

Ensemble RXTX 08_TX Opamps

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TX Opamps Introduction

General

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)).

Theory of Operation

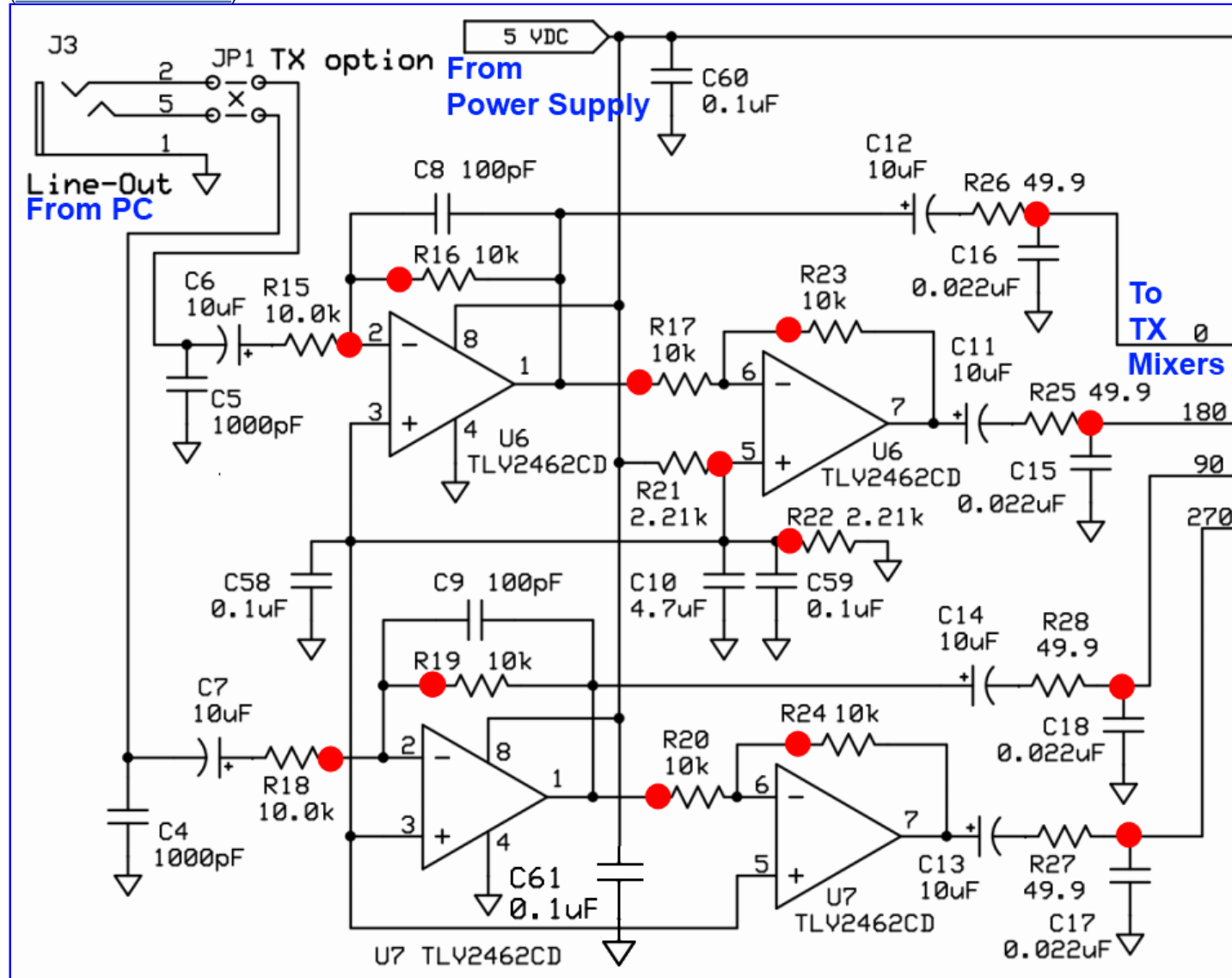
(see the [Theory of Operation](#) in the TX Mixer (QSE) Stage)

