

Ensemble RXTX 07_RX Opamps and Output

[Home](#) [Bill of Materials](#) [Power Supply](#) [USB Power Supply](#) [Local Oscillator](#) [Dividers](#) [RF I/O and Switching](#) [RX Mixer \(QSD\)](#) [RX Opamps and Output](#) [TX Opamps](#) [TX Mixer \(QSE\)](#) [Driver/PA](#) [External Connections](#) [Comments](#)
[Acronyms](#) [Inventory](#) [Revisions as of 3/21/2011](#) [Components By Stage](#) [WB5RVZ Main Website](#)

Search: Search selected SDR sites

RX Opamps and Output Introduction

General

This stage accepts, as input, the down-converted "chunk" of spectrum containing the signals occurring either side of the center frequency set by the Quadrature Clock Generator (Dividers). This "chunk" is in the base-band, at frequencies ranging from zero to (roughly) 100 kHz or so. There are "I" (In-Phase) and a "Q" (Quadrature) signals, each identical in all respects except phase (90 degrees difference).

The "I" and "Q" signals are amplified in this high-gain op-amp and output to the "Line-In" jack for input to the PC's soundcard's "Line-In" jack. A very important aspect of this latter is that the PC's soundcard MUST be capable of accepting STEREO inputs. If the input to the soundcard is MONO, the radio will not work correctly, and you will see identical, "mirror" images on either side of the center frequency in the spectrum display of the SDR program..

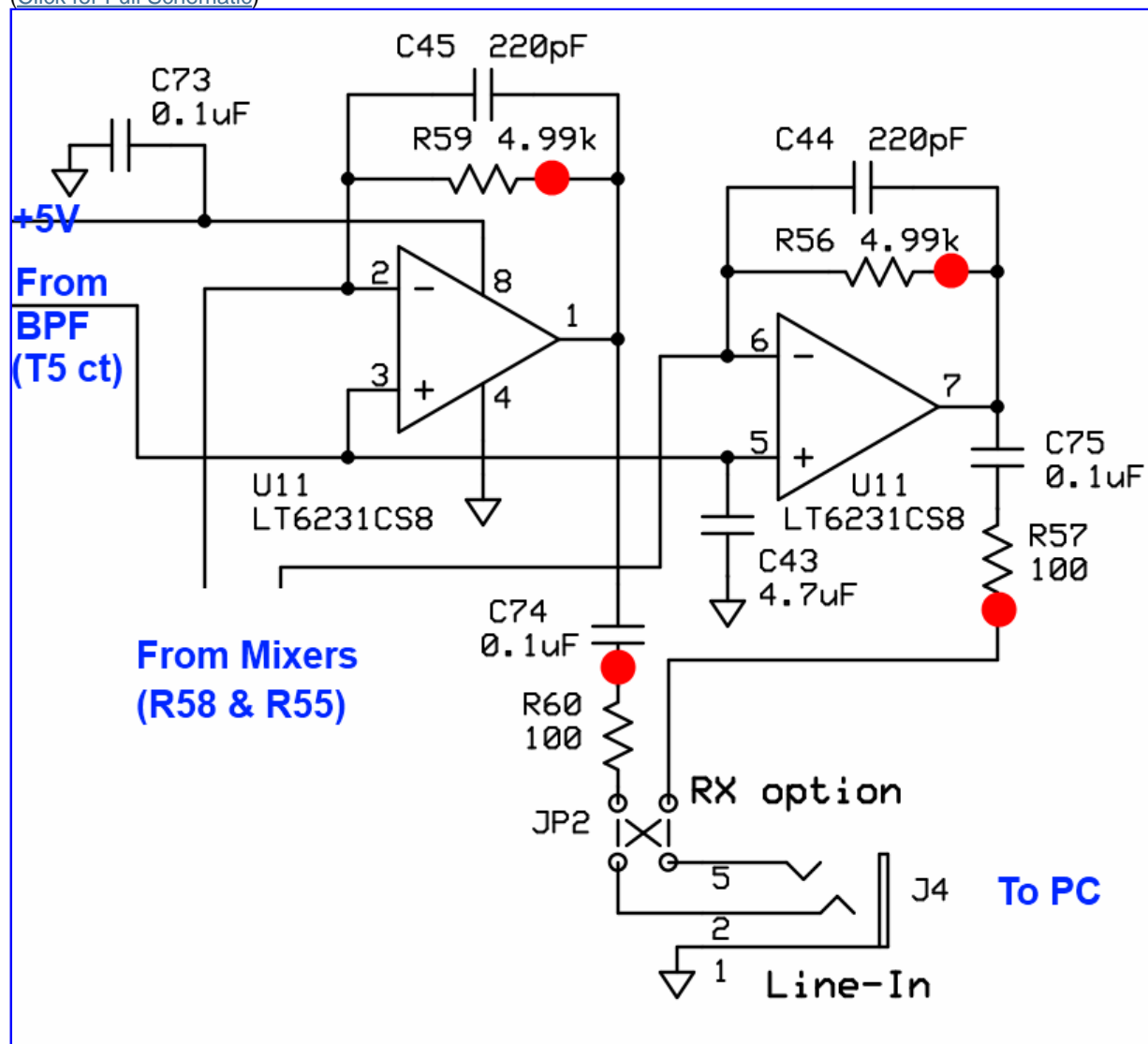
At the completion of this stage, you should have and be able to exercise RX capability!.

