	1 for each PAF board	PAF-4
[___]	6-32 nut	6-32 hex nut		hardware	1	1 for each PAF board	PAF-4
[___]	BN-61-2402	BN-61-2402 core	BN-61-2402	binocular core	2		PAF-4
[___]	C200-4	47 pF	47	ceramic	1	PAF-4	PAF-4
[___]	C201-4	22 pF	22	ceramic	1	PAF-4	PAF-4
[___]	C202-4	220 pF	221	ceramic	1	PAF-4	PAF-4
[___]	C203-4	100 pF	101	ceramic	1	PAF-4	PAF-4
[___]	C204-4	180 pF	181	ceramic	1	PAF-4	PAF-4
[___]	C205-4	100 pF	101	ceramic	1	PAF-4	PAF-4

[___]	C206-4	0.01 uF		SMT 1206 CAP	1	PAF-4	PAF-4
[___]	C207-4	0.01 uF		SMT 1206 CAP	1	PAF-4	PAF-4
[___]	C208-4	0.01 uF		SMT 1206 CAP	1	PAF-4	PAF-4
[___]	C209-4	0.01 uF		SMT 1206 CAP	1	PAF-4	PAF-4
[___]	C210-4	0.01 uF		SMT 1206 CAP	1	PAF-4	PAF-4
[___]	C211-4	0.01 uF		SMT 1206 CAP	1	PAF-4	PAF-4
[___]	CA-4	22 pF	22	ceramic	1	PAF-4	PAF-4
[___]	D200-4	1N4003		Diode	1	FlatV	PAF-4
[___]	P200-4	4-pin header		connector (male)	1	PAF-4	PAF-4
[___]	P201-4	5-pin header		connector (male)	1	PAF-4	PAF-4
[___]	PAF-4	PA/Filter Board		RXTX V6.3 PA/Filter Board	1	PAF-4 15/12/10m	PAF-4
[___]	Q202-4	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-4	PAF-4
[___]	Q203-4	BS170		TO-92 Transistor (N-Channel, FET)	1	PAF-4	PAF-4
[___]	Q204-4	2N3904		Transistor (NPN) TO-92	1	PAF-4	PAF-4
[___]	R200-4	475	yellow-violet-green-black-brown	Resistor 1%	1	FlatH	PAF-4
[___]	R201-4	56.2	green-blue-red-gold-brown	Resistor 1%	1	FlatH	PAF-4
[___]	R202-4	68.1	blue-grey-brown-gold-brown	Resistor 1%	1	S-N	PAF-4
[___]	R203-4	2.21 k	red-red-brown-red-brown	Resistor 1%	1	FlatV	PAF-4
[___]	R204-4	221	red-red-brown-black-brown	Resistor 1%	1	E-W	PAF-4

[___]	R205-4	221	red-red-brown-black-brown	Resistor 1%	1	E-W	PAF-4
[___]	R206-4	221	red-red-brown-black-brown	Resistor 1%	1	N-S	PAF-4
[___]	R207-4	22.1 k	red-red-brown-red-brown	Resistor 1%	1	N-S	PAF-4
[___]	R208-4	2.21 k	red-red-brown-red-brown	Resistor 1%	1	S-N	PAF-4
[___]	R209-4	33.2	orange-orange-red-gold-brown	Resistor 1%	1	N-S	PAF-4
[___]	R210-4	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-4
[___]	R211-4	2.2	red-red-black-silver-green	Resistor 5% 1/4W ???	1	FlatH	PAF-4
[___]	T30-6 (yellow)	T30-6 (yellow)	yellow	toroid core	2		PAF-4
[___]	T37-6 (yellow)	T37-6 (yellow)	yellow	toroid core	2		PAF-4
[___]	TO18 Heat sink	TO18 Heat sink for Q200		hardware	1	1 for each PAF board	PAF-4
[___]	TO220 Heatsink	TO220 Heatsink for Q201-203		hardware	1	1 for each PAF board	PAF-4
[___]	TO220 Silpad	Silpad for TO220 heat sink		hardware	1	1 for each PAF board	PAF-4

Inductor Winding Data

Circuit Designation	Component	(Color) Code	Type	Windings
PAF-4 L200-4	2.1 uH	yellow	T30-6 #30	24 #30 (15")
PAF-4 L201-4	.36 uH	yellow	T37-6 (yellow) #26	11T #26 (9")
PAF-4 L202-4	.36 uH	yellow	T37-6 (yellow) #26	11T #26 (9")

PAF-4	T200-4	0.81 uH	yellow	T30-6 #30	primaries 8T bifilar #30 (2x 6in.); secondary 0.81 uH 15T #30 (11 in.)
PAF-4	T201-4			BN-61-2402	primary 5T of #30 (10 in.); secondaries 3T bifilar of #30 (2x 5 in.)
PAF-4	T202-4			BN-61-2402	primaries 3T bifilar of #30 (2x 6 in.); secondary 5T of #30 (9 in.)

