Home - Softrock 40 R2 USB RX
Band: 20m

Introduction

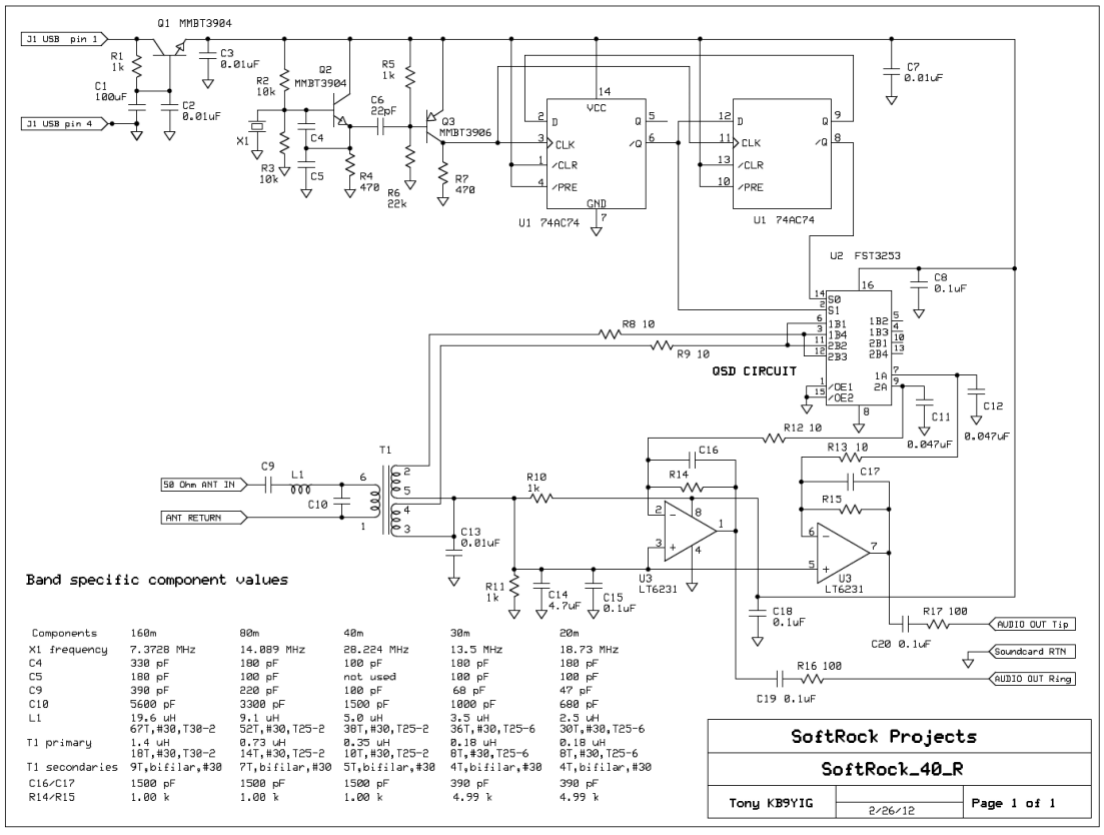
General Info

The most difficult part of this build is making sure you do not lose any of the SMT components. The resistors and capacitors are very small and extremely lightweight. They can be accidentally "launched" by a shaky hand and a bad set of tweezers. Invest in a good set of tweezers and a baking sheet with 0.5-1" walls around the edges. If a chip ever lands in the carpet, you will never find it!

This kit is for the 20m band

Theory of Operaton

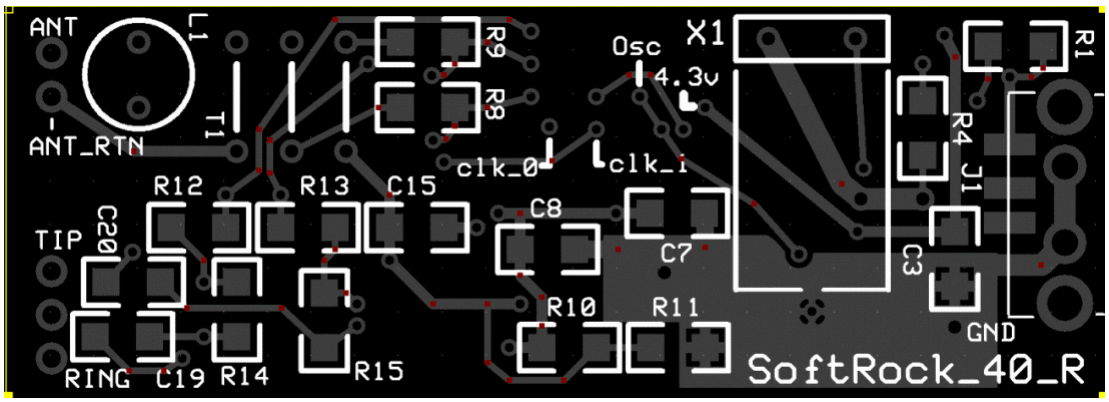
Schematic



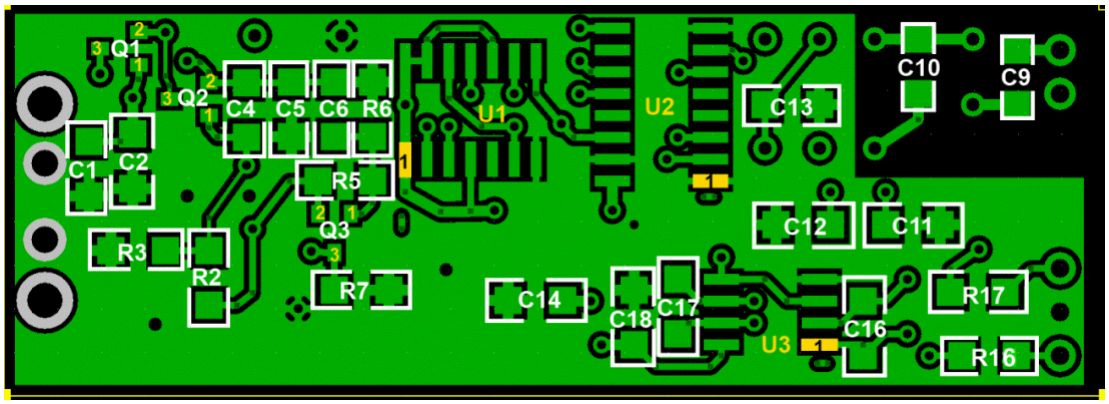
Components	160m	80m	40m	30m	20m
X1 frequency	7.3728 MHz	14.089 MHz	28.224 MHz	13.5 MHz	18.73 MHz
C4	330 pF	180 pF	100 pF	180 pF	180 pF
C5	180 pF	100 pF	not used	100 pF	100 pF
C9	390 pF	220 pF	100 pF	68 pF	47 pF
C10	5600 pF	3300 pF	1500 pF	1000 pF	680 pF
L1	19.6 uH 67T,#30,T30-2	9.1 uH 52T,#30,T25-2	5.0 uH 38T,#30,T25-2	3.5 uH 36T,#30,T25-6	2.5 uH 30T,#30,T25-6
T1 primary	1.4 uH 18T,#30,T30-2	0.73 uH 14T,#30,T25-2	0.35 uH 10T,#30,T25-2	0.18 uH 8T,#30,T25-6	0.18 uH 8T,#30,T25-6
T1 secondaries	9T,bifilar,#30	7T,bifilar,#30	5T,bifilar,#30	4T,bifilar,#30	4T,bifilar,#30
C16/C17	1500 pF	1500 pF	1500 pF	390 pF	390 pF
R14/R15	1.00 k	1.00 k	1.00 k	4.99 k	4.99 k

Board Layouts

Topside

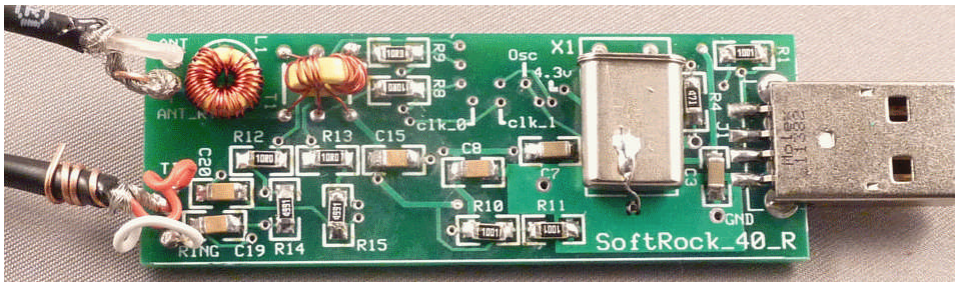


Underside

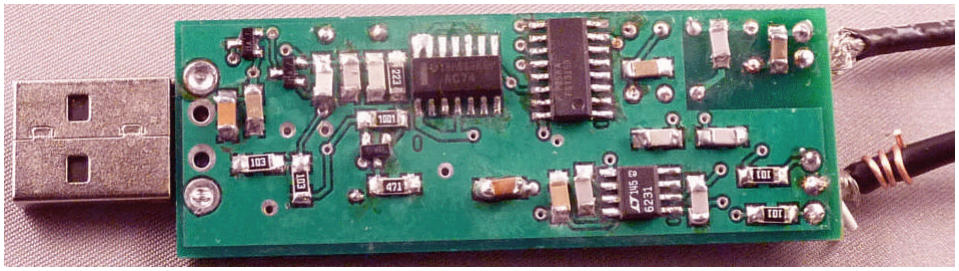


Completed Images

Topside



Underside



BOM-Stage Cross Reference
Band: 20m

Designation	Component	Band	Installed In
C01	100uF 20%	All	PowerSupply and Rail
C02	0.01 uF	All	PowerSupply and Rail
C03	0.01 uF	All	PowerSupply and Rail
C04	180pF 5%	20m	Local Oscillator/Phase Shifter
C05	100pF 5%	20m	Local Oscillator/Phase Shifter
C06	22pF 5%	All	Local Oscillator/Phase Shifter
C07	0.01 uF	All	PowerSupply and Rail
C08	0.1 uF	All	PowerSupply and Rail
C09	47pF 5%	20m	BandPass Filter
C10	680pF 5%	20m	BandPass Filter
C11	0.047uF 5%	All	Quadrature Sampling Detector
C12	0.047uF 5%	All	Quadrature Sampling Detector
C13	0.01 uF	All	PowerSupply and Rail
C14	4.7uF 20%	All	BandPass Filter
C15	0.1 uF	All	BandPass Filter
C16	390pF 5%	20m	Operational Amplifiers
C17	390pF 5%	20m	Operational Amplifiers
C18	0.1 uF	All	PowerSupply and Rail
C19	0.1 uF	All	Operational Amplifiers
C20	0.1 uF	All	Operational Amplifiers
cbl_ant	antenna COAX	All	External Connections
cbl-audio	1/8" M-M Stereo Audio Shld Cable	All	External Connections
J01	usb pcb mount plug	All	PowerSupply and Rail
L01	2.5 uH 30T #30 on T25-6 (14")	20m	BandPass Filter
L01-C	T25-6 toroid core	20m	BandPass Filter
Q01	MMBT3904	All	PowerSupply and Rail
Q02	MMBT3904	All	PowerSupply and Rail
Q03	MMBT3906	All	Local Oscillator/Phase Shifter
R01	1k ohm 1% 1/4W	All	PowerSupply and Rail
R02	10k 1/4W 5%	All	Local Oscillator/Phase Shifter
R03	10k 1/4W 5%	All	Local Oscillator/Phase Shifter
R04	470 1/4W 5%	All	Local Oscillator/Phase Shifter
R05	1k ohm 1% 1/4W	All	Local Oscillator/Phase Shifter
R06	22k 1/4W 5%	All	Local Oscillator/Phase Shifter
R07	470 1/4W 5%	All	Local Oscillator/Phase Shifter
R08	10 ohm 1% 1/4W	All	BandPass Filter

R09	10 ohm 1% 1/4W	All	BandPass Filter
R10	1k ohm 1% 1/4W	All	BandPass Filter
R11	1k ohm 1% 1/4W	All	BandPass Filter
R12	10 ohm 1% 1/4W	All	Quadrature Sampling Detector
R13	10 ohm 1% 1/4W	All	Quadrature Sampling Detector
R14	4.99k 1/4W 1%	20m	Operational Amplifiers
R15	4.99k 1/4W 1%	20m	Operational Amplifiers
R16	100 1/4W 5%	All	Operational Amplifiers
R17	100 1/4W 5%	All	Operational Amplifiers
strain_relief	misc hookup wire	All	External Connections
T01	0.18 uH 8T/2x4T bifilar #30 on T25-6 (6")	20m	BandPass Filter
T01-C	T25-6 toroid core	20m	BandPass Filter
U01	74AC74 Dual D FF	All	Local Oscillator/Phase Shifter
U02	FST3253 mux/demux switch	All	Quadrature Sampling Detector
U03	LT6231 dual op-amp	All	Operational Amplifiers
wire	Magnetic Wire, enameled #30	All	BandPass Filter
X01	18.73 MHz	20m	Local Oscillator/Phase Shifter

Softrock40-R2: PowerSupply and Rail
Band: 20m

Introduction

General Info About the Stage

This first stage is straight-forward. The RX receives its power from the USB 5V power bus (pin 1 of the USB plug), with respect to the USB ground, pin 4. We install the plug, the conditioning circuitry, and all of the bypass capacitors along the 5V power rail for the RX.