[\(go directly to build notes\)](#)

RX Opamps and Output Schematic

(Resistor testpoints (hairpin, top, or left-hand lead), as physically installed on the board, are marked in the schematic with red dots)

([Click for Full Schematic](#))





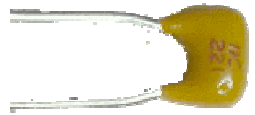




(above schematic has clickable areas that can be used for navigation)

([go directly to build notes](#))

RX Opamps and Output Bill of Materials

Stage Bill of Materials

(resistor images and color codes courtesy of [Wilfried, DL5SWB's R-Color Code program](#))

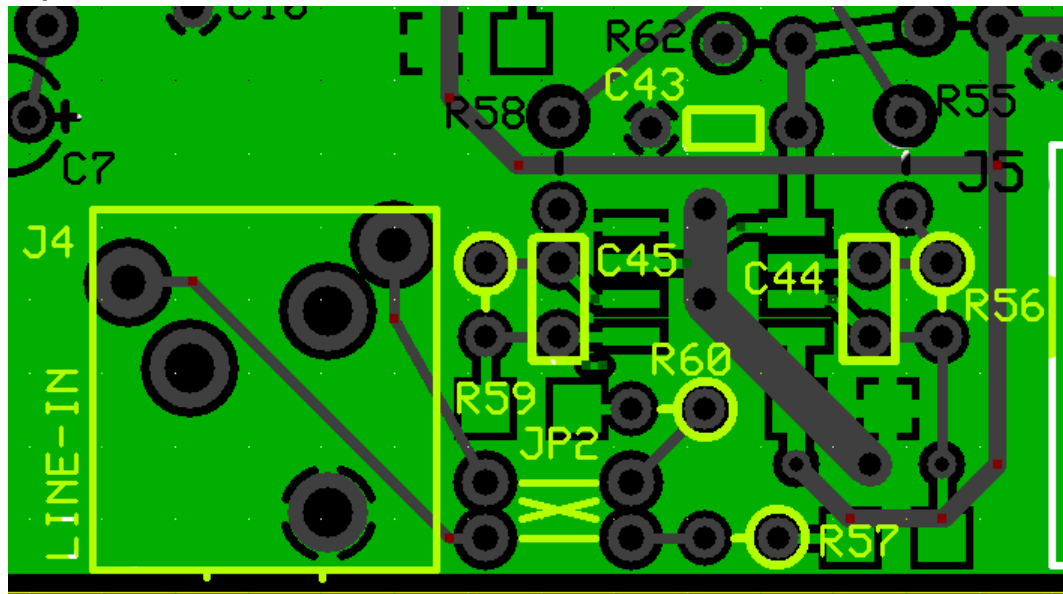
Check	Count	Component	Marking	Category
<input type="checkbox"/>	2	4.99 k 1/4W 1%	y-w-w-br-br 	1/4W
<input type="checkbox"/>	2	100 1/6W 5%	br-blk-br-gld 	1/6W
<input type="checkbox"/>	2	220 pF 5%	 221	Ceramic
<input type="checkbox"/>	1	4.7 uF 10% 16V X7R RAD	 475	Ceramic
<input type="checkbox"/>	2	shunt wire (cut-off lead)		Cutoff
<input type="checkbox"/>	1	3.5mm stereo jack - PCB mount (rt-angle)		Jack-RA
<input type="checkbox"/>	3	0.1 uF	(smt) black stripe 	SMT 1206
<input type="checkbox"/>	1	LT6231 dual op-amp	 LT6231	SOIC-8