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

TX Opamps 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](#))








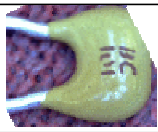






(above schematic has clickable areas that can be used for navigation)

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

TX Opamps Bill of Materials

Stage Bill of Materials

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

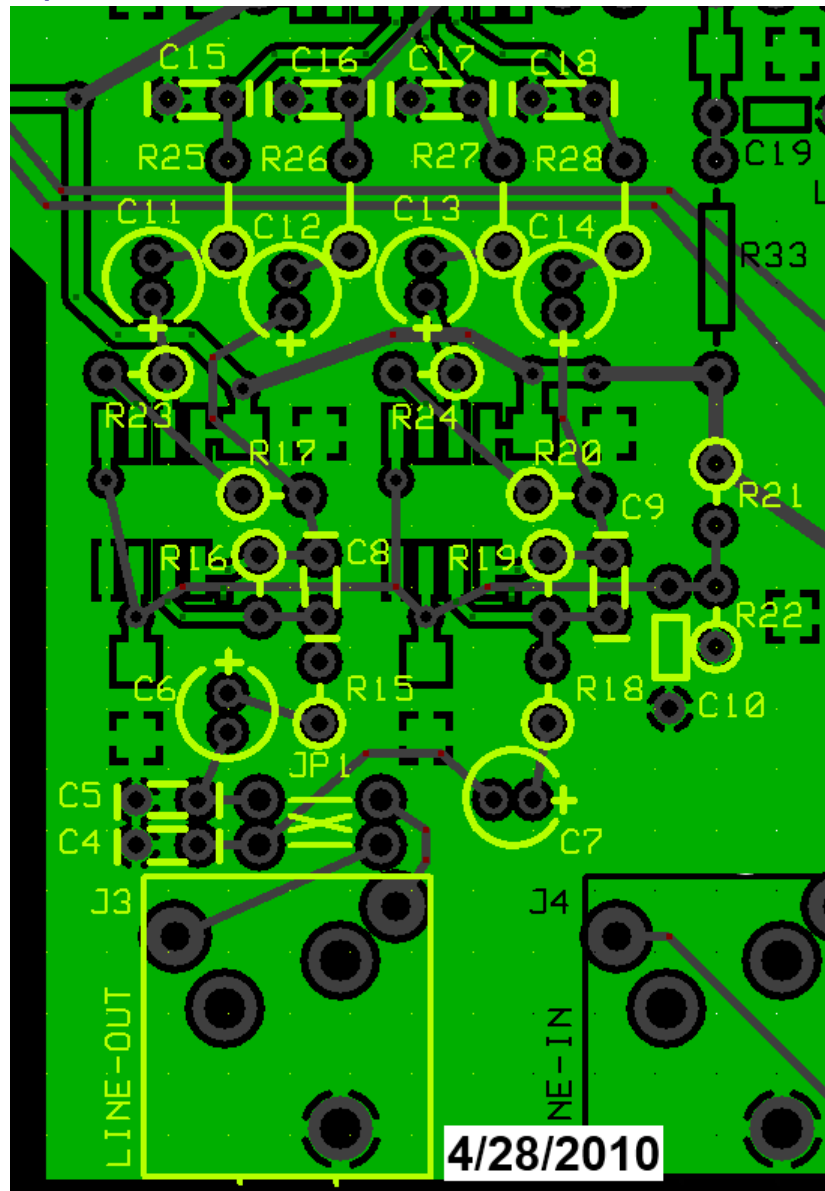
Check	Count	Component	Marking	Category
<input type="checkbox"/>	8	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W
<input type="checkbox"/>	2	2.21 k 1/4W 1%	r-r-br-br-br 	1/4W
<input type="checkbox"/>	4	49.9 ohm 1%	yel-wht-wht-gld-brn 	1/4W
<input type="checkbox"/>	1	100k 1/6W 5%	brn_blk_yel_grn 	1/6W
<input type="checkbox"/>	4	0.022 uF 5%	 223	Ceramic
<input type="checkbox"/>	2	100 pF 5%	 101	Ceramic
<input type="checkbox"/>	2	1000 pF 5%	 102	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"/>	6	10uF/16 VDC		Electrolytic
<input type="checkbox"/>	1	3.5mm stereo jack - PCB mount (rt-angle)		Jack-RA
<input type="checkbox"/>	4	0.1 uF	(smt) black stripe 	SMT 1206
<input type="checkbox"/>	2	TLV2462CD dual opamp	 TVL2462CD	SOIC-8