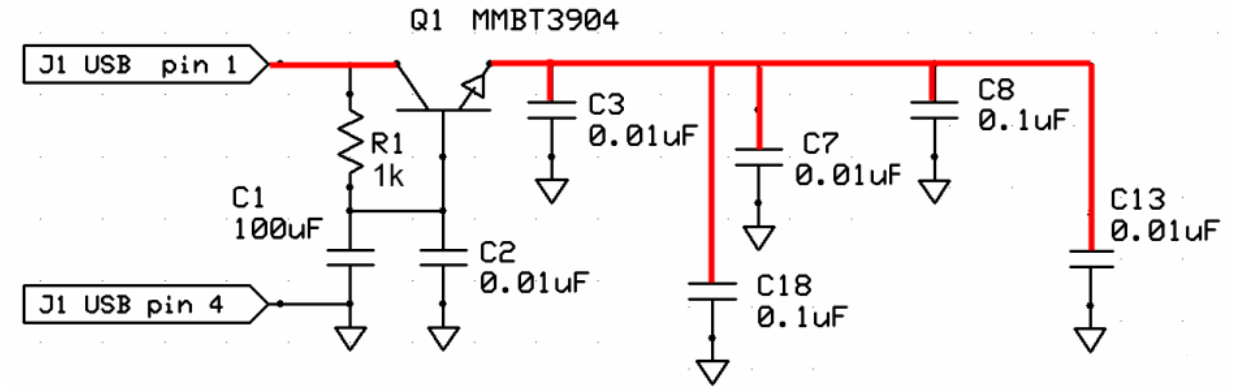
The tricky part of this stage is soldering Q1 and Q2 (even though Q2 is part of the next (LO) stage, it is a good idea to install it at this point, due to the close proximity of the two transistors and the avoidance of obstacles in further stages). These transistors are very tiny and it is easy to introduce solder bridges on the closely spaced contacts.

Note: this design does not have any short protection or current limiting on the input 5Vdc line from the PC's USB power bus. This suggests that you ALWAYS check that line before powering up to be sure you have not introduced a short.

Theory of Operation

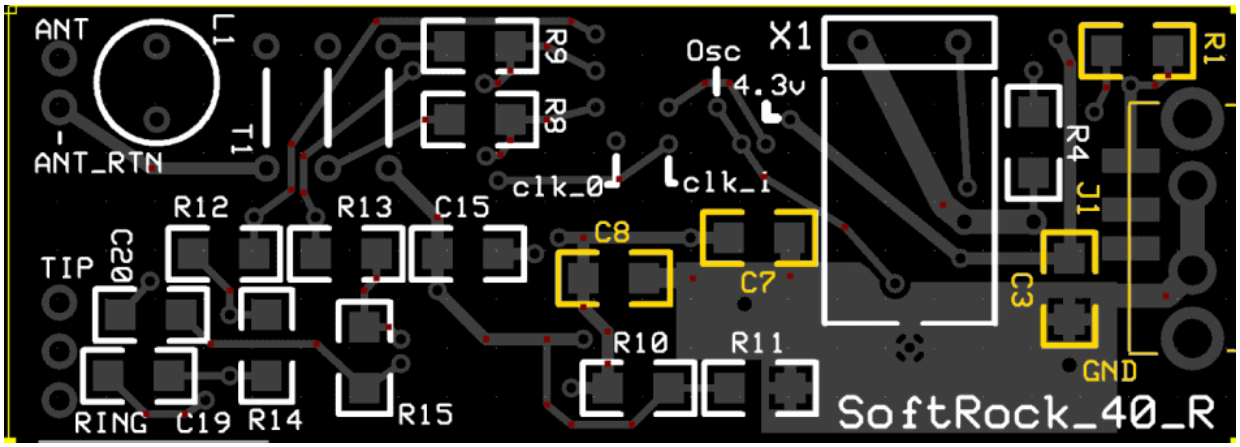
This is straight-forward. The active components in the radio require a clean, ripple-free nominally 5 Vdc. The 5V from the USB power bus is input to the condioning circuit (Q1) in order to drastically reduce the ripple from the PC's USB power supply. The resultant Vcc voltage is nominally 4.3 Vdc (due to the 0.7 V drop across Q1's junction) with negligible ripple, perfectly adequate to meet the power requirements of the RX circuit.

Stage Schematic

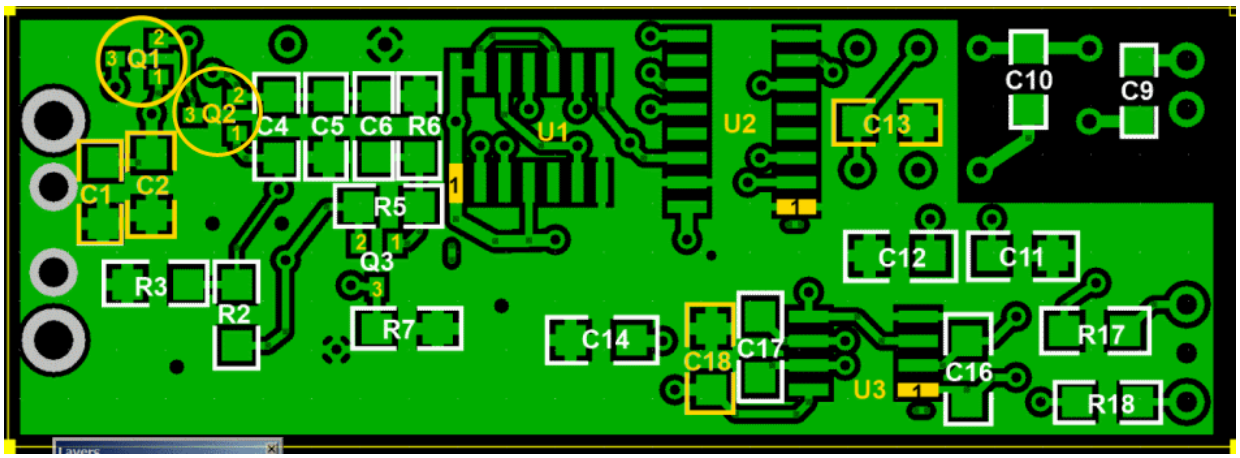


Board Layouts

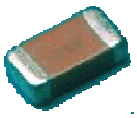
Board Top

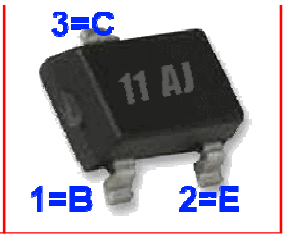


Board Bottom



Stage Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
[ ]	Capacitor	SMT 1206	0.01 uF	4	(smt) no stripe	
[ ]	Capacitor	SMT 1206	0.1 uF	2	(smt) black stripe	
[ ]	Capacitor	SMT 1206	100uF 20%	1	in bag	
[ ]	Connector	usb plug	usb pcb mount plug	1		
[ ]	Resistor	SMT 1206 1/4W	1k ohm 1% 1/4W	1	1001	
[ ]	Transistor	SOT-23	MMBT3904	2	11A J ESD!!!	

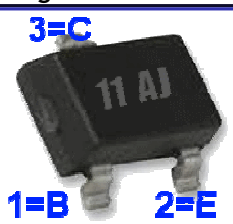
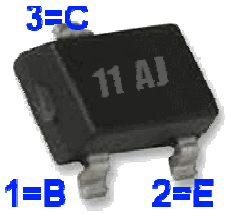
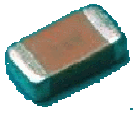


Detailed Build Steps

The critical task here is to be sure to install Q1 and Q2 first and carefully inspect the solder joints. Once Q1 and Q2 are installed, the remaining 1206 parts (bottom and topside) can be installed. The components for each step are listed in the sequence of their installation.

Install Bottomside Components

Yadayada

Check	Designation	Component	top/Bottom	Marking	Image
[ ]	Q01	MMBT3904	bot	11A J **ESD!!!**	
[ ]	Q02	MMBT3904	bot	11A J **ESD!!!**	
[ ]	C01	100uF 20%	bot	in bag	
[ ]	C02	0.01 uF	bot	(smt) no stripe	
[ ]	C13	0.01 uF	bot	(smt) no stripe	
[ ]	C18	0.1 uF	bot	(smt) black stripe	

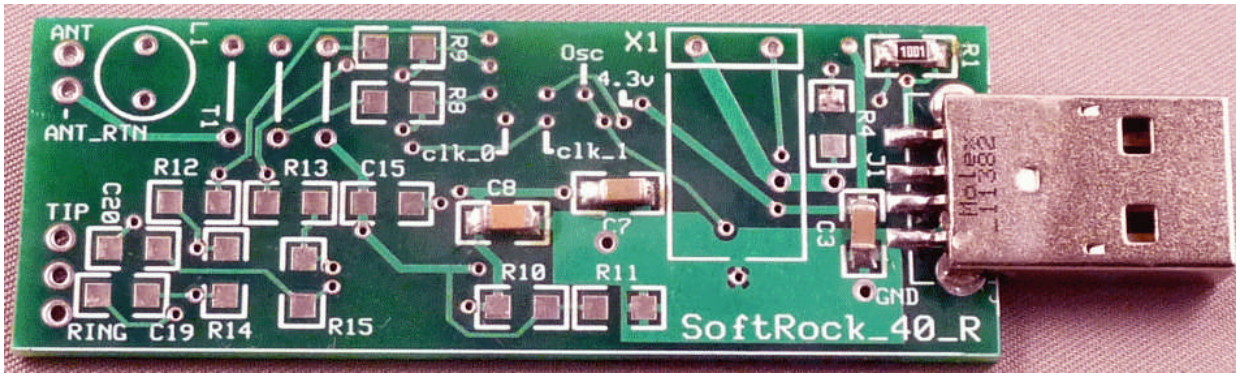
Install Topside Components

Check	Designation	Component	top/Bottom	Marking	Image
[ ]	C08	0.1 uF	top	(smt) black stripe	
[ ]	C07	0.01 uF	top	(smt) no stripe	
[ ]	C03	0.01 uF	top	(smt) no stripe	
[ ]	R01	1k ohm 1% 1/4W	top	1001	

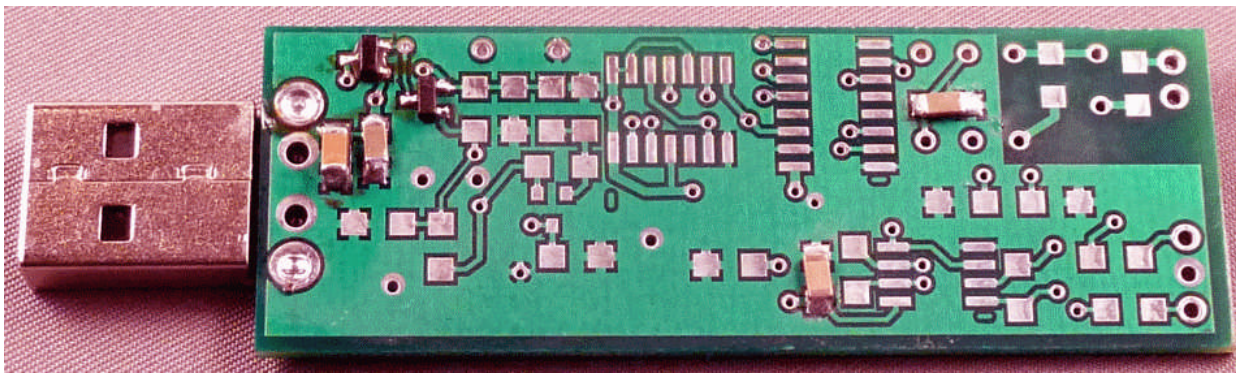
					1001
[ ]	J01	usb pcb mount plug	top		

Completed Photos

View of Completed Topside



View of Completed Underside

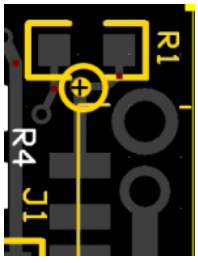


Testing

Overview

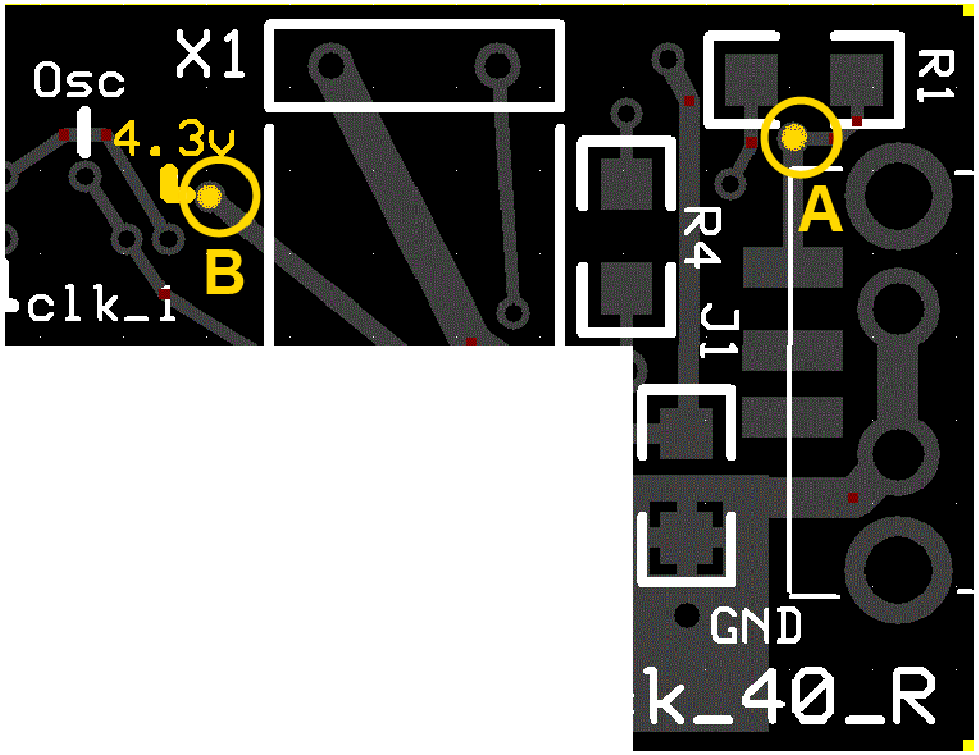
Before doing any testing, use a bright light and good magnification to verify correct soldering. Soldering problems are the greatest cause of test failures. Pay particular attention to Q1 and Q2.

USB Rail Integrity Test



Before powering up, check the resistance across the 5V USB connections (pins 1 (5V) and 4 (gnd) of J1). If you get something very close to zero, you may have introduced a short and the possibility of "frying" your PC's USB Power Bus.

Voltage Tests



Connect the USB Plug to a USB (power) source. Measure the voltage (WRT ground) at point A. If the voltage is as expected, measure the voltage (WRT ground) at point B.