RX Opamps and Output Summary Build Notes

- Install Bottomside Caps and IC
- Install Topside Resistors and Caps
- Install Jack and I/Q Shunts
- [Test the Stage](#)

RX Opamps and Output Detailed Build Notes





Top of the Board






Install Topside Resistors and Caps

Note: the two 100 ohm resistors (R57 and R60) in series with the outputs are there because the op-amps don't like to drive purely capacitive loads - it degrades the phase margins.


Note also that these are the smaller 1/6Watt resistors; not 1/4 watt variety.

Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	C44	220 pF 5%	221 	Ceramic		
<input type="checkbox"/>	C45	220 pF 5%	221 	Ceramic		
<input type="checkbox"/>	C43	4.7 uF 10% 16V X7R RAD		Ceramic		
<input type="checkbox"/>	R57	100 1/6W 5%	475 br-blk-br-gld 	1/6W	E-W	

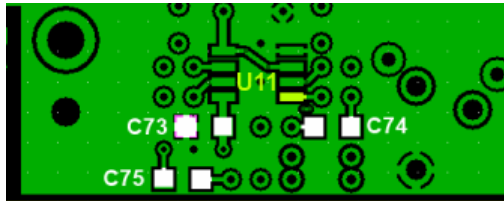
<input type="checkbox"/>	R60	100 1/6W 5%	br-blk-br-gld 	1/6W	E-W	
<input type="checkbox"/>	R56	4.99 k 1/4W 1%	y-w-w-br-br 	1/4W	N-S	
<input type="checkbox"/>	R59	4.99 k 1/4W 1%	y-w-w-br-br 	1/4W	N-S	

Install Jack and I/Q Shunts



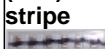
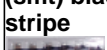
In both the RX op amp and TX QSE sections, the jumper links on the I/Q input and outputs should ideally be fitted crossed over. That provides compatibility with all versions of PowerSDR. For Rocky and Winrad it is necessary to use the 'swap IQ' functions in their set up. If you jumper them straight across fine for Rocky and Winrad, but you will not be able to use any version of PSDR. (Author wired for Rocky)

Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	J4	3.5mm stereo jack - PCB mount (rt-angle)		Jack-RA		
<input type="checkbox"/>	JP2a	shunt wire (cut-off lead)		Cutoff		
<input type="checkbox"/>	JP2b	shunt wire (cut-off lead)		Cutoff		