TX Opamps Summary Build Notes

- Install Bottomside Components
- Install Topside Components
- Install IQ-In Jack and Jumpers
- [Test the Stage](#)

















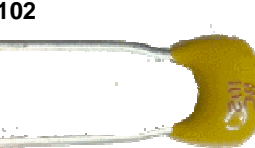
TX Opamps Detailed Build Notes

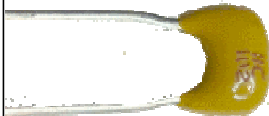












Top of the Board



Install Topside Components

After installing R21 and R22, you might want to run a quick powered test at the junction (R21 hairpin lead). R21/22 form a voltage divider on the 5 volt rail and you should see one-half the 5 volt rail voltage WRT regular ground (about 2.5 Vdc).

Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	R21	2.21 k 1/4W 1%	r-r-br-br-br 	1/4W	N-S	
<input type="checkbox"/>	R22	2.21 k 1/4W 1%	r-r-br-br-br 	1/4W	S-N	
<input type="checkbox"/>	R25	49.9 ohm 1%	yel-wht-wht-gld-brn 	1/4W	S-N	
<input type="checkbox"/>	R26	49.9 ohm 1%	yel-wht-wht-gld-brn 	1/4W	S-N	
<input type="checkbox"/>	R27	49.9 ohm 1%	yel-wht-wht-gld-brn 	1/4W	S-N	
<input type="checkbox"/>	R28	49.9 ohm 1%	yel-wht-wht-gld-brn 	1/4W	S-N	
<input type="checkbox"/>	R15	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	S-N	
<input type="checkbox"/>	R16	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	N-S	
<input type="checkbox"/>	R17	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	W-E	
<input type="checkbox"/>	R18	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	S-N	
<input type="checkbox"/>	R19	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	N-S	
<input type="checkbox"/>	R20	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	W-E	
<input type="checkbox"/>	R23	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	E-W	
<input type="checkbox"/>	R24	10 k 1/4W 1%	br-blk-blk-r-br 	1/4W	E-W	
<input type="checkbox"/>	C08	100 pF 5%	 101	Ceramic		
<input type="checkbox"/>	C09	100 pF 5%	 101	Ceramic		
<input type="checkbox"/>	C04	1000 pF 5%	 102	Ceramic		


<input type="checkbox"/>	C05	1000 pF 5%	102 	Ceramic		
<input type="checkbox"/>	C15	0.022 uF 5%	223 	Ceramic		
<input type="checkbox"/>	C16	0.022 uF 5%	223 	Ceramic		
<input type="checkbox"/>	C17	0.022 uF 5%	223 	Ceramic		
<input type="checkbox"/>	C18	0.022 uF 5%	223 	Ceramic		
<input type="checkbox"/>	C10	4.7 uF 10% 16V X7R RAD	475 	Ceramic		
<input type="checkbox"/>	C06	10uF/16 VDC		Electrolytic		
<input type="checkbox"/>	C07	10uF/16 VDC		Electrolytic		
<input type="checkbox"/>	C11	10uF/16 VDC		Electrolytic		
<input type="checkbox"/>	C12	10uF/16 VDC		Electrolytic		
<input type="checkbox"/>	C13	10uF/16 VDC		Electrolytic		
<input type="checkbox"/>	C14	10uF/16 VDC		Electrolytic		
<input type="checkbox"/>	R-TEST	100k 1/6W 5%	brn blk_yel_grn 	1/6W	(Not supplied with kit)	Only needed for TX