Note: The unloaded output from the power supply is likely to be a little higher than the loaded output (as the build progresses into the later stages). This is normal. Also, please note that the 5.0Vdc for the USB power source is **nominal**. This can vary somewhat from PC to PC or hub to hub.

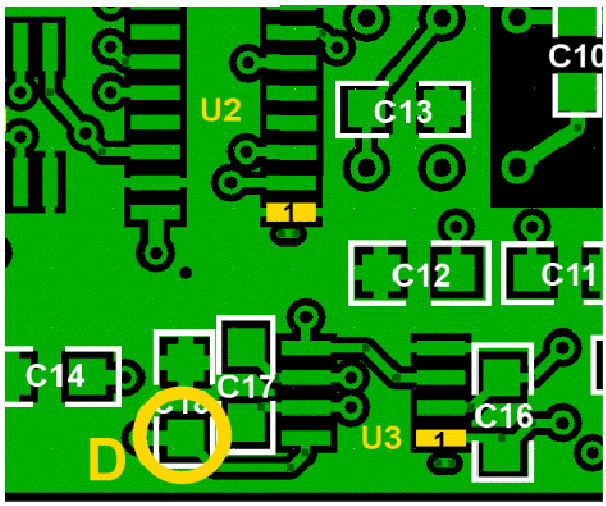
Potential (no pun intended) issues:

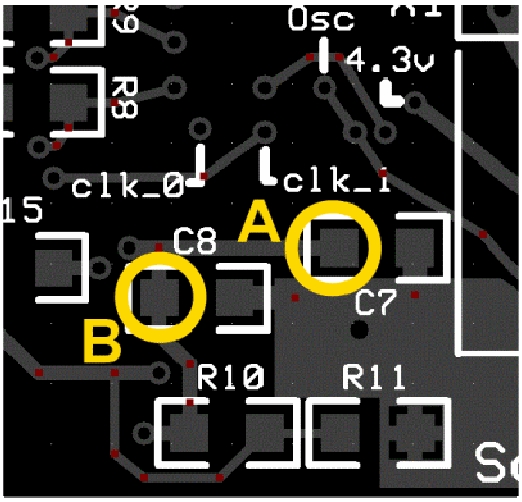
- Point A is not 5V. Check the J1 installation. Be sure the USB source is actually powered up.
- Point B is not ~4.3 V. Check installation of Q1, R1, and C3

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	"A" on topside	Vdc	5	5.04	_____
2	"B" on topside	Vdc	4.3	4.24	_____

Testing The Rest of the Rail





Connect the USB Plug to a USB (power) source. Measure the voltage (WRT ground) at topside points A and B and underside points C and D. Measure by placing the "hot" probe on the capacitor itself (tests adequate solder job, no short)

Potential issues:

- Testpoint is not 5V. Check the capacitor's soldering. Be sure the USB source is actually powered up.

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	"A" on topside	Vdc	4.3	4.24	_____
2	"B" on topside	Vdc	4.3	4.24	_____
3	"D" on underside	Vdc	4.3	4.24	_____

Next - Local Oscillator Stage

Softrock40-R2: Local Oscillator/Phase Shifter Band: 20m

Introduction

General Info About the Stage

Recollect that Q2 (part of this stage) was, for convenience, installed in the preceding (Power Supply) stage. This stage provides the Local Oscillator and the two Quadrature outputs.

Theory of Operation

The Local Oscillator stage implements a basic Colpitts Crystal Oscillator with a buffer stage to increase the signal level. The oscillator produces a signal that is at the crystal's specified fundamental frequency.

For the lower bands, this frequency is the receiver's "center frequency; for 30 and 20 meter bands, this frequency is four-thirds the desired "center frequency". (See the discussion on SubHarmonics, below)

In reality, for each frequency the crystal circuit will oscillate at a slightly lower frequency (~ - 1 kHz), due to the capacitive divider (C4/C5) pulling the crystal down somewhat. The effect is more pronounced for the higher bands.

The output of the Colpitts Oscillator is fed to U1, which has the effect of dividing the oscillator's fundamental frequency by 4 AND (most importantly) shifting the phase of its 2 output signals, such that they are in quadrature (90 degrees apart in phase)

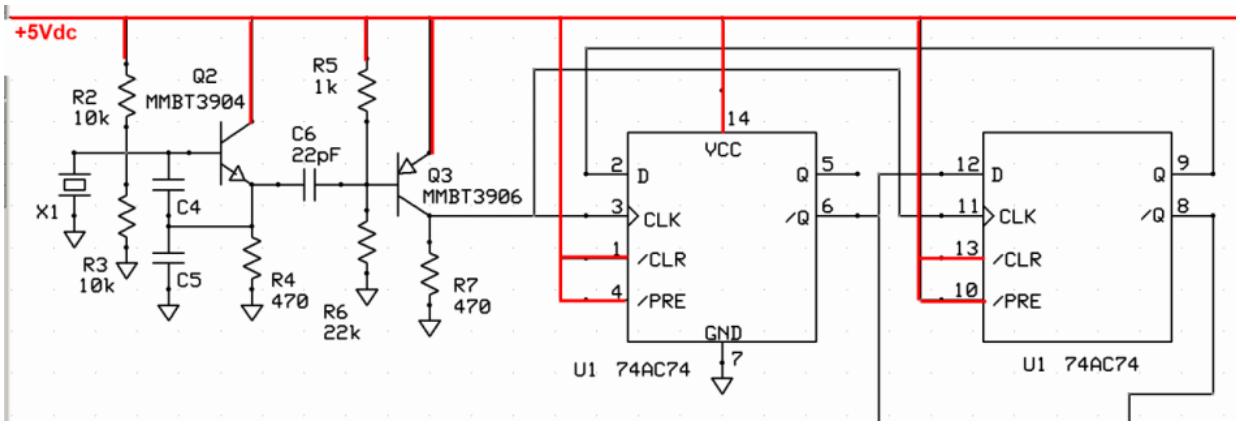
Sub-harmonic Sampling

Alan, G4ZFQ points out that on the 30m and 20m receivers, the Local Oscillator produces a signal that is 4/3 times the desired center frequency as opposed to the 4x the center frequency output for the lower band models.

"Subharmonic" works like this:

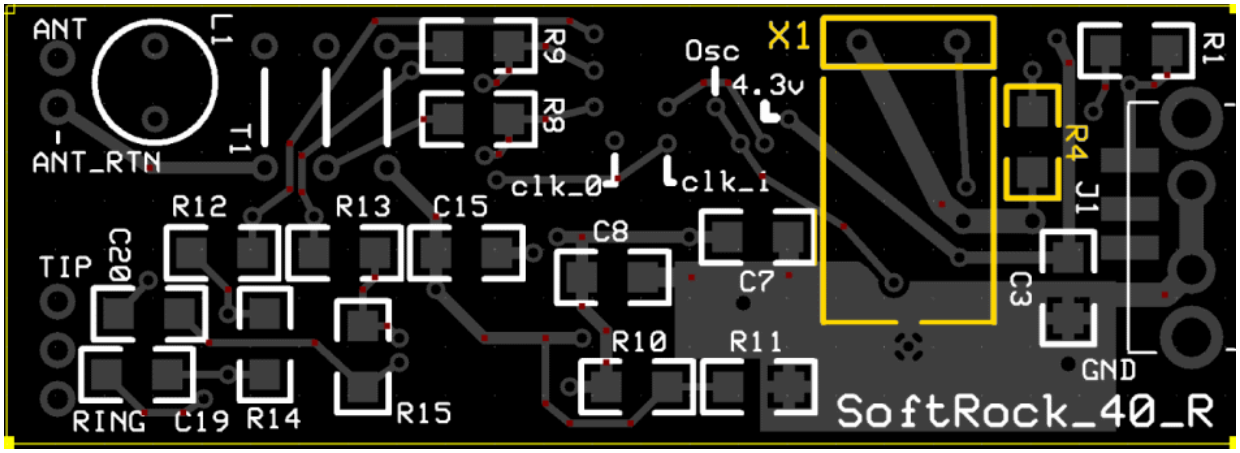
- The LO outputs a 18.730 MHz signal that goes to the dividers /4, resulting in a 4.6825 MHz square wave (rich in odd harmonics) being fed to the mixer.
- At the mixer, a strong 3rd harmonic is present on the clock inputs, along with the fundamental of 4.6825 MHz. The 4.6825 fundamental multiplied by 3 yields the third harmonic of 14.0475 MHZ.
- The Bandpass filter (BPF) performs the essential function of severely attenuating any signals centered around the 4.6825 MHz fundamental frequency and first harmonmic, but allows 20m signals centering around the third harmonic of the 4.6825 MHz LO output.
- The result is that the mixer is dealing with signals in the passband, centering on 14.0475 MHz, as though the dividers were passing a fundamental frequency of 14.0475 to the mixer. BPFs are all that stop Softrocks from working on unwanted frequencies!

Stage Schematic

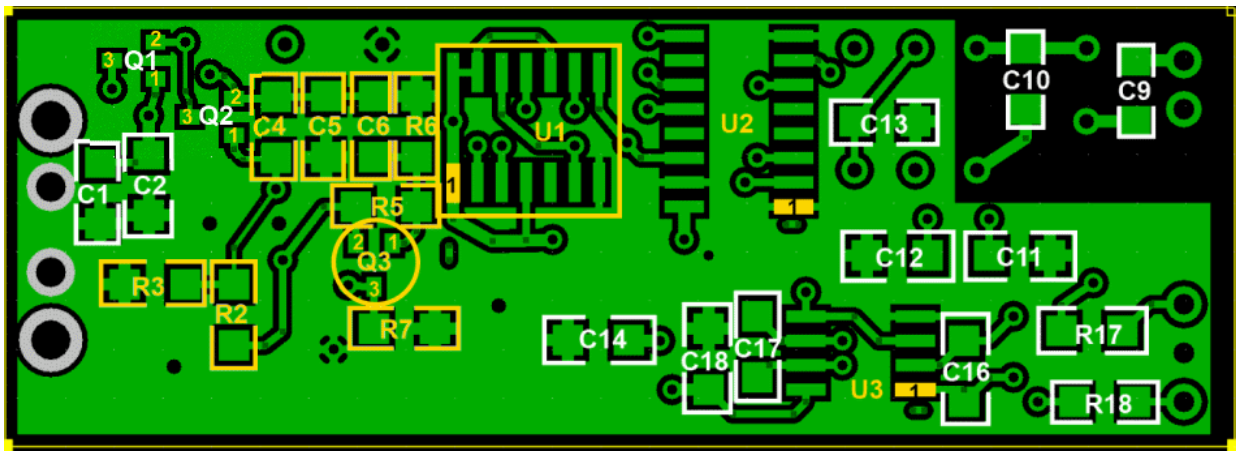


Board Layouts

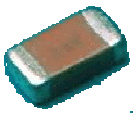
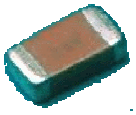
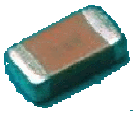
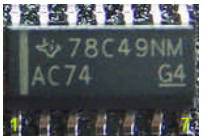
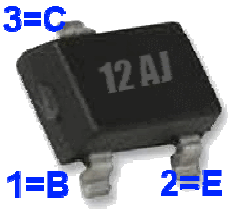
Board Top



Board Bottom



Stage Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
[ ]	Capacitor	SMT 1206	22pF 5%	1	in bag	
[ ]	Capacitor	SMT 1206	100pF 5%	1	in bag	
[ ]	Capacitor	SMT 1206	180pF 5%	1	in bag	
[ ]	IC	SOIC-14	74AC74 Dual D FF	1	74AC74 ESD!!!	
[ ]	Resistor	SMT 1206 1/4W	470 1/4W 5%	2	471	
[ ]	Resistor	SMT 1206 1/4W	1k ohm 1% 1/4W	1	1001	
[ ]	Resistor	SMT 1206 1/4W	10k 1/4W 5%	2	103	
[ ]	Resistor	SMT 1206 1/4W	22k 1/4W 5%	1	223	
[ ]	Transistor	SOT-23	MMBT3906	1	12A J ESD!!!	
[ ]	Xtal	Xtal	18.73 MHz	1	18.730 1108	

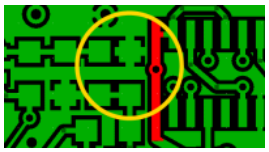
Detailed Build Steps

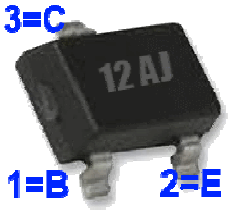
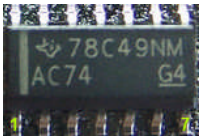
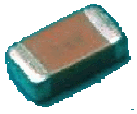
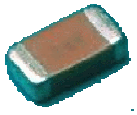
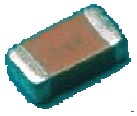
As in the preceding stage, the critical tasks here are installation - first - of the active components, Q2, Q3, and U1. Installing them prior to installing the passive SMT 1206 components gives you a chance to work on them without being blocked by adjacent comnponents and inspect each from all angles. The components for each step are listed in the order of their installation sequence.

The other tricky part is the installation of the crystal, X1. It must be installed with sufficient gap between the bottom of the case and the two lead holes' plating. Also, it must be bent over 90 degrees, to lay flat on its side snugly against the board. Once it is snugged up against the board, a ground wire should be soldered to the case and to the ground lead hole (located directly above the "f" in "Softrock" on the board).

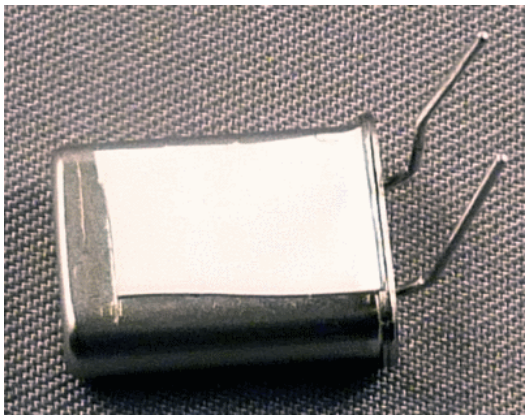
Install Underside Components

Take care in installing R6; it is very close to the 5V rail trace feeding Vcc to U1. A solder whisker between the ground (top-end) pad for R6 and that power rail could be catastrophic!



Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	Q03	MMBT3906	bot	12A J **ESD!!!**		any
[ ]	U01	74AC74 Dual D FF	bot	74AC74 **ESD!!!**		any
[ ]	R06	22k 1/4W 5%	bot	223		any
[ ]	C06	22pF 5%	bot	in bag		any
[ ]	C05	100pF 5%	bot	in bag		20m
[ ]	C04	180pF 5%	bot	in bag		20m
[ ]	R05	1k ohm 1% 1/4W	bot	1001		any
[ ]	R07	470 1/4W 5%	bot	471		any
[ ]	R03	10k 1/4W 5%	bot	103		any
[ ]	R02	10k 1/4W 5%	bot	103		any

Install Topside Components



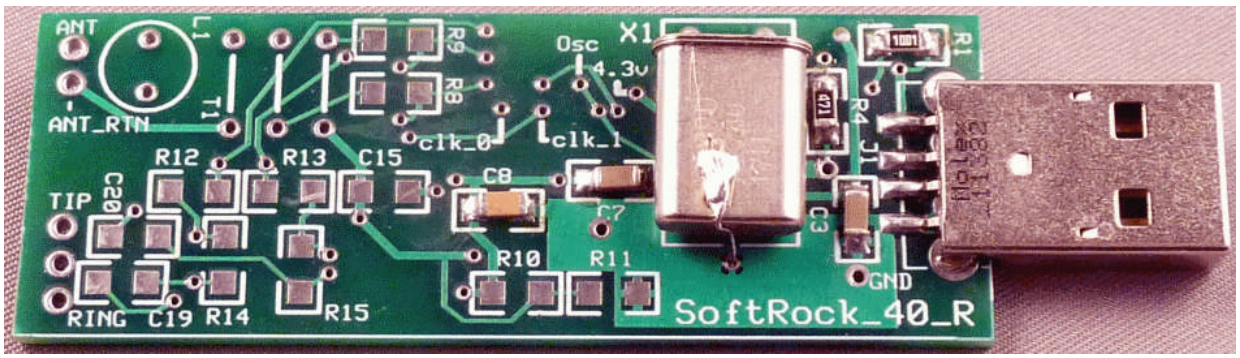
Preparing the crystal for installation. You should use the two mounting holes for the Xtal as a "jig" to get a 90 degree bend in the leads of the crystal, such that it fits snugly against the board. In order to keep the case of the crystal from touching the plated thru vias on the board, it is a good idea to put an insulator (author used white electrical tape) om the underside of the crystal to isolate the case from those vias

Once the Xtal is installed, take a 2-3" piece of the #30 magnetic wire and tin it. Using the tinned portion of the wire, thread it through the ground hold near the top of the Xtal and solder the wire to the Xtal case (see the completed photo below for a picture of this wire installed). Then solder to other end of the wire in the ground hole.

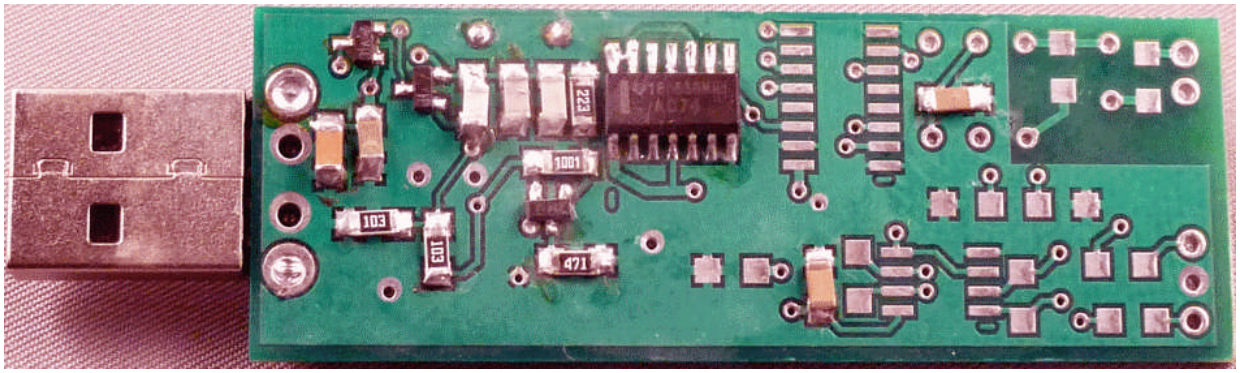
Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	R04	470 1/4W 5%	top	471		any
[ ]	X01	18.73 MHz	top	18.730 1108		20m

Completed Photos

View of Completed Topside



View of Completed Underside



Testing

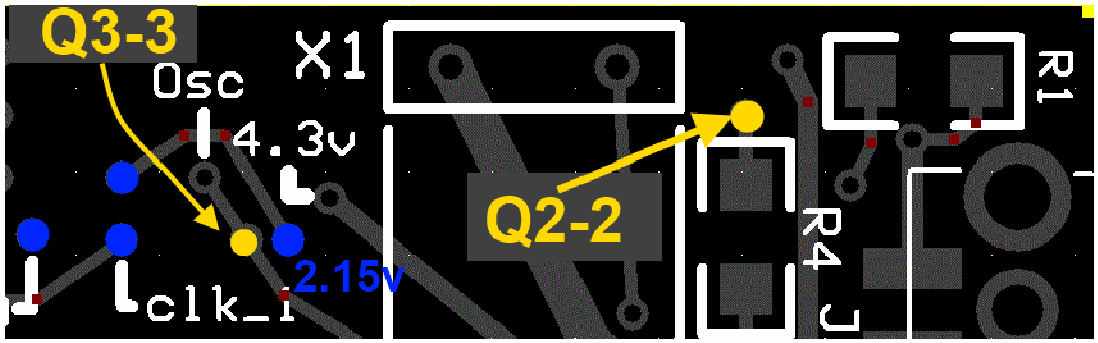
Overview

Before doing any testing, use a bright light and good magnification to verify correct soldering. Soldering problems are the greatest cause of test failures. Pay particular attention to Q2, Q3, and U1.

USB Rail Integrity Test

Before powering up, check the resistance across the 5V USB connections (pins 1 (5V) and 4 (gnd) of J1). If you get something very close to zero, you may have introduced a short and the possibility of "frying" your PC's USB Power Bus.

Voltage Tests - Topside



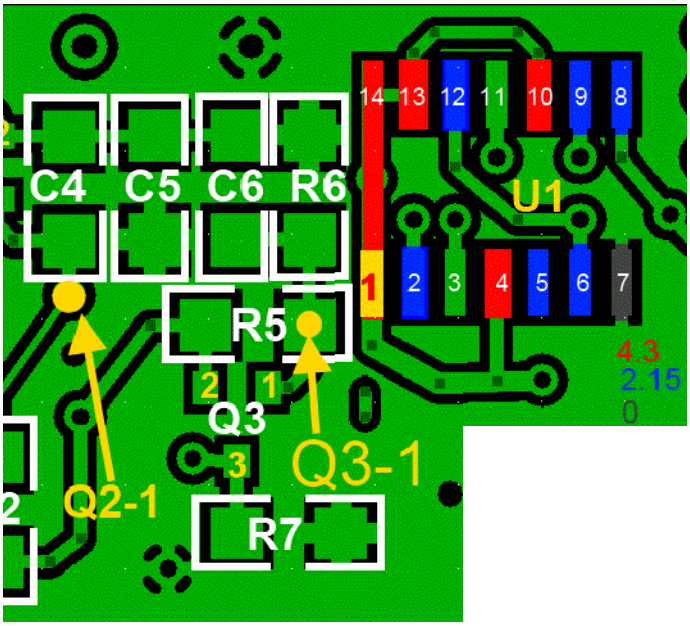
Connect the USB Plug to a USB (power) source. Measure the voltages (WRT ground) at the pins indicated in the above figure.

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	Q2-2 - emitter	Vdc	1.75	1.99	_____
2	Q3-3 - collector	Vdc	2.12	2.37	_____
3	blue test points in above figure	Vdc	2.15	2.1	_____

(pins 3 and 11 of U1 will carry the signal from the oscillator and will vary in voltage depending upon your DMM (due to the ac components on those pins).

Voltage Tests - Underside



When measuring pin voltages on U1, test the voltage on BOTH the pin and the pad. This will drive out any cases where the pad has the requisite voltage, but a bad solder joint causes the pin not to have the same voltage.

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	U1 - Pin 1	Vdc	4.3	4.23	_____
2	U1 - Pin 2	Vdc	2.15	2.11	_____
4	U1 - Pin 4	Vdc	4.3	4.23	_____
5	U1 - Pin 5	Vdc	2.15	2.11	_____
6	U1 - Pin 6	Vdc	2.15	2.10	_____
7	U1 - Pin 7	Vdc	0	0	_____
8	U1 - Pin 8	Vdc	2.15	2.10	_____
9	U1 - Pin 9	Vdc	2.15	2.11	_____
10	U1 - Pin 10	Vdc	4.3	4.23	_____
12	U1 - Pin 12	Vdc	2.15	2.10	_____
13	U1 - Pin 13	Vdc	4.3	4.23	_____

14	U1 - Pin 14	Vdc	4.3	4.23	_____
15	Q2-1 - base	Vdc	2.15	2.02	_____
16	Q3-1 - base	Vdc	4.11	4.12	_____

(pins 3 and 11 will carry the signal from the oscillator and will vary in voltage depending upon your DMM (due to the ac components on those pins).

Potential issues:

- All voltages are way off of the nominals: check your DMM (author experienced this when using cheap $1.99 DMM; went to $30 DMM and got above values)
-

Frequency Tests

Connect the USB Plug to a USB (power) source. Tack-solder a short (~6 inch) lead of wire to each of the test points shown in this graphic. These leads will act as radiating "antennae" for output of the oscillators and the two outputs of the of the divider chip, U1.

Then tune a receiver to 18.73 MHz and listen for the signal from the oscillator.

Then tune a radio to 4.6825 MHz and listen for the signal at each of the "clk" "antennae".

Potential issues:

-

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	Osc on topside	MHz	18.73	rcvd 18.726	_____
2	clk-0 on topside	MHz	4.683	rcvd 4.681	_____
3	clk-1 on topside	MHz	4.683	rcvd 4.681	_____

Next - Band-Pass Filter Stage

Softrock40-R2: BandPass Filter
Band: 20m

Introduction

General Info About the Stage

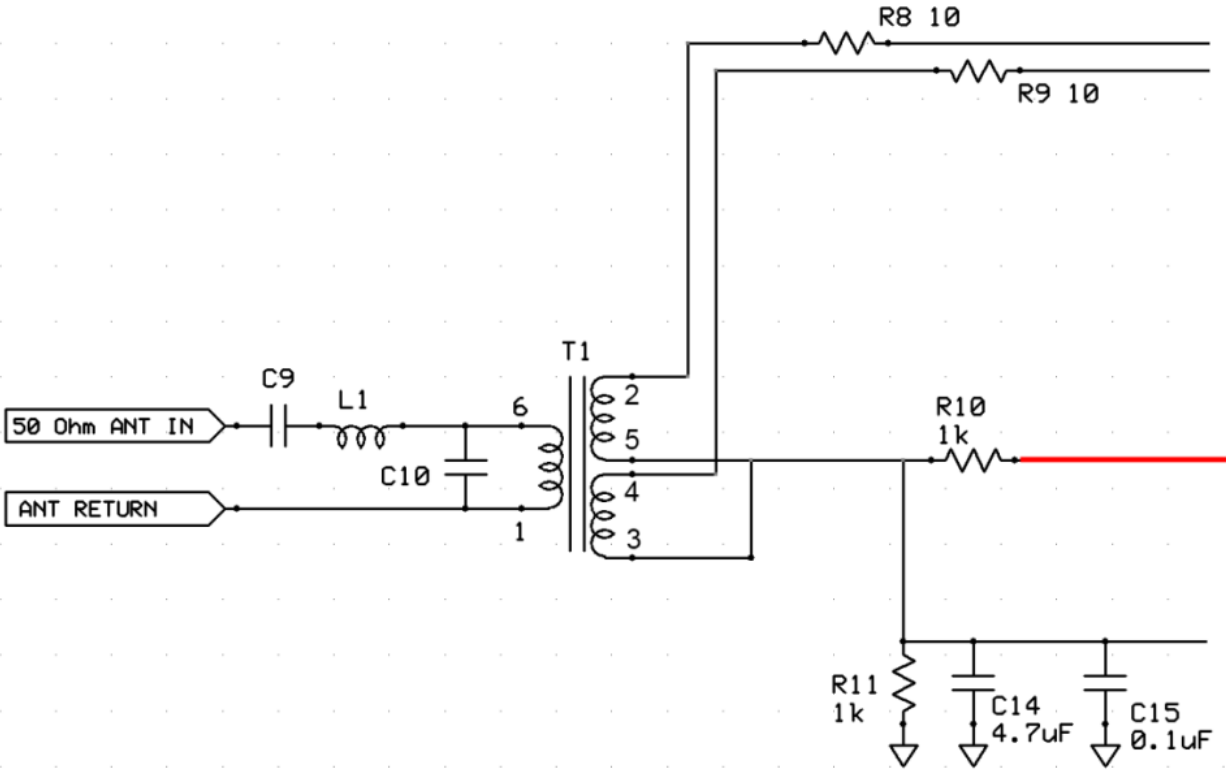
The challenge in this stage is to successfully wind and install the two inductors, L1 and T1. The most common sources of problems from this stage will be in the soldering of the inductors' leads. If the leads are not well cleaned with the insulation removed and then neatly tinned, cold joints could occur (often very difficult to detect and remedy).

We have a nice set of guidelines for winding and installing inductors. If you have little or no experience in this area, these guidelines are a "must read".