Bottom of the Board

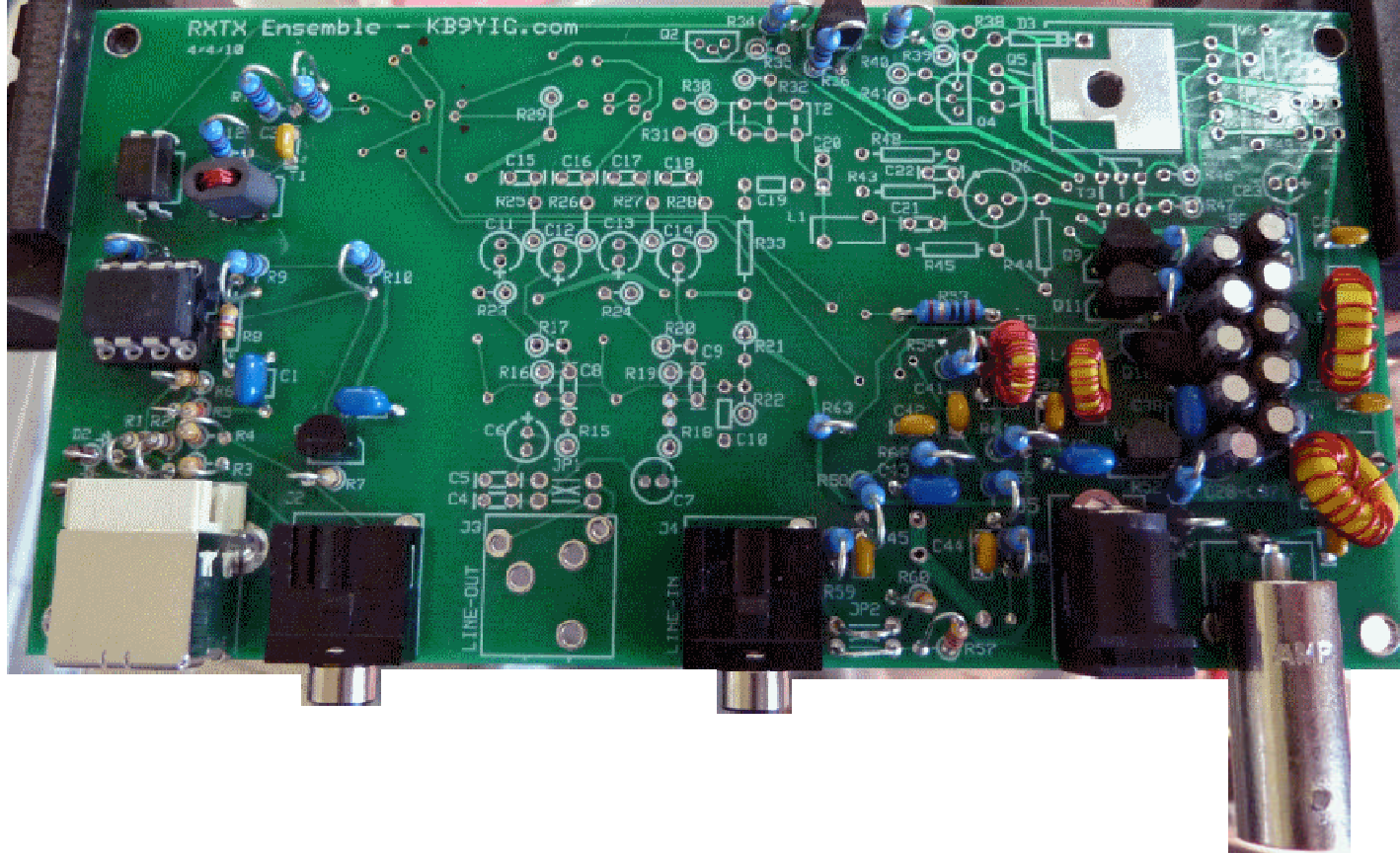


Install Bottomside Caps and IC

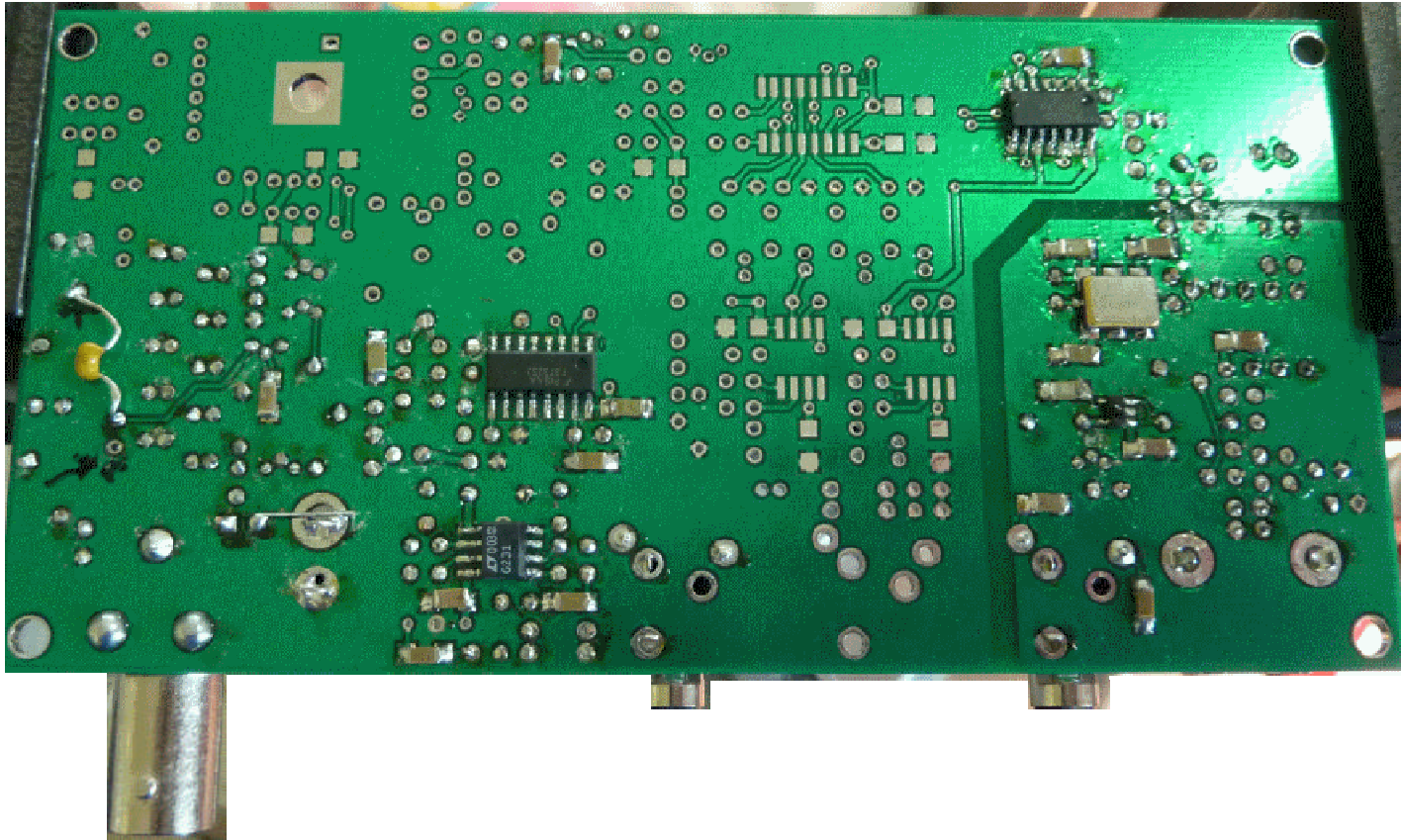
Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	U11	LT6231 dual op-amp		SOIC-8	(or LT6221)	Take ESD precautions Some kits may substitute 6221
<input type="checkbox"/>	C73	0.1 uF	(smt) black stripe 	SMT 1206		
<input type="checkbox"/>	C74	0.1 uF	(smt) black stripe 	SMT 1206		
<input type="checkbox"/>	C75	0.1 uF	(smt) black stripe 	SMT 1206		

RX Opamps and Output Completed Stage

Top of the Board



Bottom of the Board



RX Opamps and Output Testing

Current Draw

Test Setup

Measure the current draw of the board with both USB and regular power applied.