OpAmps functional test

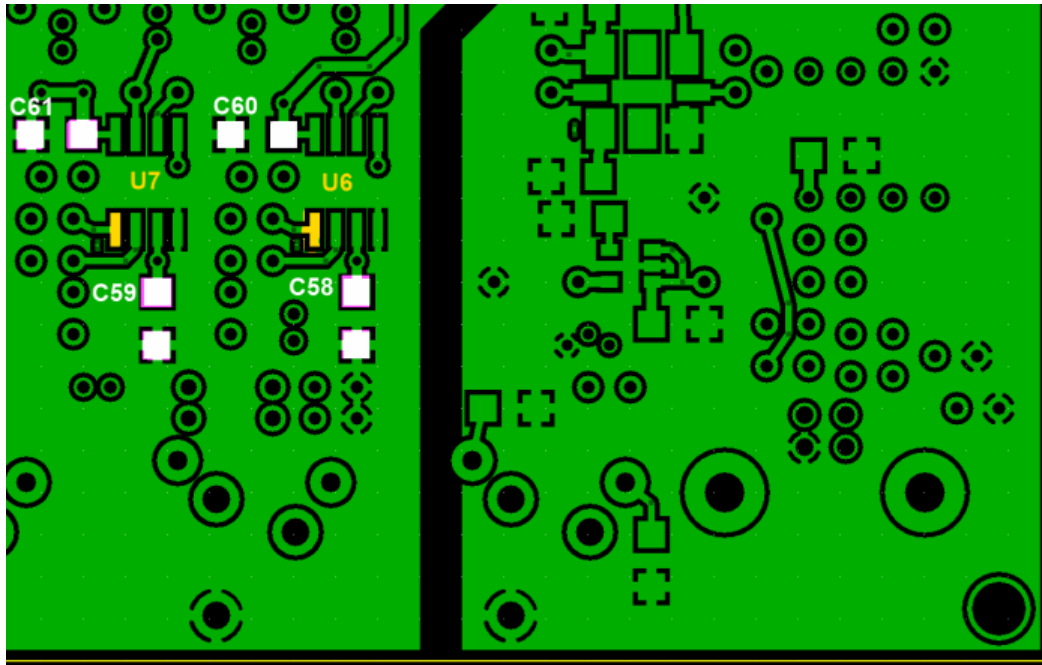
Install IQ-In Jack and Jumpers

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)






Recently, there have been extensive [discussions on the reflector](#) concerning the fact that some builders have a combination of soundcard, software, PC, and operating system in which the jumpers/leads for the TX I and Q signals must be the reverse of the jumpers/leads for the RX I and Q. This has been pretty much a case-by-case experience. We are building a [spreadsheet depicting various combinations of the relevant variables](#) (soundcard, program, kit, PS, OS, etc.) and the wiring that "works" for the RX and TX I and Q signals.

Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	JP1A	shunt wire (cut-off lead)		Cutoff		
<input type="checkbox"/>	JP1B	shunt wire (cut-off lead)		Cutoff		
<input type="checkbox"/>	J3	3.5mm stereo jack - PCB mount (rt-angle)		Jack-RA		