Theory of Operation

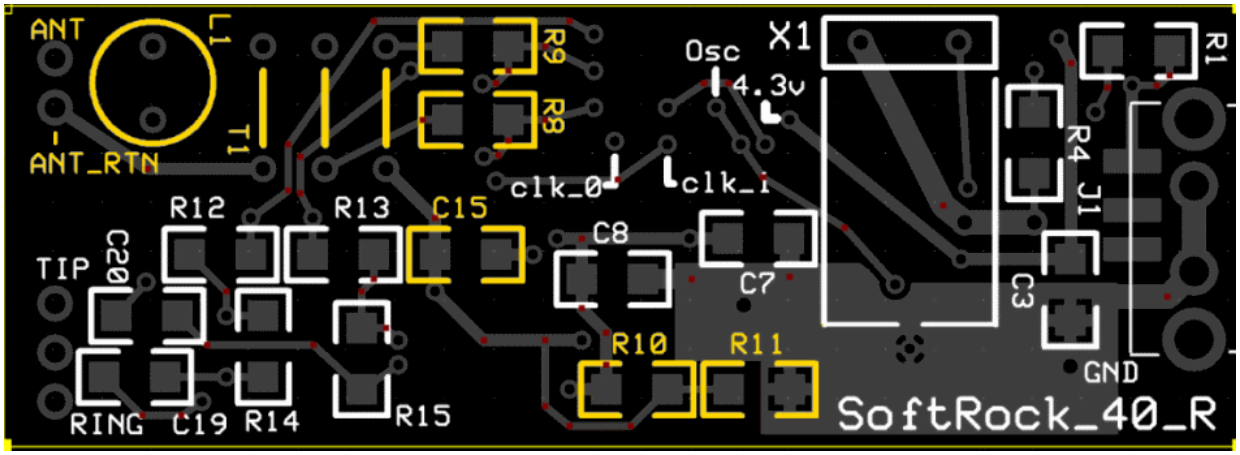
This stage takes in RF from a 50 ohm antenna and filters the RF into a "window" (pass band) on the spectrum that "sees" signals in the 20m band(s) and attenuates all other signals significantly.

Stage Schematic

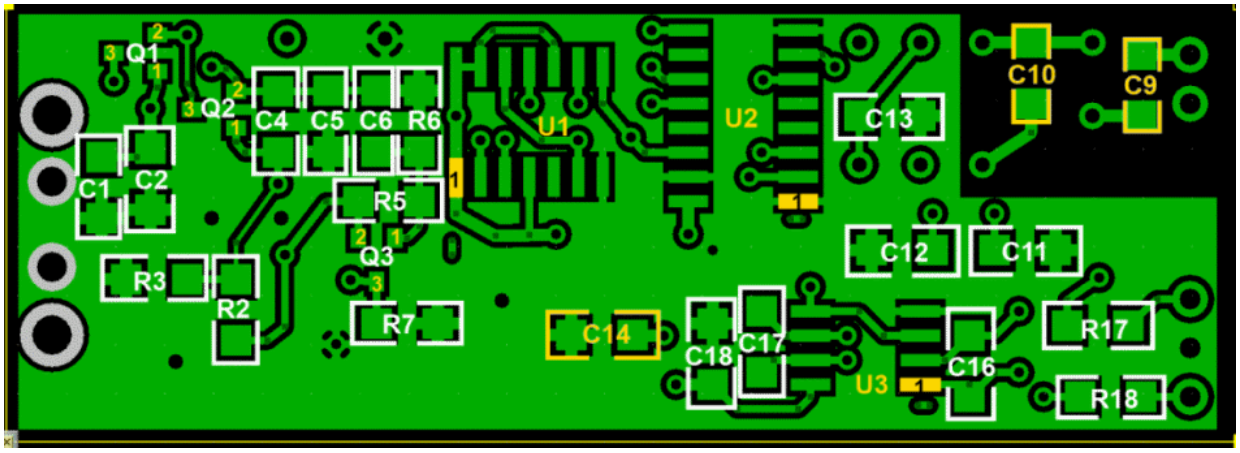


Board Layouts

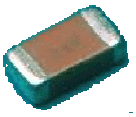
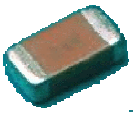
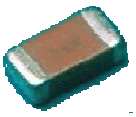
Board Top



Board Bottom



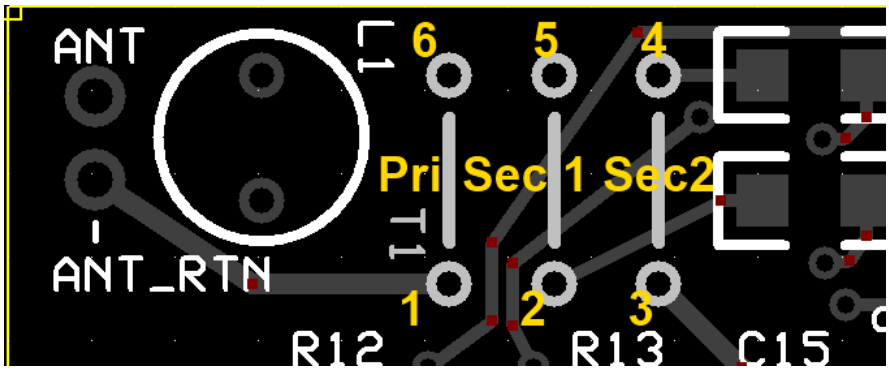
Stage Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
[ ]	Capacitor	SMT 1206	47pF 5%	1	in bag	
[ ]	Capacitor	SMT 1206	680pF 5%	1	in bag	
[ ]	Capacitor	SMT 1206	0.1 uF	1	(smt) black stripe	
[ ]	Capacitor	SMT 1206	4.7uF 20%	1	in bag	
[ ]	inductor	Toroid	T25-6 toroid core	2	yellow	
[ ]	Inductor	Xfrmr	0.18 uH 8T/2x4T bifilar #30 on T25-6 (6")	1	yellow	0.18 uH 8T/2x4T bifilar #30 on T25-6 (6")
[ ]	Inductor	Coil	2.5 uH 30T #30 on T25-6 (14")	1	yellow	2.5 uH 30T #30 on T25-6 (14")
[ ]	Resistor	SMT 1206 1/4W	10 ohm 1% 1/4W	2	10R0	
[ ]	Resistor	SMT 1206 1/4W	1k ohm 1% 1/4W	2	1001	
[ ]	wire	Magnetic	Magnetic Wire,	1		

			enameled #30			

Detailed Build Steps

Wind and Install Inductors

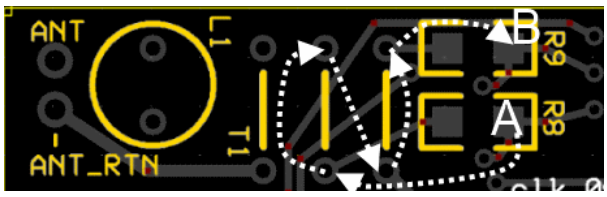


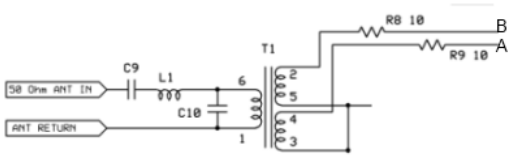
For guidance on how to wind and install the toroidal transformer, seethis page (http://www.wb5rvz.com/sdr/common/Common_Component_Mounting.htm#toroid_xfrmrs)

For guidance on winding and installing toroidal coils (e.g. L1), seethis page. (http://www.wb5rvz.com/sdr/common/Common_Component_Mounting.htm#toroid_coils)

Once you have completed this step (including installation of R8 and R9), you want to run continuity tests on the windings.

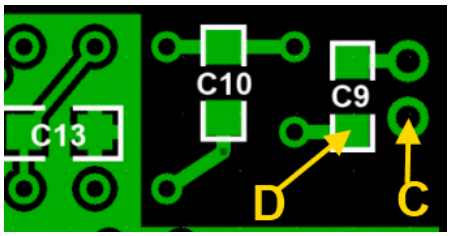
T1 Secondaries

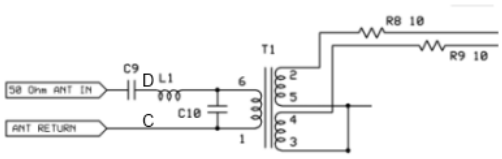




Use an ohmmeter to check the resistance from point "A" to point "B". You should see 20 ohms (R8 and R9 are in series through the center-tapped secondary windings)

L1 and T1-Primary

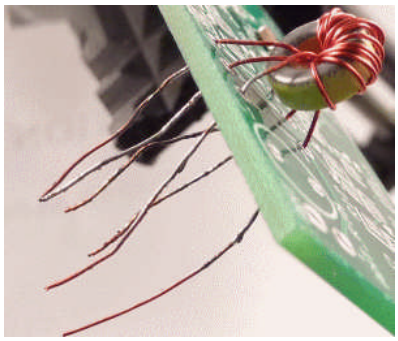




(image is of underside)

Use an ohmmeter to test continuity from point "D" (junction C9/L1) and point "C" (ANT Return). We should see zero ohms on this path through L1 and thence through T1-Primary.

Here is a picture of T1 being installed:



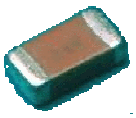
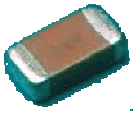
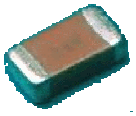
Check	Designation	Component	top/Bottom	Marking	Image	Ban
[ ]	T01	0.18 uH 8T/2x4T bifilar #30 on T25-6 (6")	top	yellow	0.18 uH 8T/2x4T bifilar #30 on T25-6 (6")	20m
[ ]	T01-C	T25-6 toroid core	top	yellow		20m
[ ]	L01	2.5 uH 30T #30 on T25-6 (14")	top	yellow	2.5 uH 30T #30 on T25-6 (14")	20m
[ ]	L01-C	T25-6 toroid core	top	yellow		20m
[ ]	R08	10 ohm 1% 1/4W	top	10R0		any
[ ]	R09	10 ohm 1% 1/4W	top	10R0		any
[ ]	wire	Magnetic Wire, enameled #30	top			any

Install Voltage Divider

Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	C15	0.1 uF	top	(smt) black stripe		any
[ ]	R10	1k ohm 1% 1/4W	top	1001		any
[ ]	R11	1k ohm 1% 1/4W	top	1001		any

Install Underside Components

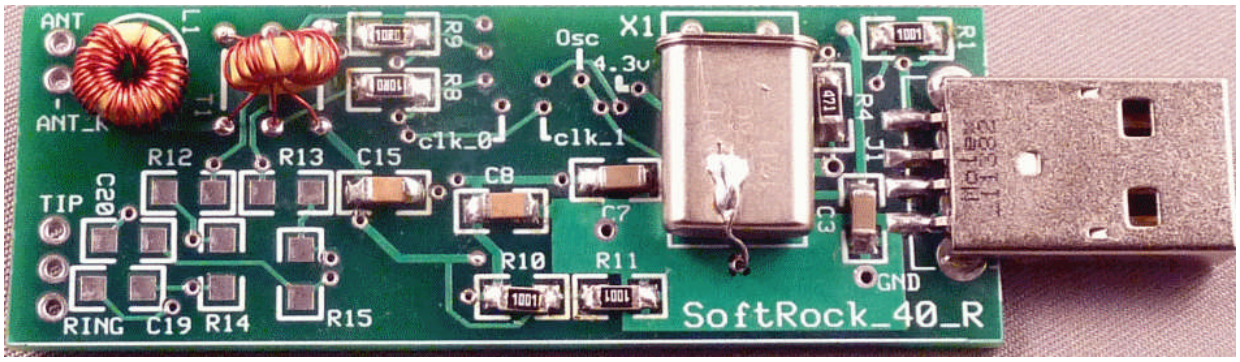
Careful with C14. It is pretty fat for an SMT cap and its conmnection with the ground pad can easily go the cold solder joint route.

Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	C09	47pF 5%	bot	in bag		20m
[ ]	C10	680pF 5%	bot	in bag		20m
[ ]	C14	4.7uF 20%	bot	in bag		any

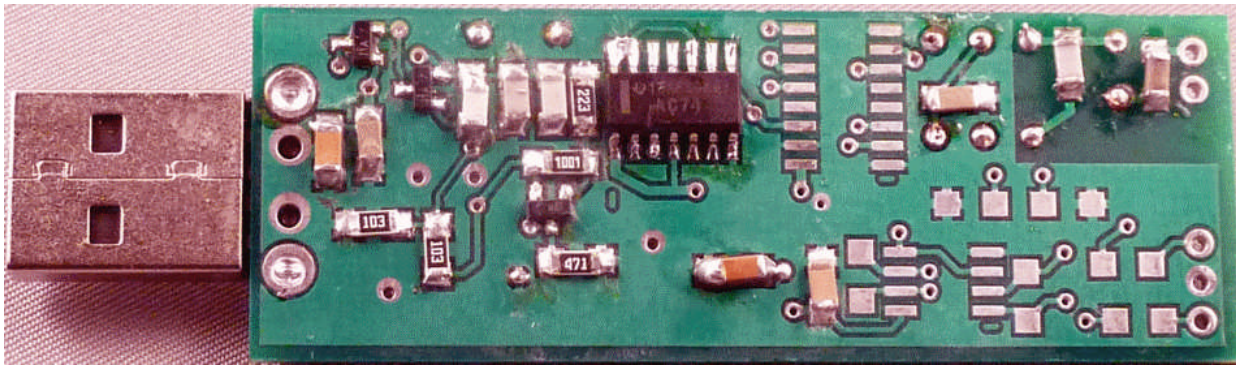
Completed Photos

Note: the completed pictures are of the 20m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside



View of Completed Underside



Testing

Overview

Before doing any testing, use a bright light and good magnification to verify correct soldering. Soldering problems are the greatest cause of test failures. Pay particular attention to the leads of the inductors. One of the most common causes of poor or non-performance on Softrocks is the soldering of the inductor leads. If they are not carefully cleaned and tinned, the joints will appear to be soldered but will in fact be a cold solder joint. Bye-bye sensitivity!

USB Rail Integrity Test

Before powering up, check the resistance across the 5V USB connections (pins 1 (5V) and 4 (gnd) of J1). If you get something very close to zero, you may have introduced a short and the possibility of "frying" your PC's USB Power Bus.

Voltage Tests

R10 and R11 form a voltage divider to provide the bias to the OpAmp stage. The divider produces 50% of Vcc (approximately 2.15 Vdc) at the junction of R10 and R11.

Connect the USB Plug to a USB (power) source. Measure the voltages (WRT ground) at the testpoints indicated in the above figure.