Test Measurements

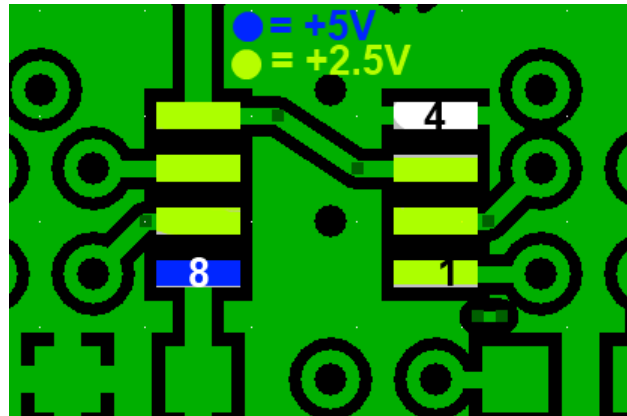
Testpoint	Units	Nominal Value	Author's	Yours
Current drawn	mA	< 25	20.7	

Pin Voltage Tests

Test Setup

Test pin voltages WRT regular ground, as per graphic

As usual, if you are having any problems with this stage, be sure to measure the pin voltages two ways: first, measure each pin at the pin itself (on the IC). Then take a second measurement at the pin pad (on the board). If those two measurements do NOT agree, you very likely have a soldering issue.



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Pin 1	Vdc	2.5	2.67	
Pin 2	Vdc	2.5	2.5	
Pin 3	Vdc	2.5	2.5	
Pin 4	Vdc	0	0	
Pin 5	Vdc	2.5	2.5	
Pin 6	Vdc	2.5	2.5	
Pin 7	Vdc	2.5	2.65	
Pin 8	Vdc	5	4.95	

OpAmp Function Test

Test Setup

Test Setup

In this test, you will test the DC gain of each of the op-amps by connecting a 10k bridging resistor R_b from each op-amp inverting input to circuit regular ground. Introducing the "bridging" resistor R_b will result in a test current equal to $2.5 / R_i$, which will be balanced by the current fed back from each op-amp's output through each feedback resistor, R_f (i.e., R56 or R59). Each op-amp output will increase in voltage by $2.5 * R_f / R_b$ from the nominal DC level of 2.5 volts.

(If you have not yet built the TX OpAmp stage, the 10k bridging resistor (R_b) will be available for your use)

Test the First OpAmp

1. Power up the circuit and measure the voltage at pin 1 of the op-amp (hairpin of R59). It should be ~2.5 Vdc
2. Power off and use clip leads to connect R_b between the hairpin of R58 and circuit ground (the left lead of C43 is a convenient ground). This provides an input resistance (R_i) of 10 k Ω to the op-amp.
3. Power up and measure the output voltage (WRT regular ground) at the hairpin of the feedback resistor R59. You should get: ~3.75 Vdc at R59 hairpin.
4. Remove R_b and the output voltage at R59 should go back to ~2.5 Vdc.