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Softrock RXTX V6.3 - Xtall - External Connections

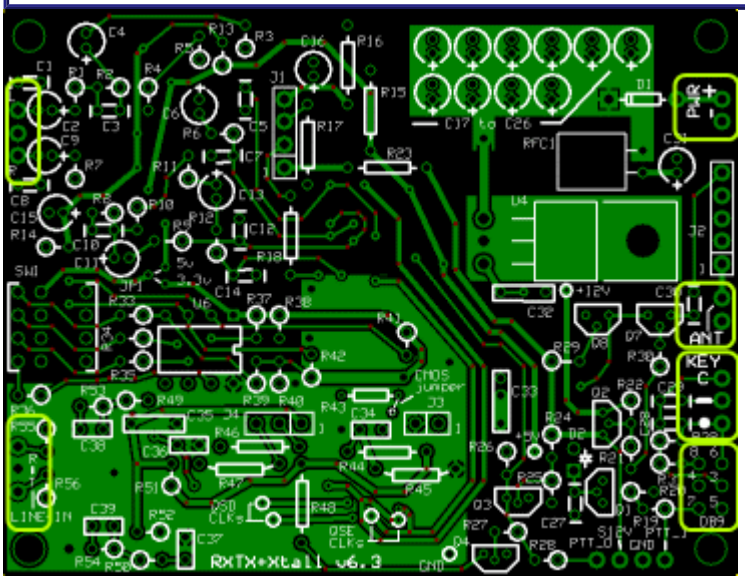
Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home

Introduction

Once actual construction is completed you will want to connect the rig to the outside world. The possible connections (depending upon your use - here we assume you will be using Rocky for RX, TX, PTT, and keyer) are:

- Power (right-hand edge of the board, near the top)
- Antenna (ANT/RET - right hand edge, near half-way down)
- Keyer (right hand edge, just below antenna connection. Three terminals: C=common, .=dot, -=dash)
- Serial Connection (for PTT and/or keyer - right-hand edge of the board, at bottom)
- TX I and Q audio inouts (left-hand edge, near top - Ring, Tip, and ground)
- RX I and Q audio outputs (left-hand edge, near bottom - Ring and Tip)

Connection Locations



Summary Build Notes

- Install RX I/Q leads
- Install TX I/Q leads

- Install antenna leads
- Install Power leads
- Install keyer connection
- Install Rocky serial interface leads and socket

Detailed Build Notes

Audio (I/Q) Connection

Sample audio cable connection

RX I and Q Audio output - LINE IN

These are the Ring(Q) and Tip audio outputs of the board, located at the bottom left edge of the board.

Depending upon your ultimate enclosure/mounting requirements, you want to connect these three pads to good quality shielded 2 conductor audio cable, terminated either by a 3.5 mm mini plug or a mini jack.
Use a short length of solid hookup wire, soldered to the shielding and to the ground/common connection, and wrapped firmly around the outer insulation of the cable as a strain relief mechanism.

If you plan on using the same sound card for both the RX and TX I and Q signals, you can reduce the possibility of ground loops (and the attendant noise in your RX) by NOT grounding the RX cable's shield and, instead, sharing the common ground in the TX cable. If you do this and you mount a stereo jack in your metal enclosure, you should be sure to use an isolated stereo jack for your RX output jack, such as the Markertek 30-711 jack

TX I and Q Audio input - "L - R"

These are the Left and Right audio outputs of the PC when in transmit mode. The connection points located at the top left edge of the board.

Depending upon your ultimate enclosure/mounting requirements, you want to connect these three pads to good quality shielded 2 conductor audio cable, terminated either by a 3.5 mm mini plug or a mini jack. Use a short length of solid hookup wire, soldered to the shielding and to the ground/common connection, and wrapped firmly around the outer insulation of the cable as a strain relief mechanism.

If you plan on using the same sound card for both the RX and TX I and Q signals, you can reduce the possibility of ground loops by NOT grounding the RX cable's shield and, instead, sharing the common ground in the TX cable. If you do this and you mount a stereo jack in your metal enclosure, you should be sure to use an isolated stereo jack, such as the Markertek 30-711 jack

Experiment with various grounding/connection configurations to give the least disturbance around the center frequency. Get it right before boxing it up in an enclosure.

Antenna Connection

Sample Antenna Connection

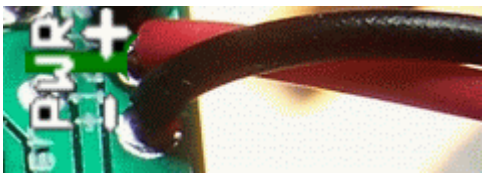
ANT/RET

These are the ANT and Ground (unmarked) connections located on the right-hand side of the board, near the top.

Use RG-174U 50 ohm "micro" coax for the antenna connection, There is a good discussion of RG-174 coax and techniques for installing connectors available on the internet.

Use the strain-relief technique illustrated above.

Power Connection



Sample Power Connection

PWR

Use the conventional red/black wire for the power line +/- connections with the connector of your choice.

Keyer Connection

Keyer Connection Leads

KEY

This works for your keyer, providided you have also connected the serial connector from Rocky. Connect leads from your keyer's common, dot, and dash lines to the corresponding points just below the antenna connection.

If you plan to mount a stereo jack in your metal enclosure to connect the keyer plug, be sure to use an isolated jack in order to eliminate ground loops.

Rocky Serial Interface Connection

DB9 Connector Location

DB9

This provides PTT signals from and, optionally, keyer dots and dashes to, Rocky through a standard DB9 connector. Plug the serial connector from your PC (directly or via a USB-to-Serial adaptor) into the DB9 connector wired into the holes at the bottom right edge of the board.

The SRv6.3 PTT_I can be activated with from +4.5 to +12 Vdc

Home BOM Power Supply Local Oscillator Dividers RX OpAmp RX Mixer(QSD) RX BPFs; TX OpAmps TX Mixer (QSE) PTT RX Switching PA/Filters External Connectons Comments Revisions WB5RVZ SDR Home