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	A	Vdc	2.15	2.11	_____

Potential issues:

-
-

Next - OpAmps Stage

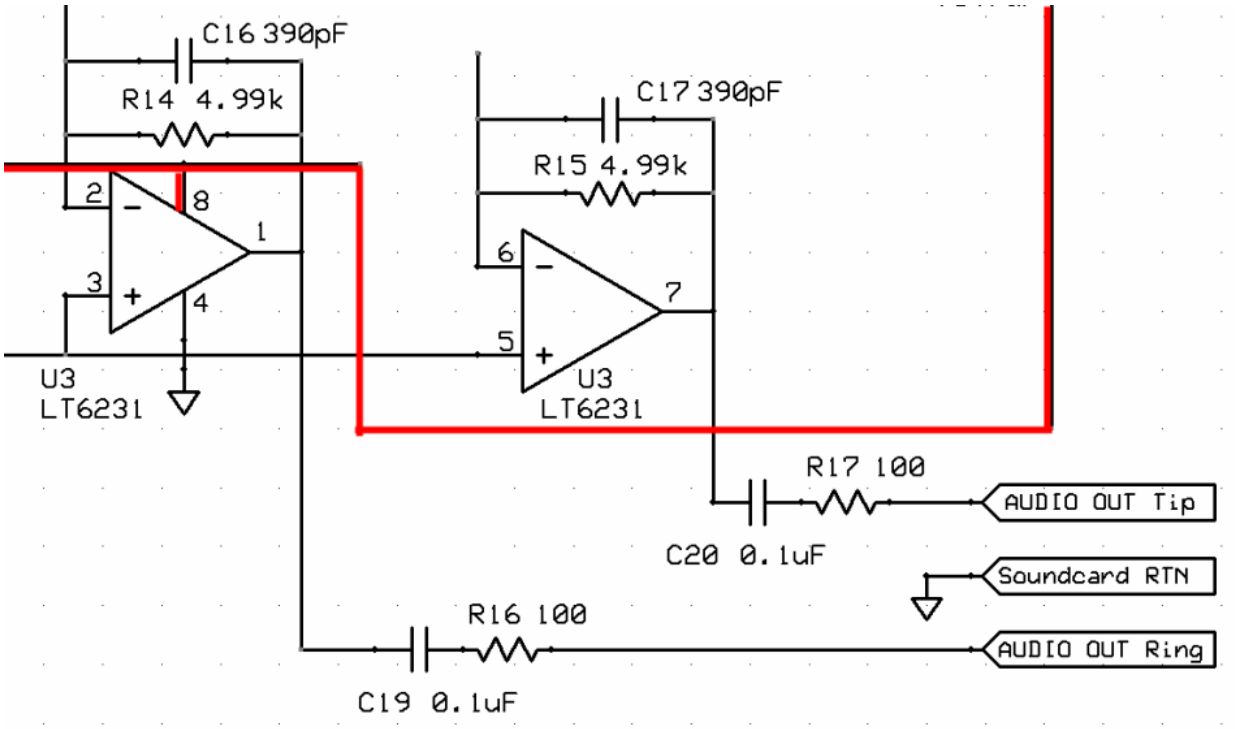
Softrock40-R2: Operational Amplifiers
Band: 20m

Introduction

General Info About the Stage

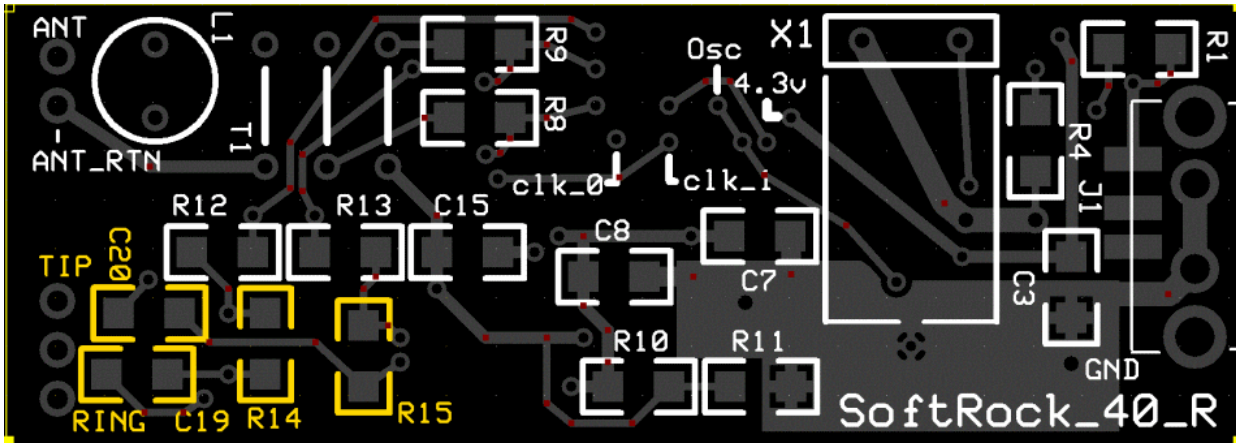
Theory of Operation

Stage Schematic

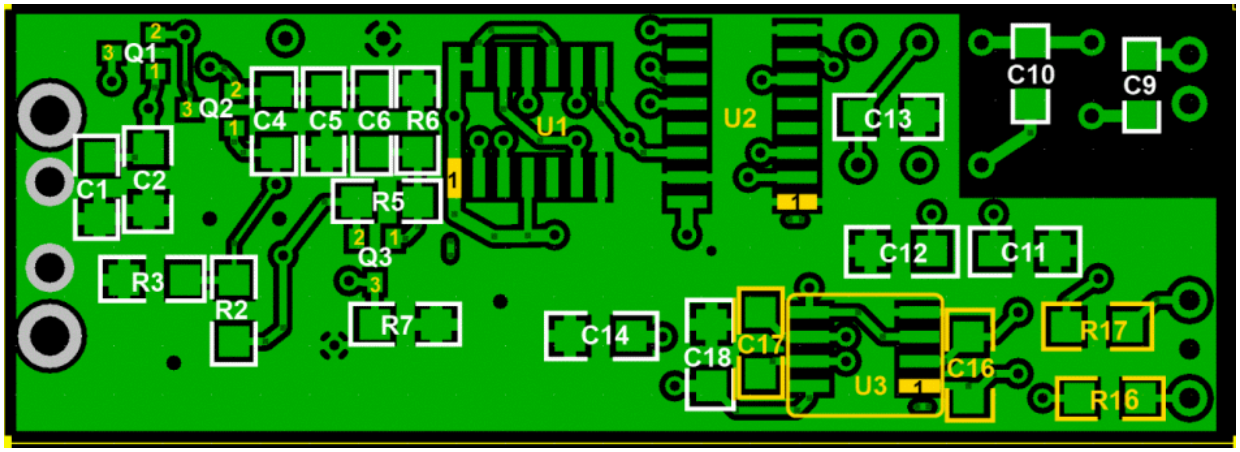


Board Layouts

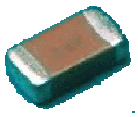
Board Top



Board Bottom



Stage Bill of Materials (20m band option)

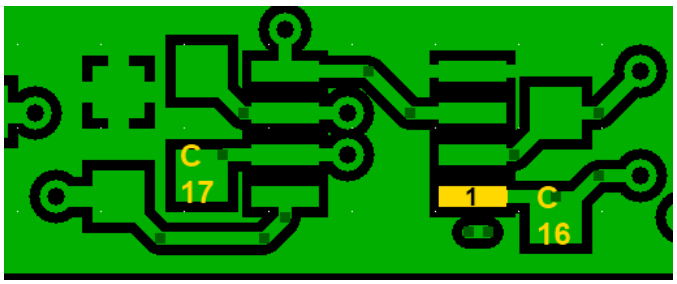
Check	Type	Category	Component	Count	Marking	Image
[ ]	Capacitor	SMT 1206	390pF 5%	2	in bag	
[ ]	Capacitor	SMT 1206	0.1 uF	2	(smt) black stripe	
[ ]	IC	SOIC-8	LT6231 dual op-amp	1	LT6231 ESD!!!	
[ ]	Resistor	SMT 1206 1/4W	100 1/4W 5%	2	101	

[ ]	Resistor	SMT 1206 1/4W	4.99k 1/4W 1%	2	4991	

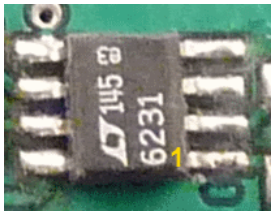
Detailed Build Steps

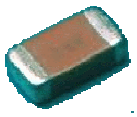
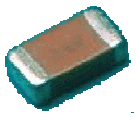
Install Underside Components

C16 and C17 will install very close to U3. Take care in installing them to be sure there are no solder splashovers to adjacent pins of U3. C16 connects to pins 1 and 2 of U3; C17 connects to pins 7 and 6 of U3. See the graphic:



U3 Orientation



Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	R16	100 1/4W 5%	bot	101		any
[ ]	R17	100 1/4W 5%	bot	101		any
[ ]	C16	390pF 5%	bot	in bag		20m
[ ]	C17	390pF 5%	bot	in bag		20m
[ ]	U03	LT6231 dual op-amp	bot	LT6231 **ESD!!!**		any

Install Topside Components

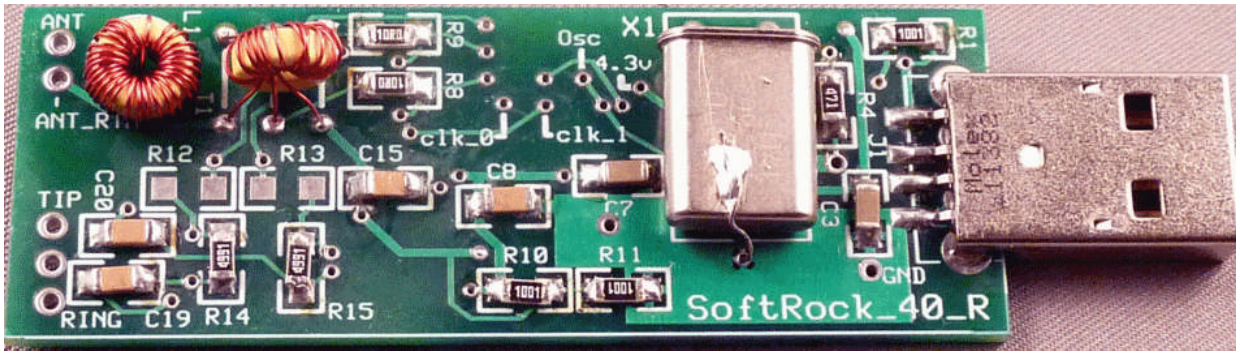
Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	C19	0.1 uF	top			any

				(smt) black stripe		
[ ]	C20	0.1 uF	top	(smt) black stripe		any
[ ]	R14	4.99k 1/4W 1%	top	4991		20m
[ ]	R15	4.99k 1/4W 1%	top	4991		20m

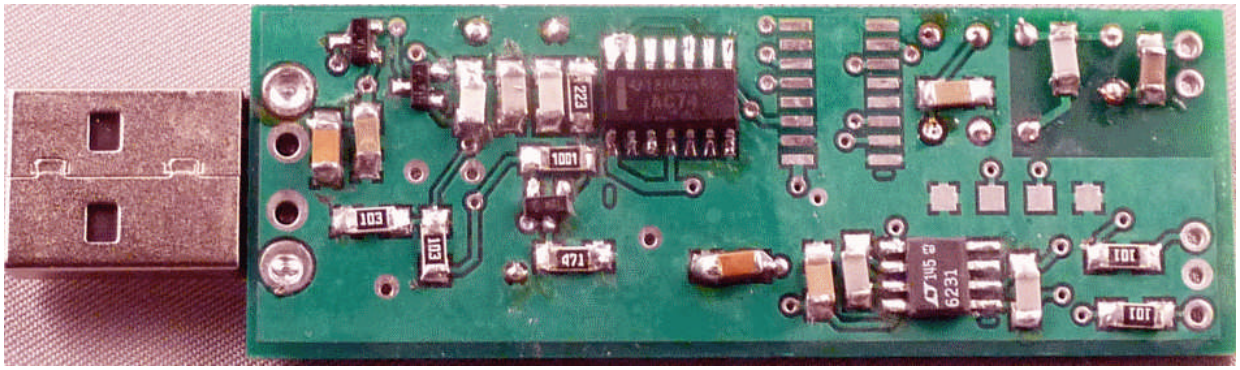
Completed Photos

Note: the completed pictures are of the 20m option, which the author built. Other band options (which the author did not build) will appear slightly different (especially the inductors, whose windings and cores will vary by band) for the band-specific components.

View of Completed Topside



View of Completed Underside



Testing

Overview

Before doing any testing, use a bright light and good magnification to verify correct soldering. Soldering problems are the greatest cause of test failures. Pay particular attention to U3.

USB Rail Integrity Test

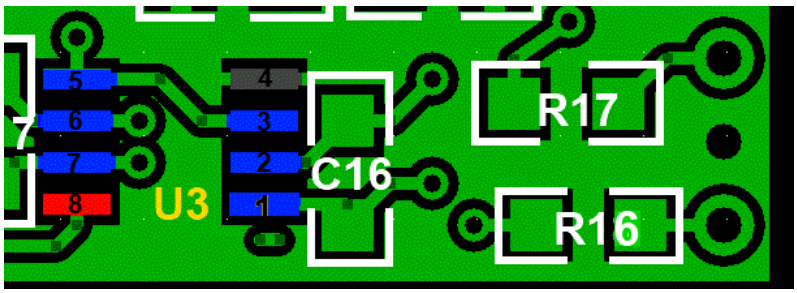
Before powering up, check the resistance across the 5V USB connections (pins 1 (5V) and 4 (gnd) of J1). If you get something very close to zero, you may have introduced a short and the possibility of "frying" your PC's USB Power Bus.

Voltage Tests - U3 Pins

When measuring pin voltages on U3, test the voltage on BOTH the pin and the pad. This will drive out any cases where the pad has the requisite voltage, but a bad solder joint causes the pin not to have the same voltage.