Test the Second OpAmp

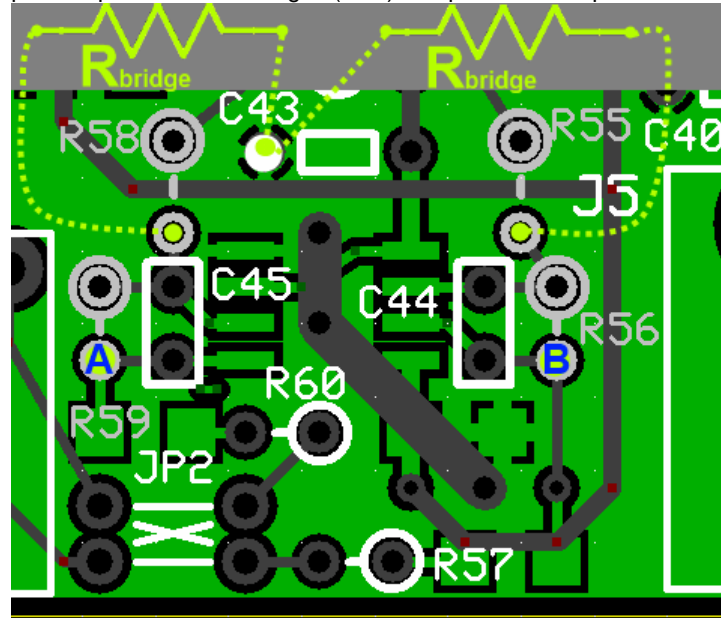
1. Power up the circuit and measure the voltage at pin 7 of the op-amp (hairpin of R56). It should be ~2.5 Vdc

2. Power off and use clip leads to connect R_b between the hairpin of R55 and circuit ground (the left lead of C43 is a convenient ground). This provides an input resistance(R_i) of 10 k Ω to the op-amp.
3. Power up and measure the output voltage (WRT regular ground) at the hairpin of the feedback resistor R56. You should get: ~3.75 Vdc at R56 hairpin.
4. Remove R_b and the output voltage at R56 should go back to ~2.5 Vdc.

The diagram below shows the test points. The yellow dots show the R_b connection points for each "side" of the opamps.

The dots marked "A" and "B" show the measurement points for the output voltages for Each "side" of the OpAmps.

An [Excel spreadsheet with a calculator for this test](#) is available for you to plug in your bridging resistor ohms (R_i) and your pin 1 or pin 7 normal voltages (E_{bias}) and predict the expected voltage when bridged (E_{out}).



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Measure "A" (R59) (normal)	Vdc	2.5	2.67	
Measure "A" (R59) (R58 bridged with 10k to ground)	Vdc	3.75	3.92	
Measure "B" (R56)	Vdc	2.5	2.65	
Measure "B" (R56) (R55 bridged with 10k to ground)	Vdc	3.75	3.89	

RX Test

Test Setup

Prepare an SDR program for RX (author recommends [Rocky](#) for the Windows XP crowd; [WinradHD](#) for other Windows OS). This usually involves downloading and installing the program; selecting the desired soundcard for the (STEREO) input of the I and Q signals from the board; and connecting the board to the soundcard with a stereo cable with 1/8" stereo plugs on either end..

Once the SDR program is ready, connect the USB cable from your PC to the board, connect the 12V power to the board, and connect a 50 ohm antenna to J6.

Start the SDR program and adjust the LO frequency to the desired center frequency. You should see signals in the displayed spectrum. If there is a contest going on at test time, you will be even more impressed with the RX.!

Note: for either SDR program to work with the Ensemble RXTX, you MUST have installed the driver (libusb) for the Microcontroller's USB functionality. For WinradHD, you will also need to have downloaded and saved in the same directory as WinradHD, the [EXTIO_Si570.dll file](#).

If you are seeing perfect mirror images of the signals either side of the center frequency, you should review the information in the [Image Rejection Hints](#) page.

[Home](#) [Bill of Materials](#) [Power Supply](#) [USB Power Supply](#) [Local Oscillator](#) [Dividers](#) [RF I/O and Switching](#) [RX Mixer \(QSD\)](#) [RX Opamps and Output](#) [TX Opamps](#)
[TX Mixer \(QSE\)](#) [Driver/PA](#) [External Connections](#) [Comments](#) [Acronyms](#) [Inventory](#) [Revisions as of 3/21/2011](#) [Components By Stage](#) [WB5RVZ Main Website](#)