Test Table

Apply USB power and measure the voltages at the following test points/pin numbers shown in the figure below:



Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	U3 - Pin 1	Vdc	2.15	2.09*	_____
2	U3 - Pin 1	Vdc	2.15	2.06	_____
3	U3 - Pin 1	Vdc	2.15	2.06	_____
4	U3 - Pin 1	Vdc	0	0	_____
5	U3 - Pin 1	Vdc	2.15	2.06	_____
6	U3 - Pin 1	Vdc	2.15	2.06	_____
7	U3 - Pin 1	Vdc	2.15	2.09*	_____
8	U3 - Pin 1	Vdc	4.3	4.13	_____

* pins 1 and 7 are the amplified I and Q outputs. They have been known to show different pin voltages from the other nominally 2.15V pins.

Next, the Quadrature Sampling Detector (QSD)

Softrock40-R2: Quadrature Sampling Detector Band: 20m

Introduction

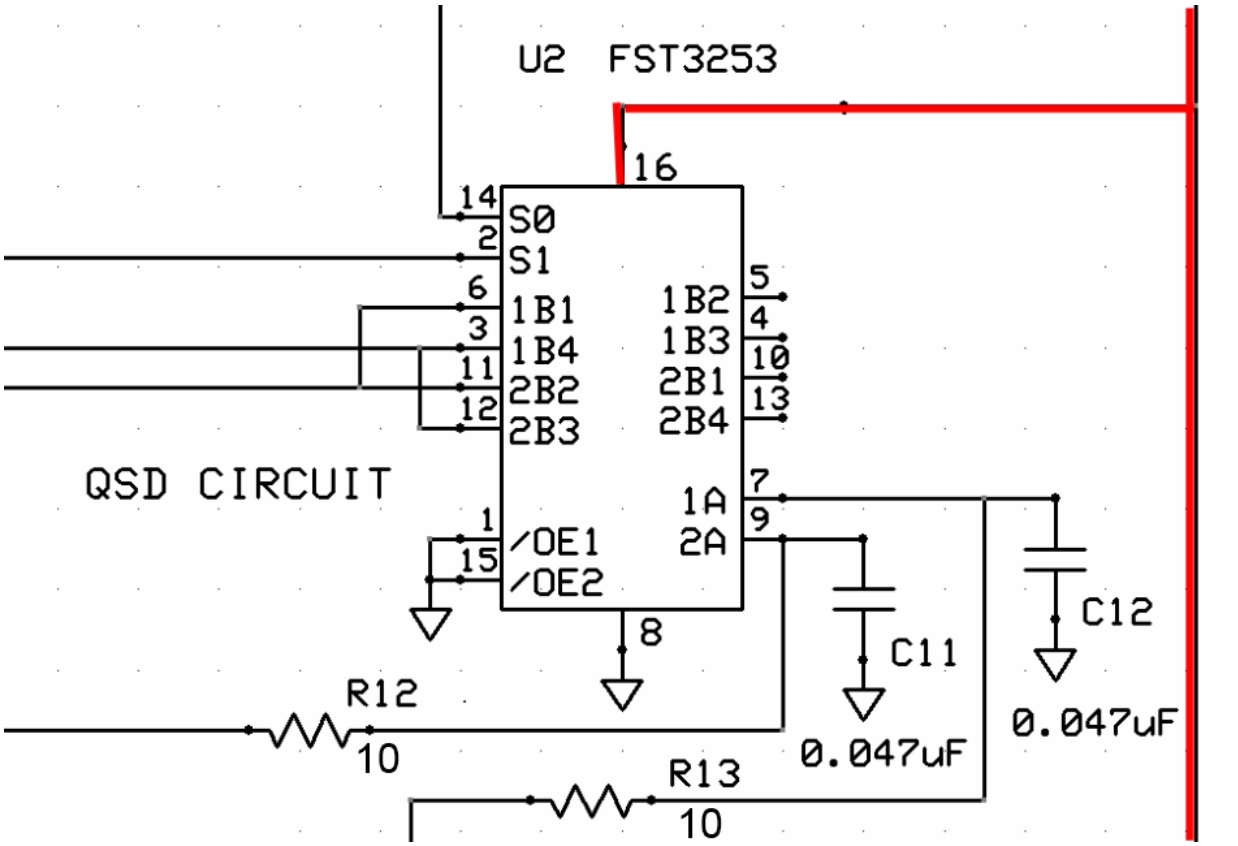
General Info About the Stage

This is the final stage before hooking up the antenna and stereo audio cables and running the "smoke test".

Theory of Operation

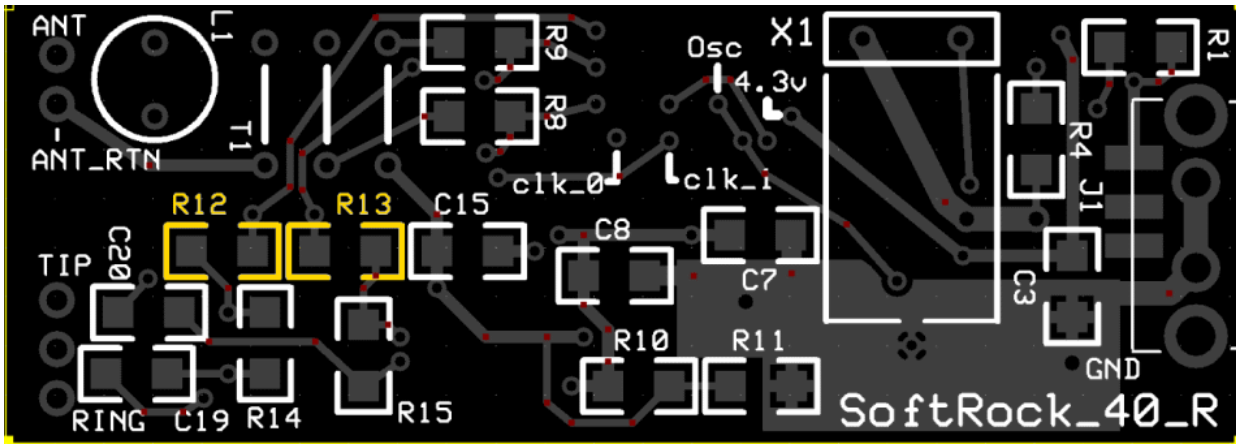
The Quadrature Sampling Detector (QSD) or "mixer" acts like two traditional direct conversion mixers operating in tandem. Each takes in half of the filtered RF from the bandpass filter stage and one of the quadrature center frequency signals, then "mixes"/down-converts them to an output being the traditional mixer products, in this case, two (infra) audio frequency signals that represent the difference between the two inputs (RF and Local Oscillator). These two signals are referred to as the detected 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).

Stage Schematic

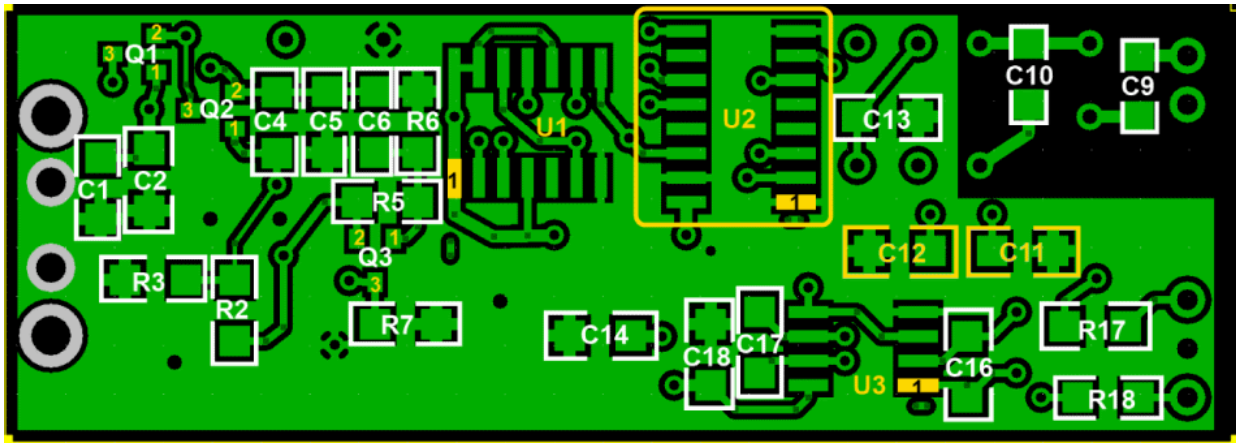


Board Layouts

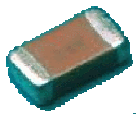
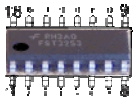
Board Top



Board Bottom

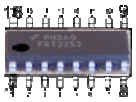
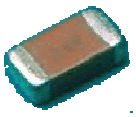
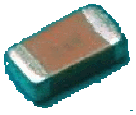


Stage Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
[ ]	Capacitor	SMT 1206	0.047uF 5%	2	in bag	
[ ]	IC	SOIC-16	FST3253 mux/demux switch	1	FST3253 ESD!!!	
[ ]	Resistor	SMT 1206 1/4W	10 ohm 1% 1/4W	2	10R0	

Detailed Build Steps

Install Underside Components

Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	U02	FST3253 mux/demux switch	bot	FST3253 ESD!!!		any
[ ]	C12	0.047uF 5%	bot	in bag		any
[ ]	C11	0.047uF 5%	bot	in bag		any

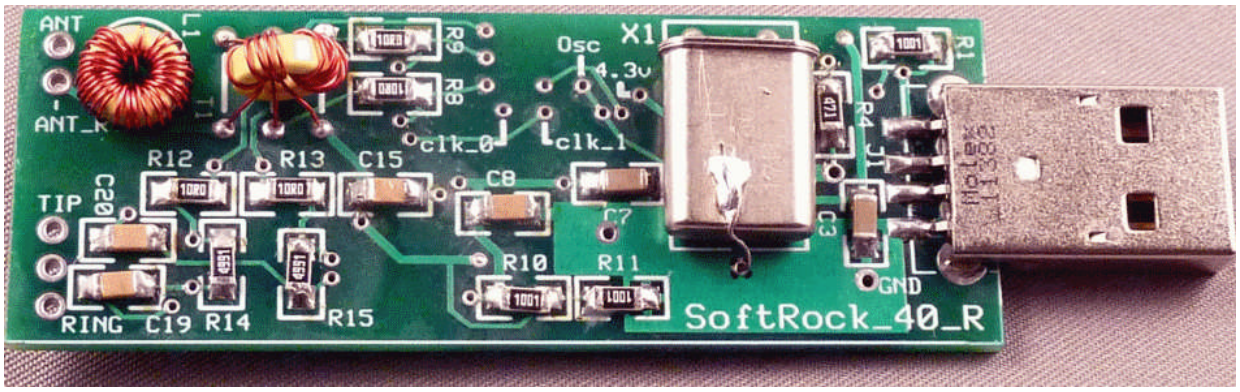
Install Topside Components

Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	R13		top	10R0		any

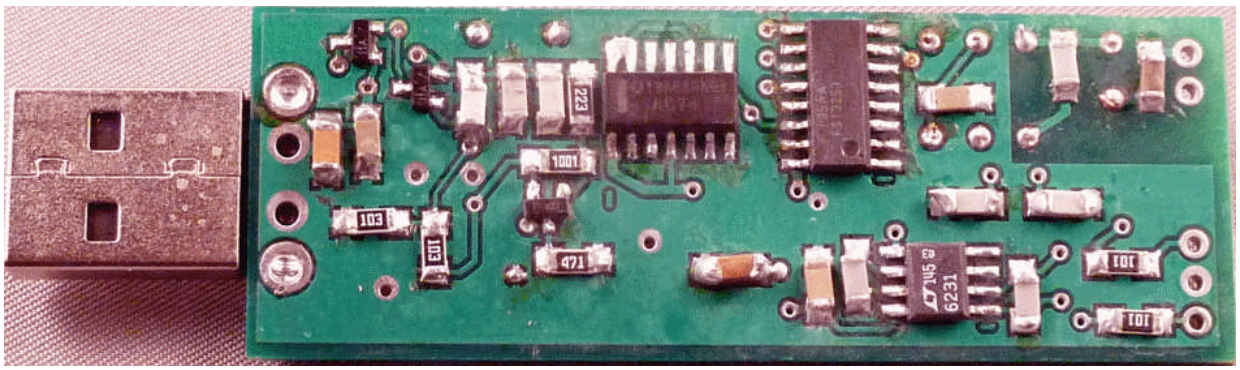
		10 ohm 1% 1/4W			10R0	
[ ]	R12	10 ohm 1% 1/4W	top	10R0	10R0	any

Completed Photos

View of Completed Topside



View of Completed Underside

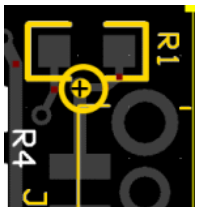


Testing

Overview

Before doing any testing, use a bright light and good magnification to verify correct soldering. Soldering problems are the greatest cause of test failures. Pay particular attention to U2.

USB Rail Integrity Test



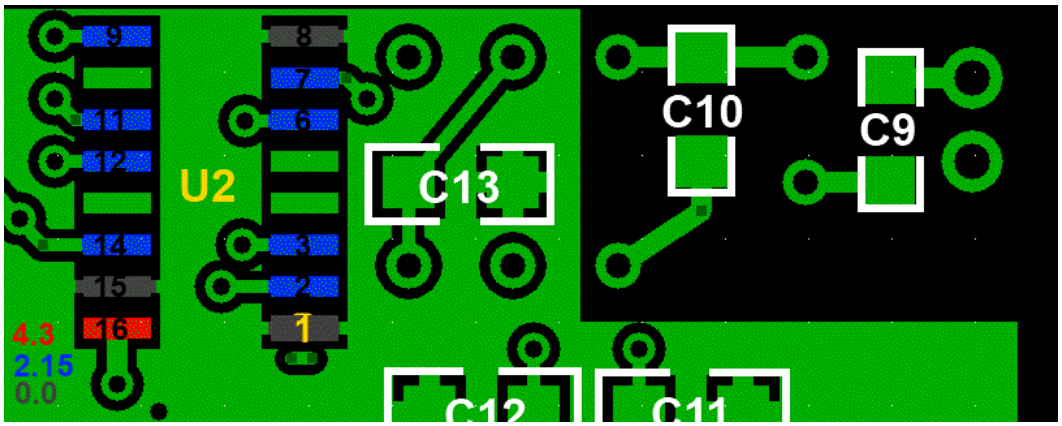
Before powering up, check the resistance across the 5V USB connections (pins 1 (5V) and 4 (gnd) of J1). If you get something very close to zero, you may have introduced a short and the possibility of "frying" your PC's USB Power Bus.

Voltage Tests - U2 Pins

When measuring pin voltages on U2, test the voltage on BOTH the pin and the pad. This will drive out any cases where the pad has the requisite voltage, but a bad solder joint causes the pin not to have the same voltage.

Test Table

Apply USB power and measure the voltages at the following test points/pin numbers shown in the figure below:



Note: pins 4,5,10, and 13 are omitted in the table below:

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	U2 - Pin 1	Vdc	0	0	_____
2	U2 - Pin 2	Vdc	2.15	2.05	_____
3	U2 - Pin 3	Vdc	2.15	2.07	_____
4	U2 - Pin 6	Vdc	2.15	2.07	_____
5	U2 - Pin 7	Vdc	2.15	2.07	_____
6	U2 - Pin 8	Vdc	0	0	_____
7	U2 - Pin 9	Vdc	2.15	2.07	_____
8	U2 - Pin 11	Vdc	2.15	2.07	_____
9	U2 - Pin 12	Vdc	2.15	2.07	_____
10	U2 - Pin 14	Vdc	2.15	2.05	_____
11	U2 - Pin 15	Vdc	0	0	_____
12	U2 - Pin 16	Vdc	4.3	4.13	_____

Next, the External Connections and Smoke Test

Softrock40-R2: External Connections
Band: 20m

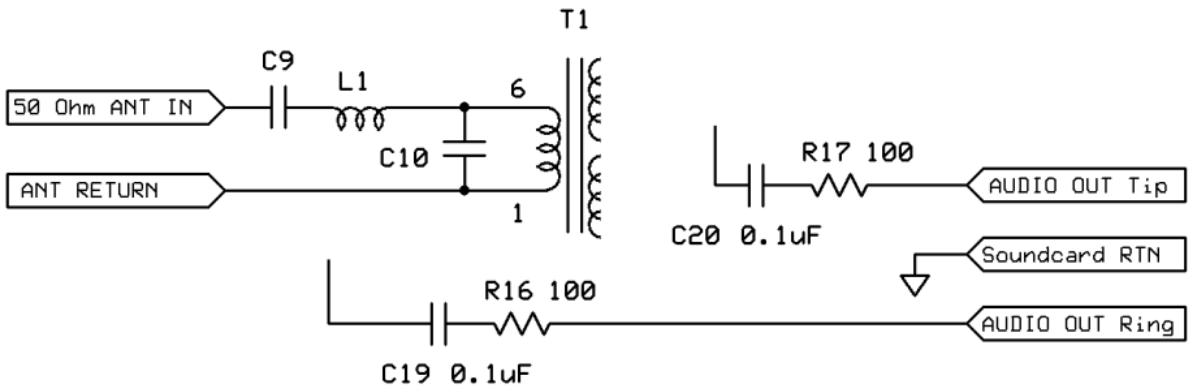
Introduction

This stage is still in construction. It involves connecting the stereo cable to the outputs of the opamps and connecting the short coax wires to the ANT/RET terminals. The software activities will be developed soon. In the meantime, refer to the similar procedures on the SR Lite II documentation for external connections and Rocky Software Installation

General Info About the Stage

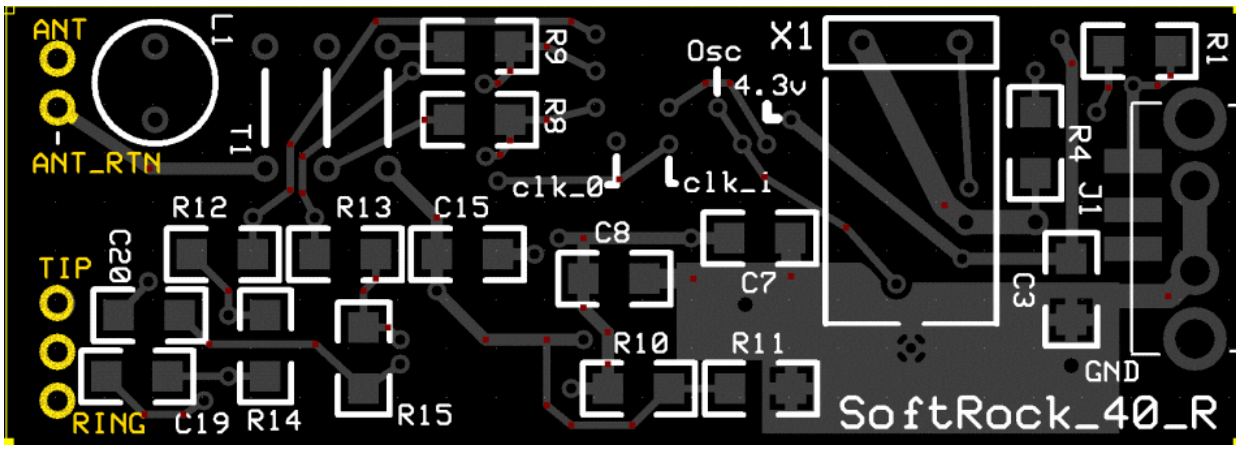
Theory of Operation

Stage Schematic

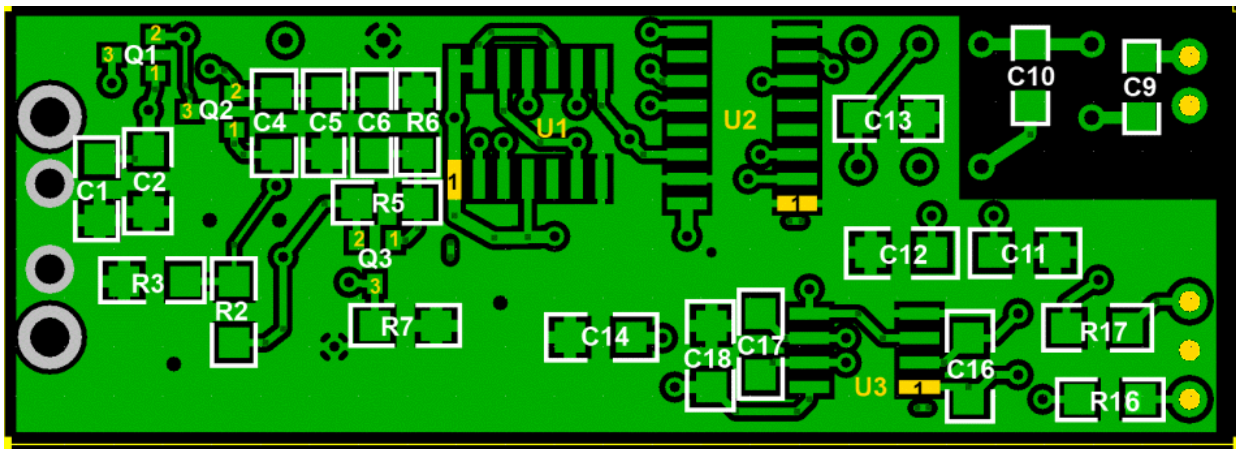


Board Layouts

Board Top



Board Bottom



Stage Bill of Materials (20m band option)

Check	Type	Category	Component	Count	Marking	Image
[ ]	Cable	User-Supplied	1/8" M-M Stereo Audio Shld Cable	1		
[ ]	connector	Cable	antenna COAX	1		
[ ]	wire	Hookup	misc hookup wire	1		

Detailed Build Steps

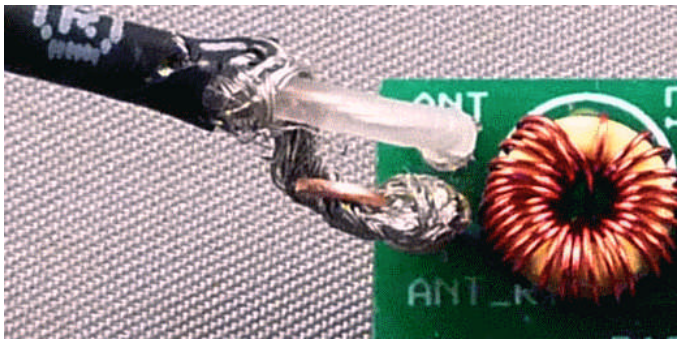
Install Cables

The audio cable provided (at least the author;s version) is two conductor with ground wire wrapped around the 2 conductors. The "TIP" conductor is a red wire; the "RING" conductor is a white wire.

Prepare the audio cable, stripping and tinning the red and white wires and soldering the common (shield) sheaf to a short length of hookup wire. This hookup wire, provided in the cable bag, will be

wrapped arounf the cable at the point of connection to the board and then soldered into the "common" hole (between the "TIP" and "RING" holes, so as to have the hookup wire take the strain/stress from the cable.

Similarly, connect the coax cable's center conductor to the "ANT" hole and the braid to the "ANT-RET" hole. (The author used a bit of hookup wire soldered to the braid to make the actual connection to the ANT-RET hole).



Check	Designation	Component	top/Bottom	Marking	Image	Band
[ ]	strain_relief	misc hookup wire	top			any
[ ]	cbl-audio	1/8" M-M Stereo Audio Shld Cable	top			any
[ ]	cbl_ant	antenna COAX	top			any

Install Software

TBD: This step will describe the installation and use of the new SDR program "SDR Sharp" (or "SDR#").

In the meantime, the process of installing and using Rocky v3.7 (as described in the SR-LITE II kit builders notes should be used

Check	Designation	Component	top/Bottom	Marking	Image	Band

Connect Radio

Once the cables are installed and the Software installed and tested, the only thing remaining is to connect the radio to the PC and to the Antenna.

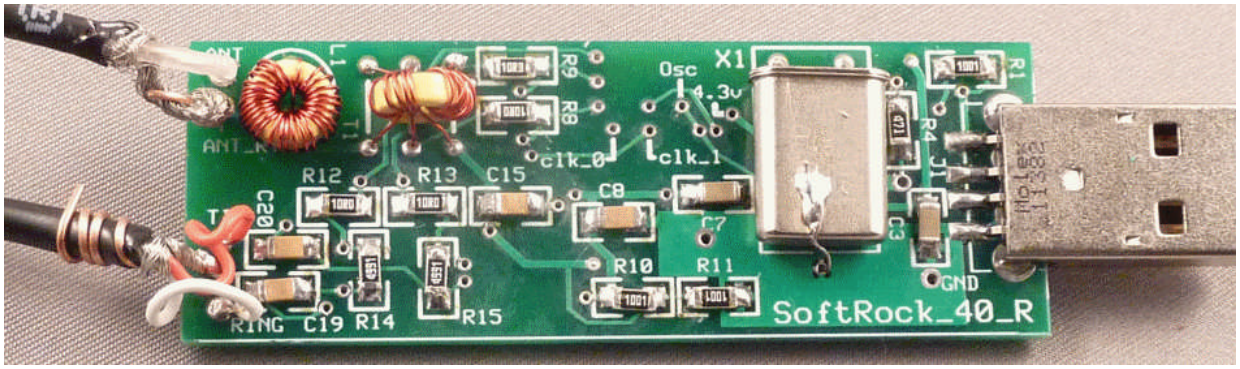
1. Connect the antenna cable to a 50 ohm antenna
2. plug the audio plug at the end of the audio calble into the "Line-In" jack of your PC's sound card. (Note: MUST BE STEREO")

3. Plug the Softrock 40-R's USB plug into a convenient USB jack on your PC
4. Start up the SDR software: Configure the software so it recognizes the center frequency for the Softrock 40-R (e.g., 20m is 14.047MHz)
5. Enjoy!

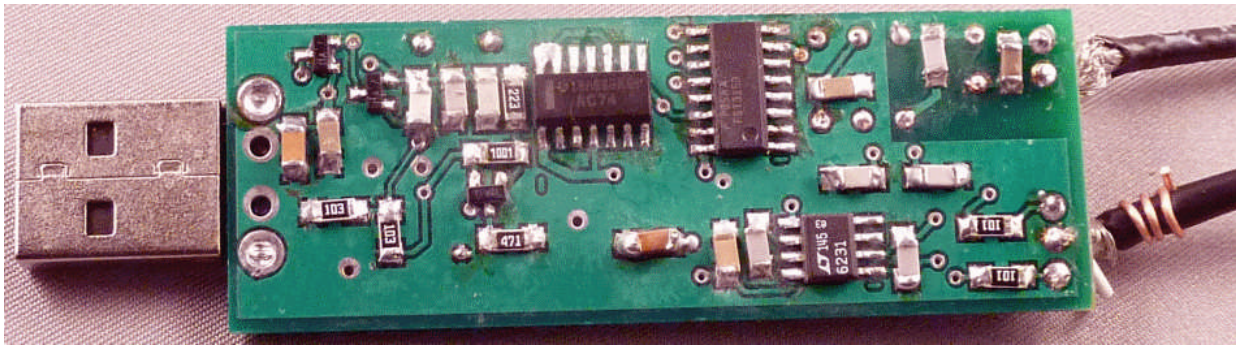
Check	Designation	Component	top/Bottom	Marking	Image	Band

Completed Photos

View of Completed Topside



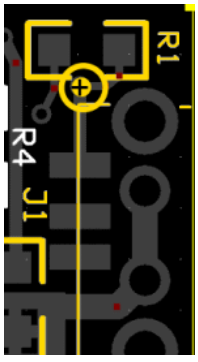
View of Completed Underside



Testing

Overview

USB Rail Integrity Test



Before powering up, check the resistance across the 5V USB connections (pins 1 (5V) and 4 (gnd) of J1). If you get something very close to zero, you may have introduced a short and the possibility of "frying" your PC's USB Power Bus.

Name of Test

<alt text>

Test Procedure

Potential issues:

-
-

Test Table

Seq	Test Point	Units	Nominal Value	Author's Value	Your Value
1	"A" on	unit	nom	authtbd	_____
2	"B" on	unit	nom	authtbd	_____