Bottom of the Board



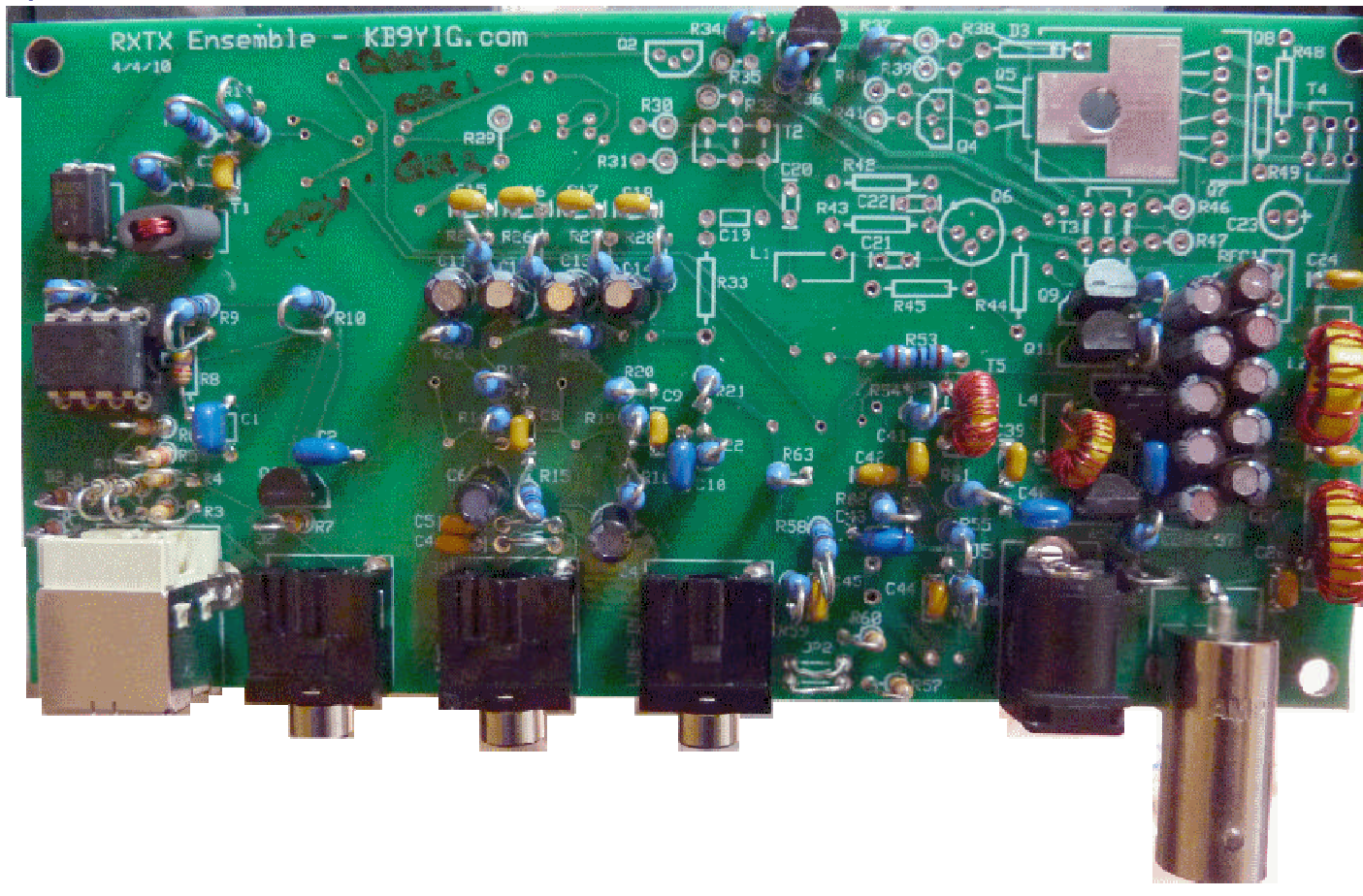
Install Bottomside Components

Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	U06	TLV2462CD dual opamp	TVL2462CD 	SOIC-8		Take ESD precautions
<input type="checkbox"/>	U07	TLV2462CD dual opamp	TVL2462CD 	SOIC-8		Take ESD precautions
<input type="checkbox"/>	C58	0.1 uF	(smt) black stripe 	SMT 1206		
<input type="checkbox"/>	C59	0.1 uF	(smt) black stripe 	SMT 1206		
<input type="checkbox"/>	C60	0.1 uF	(smt) black stripe 	SMT 1206		

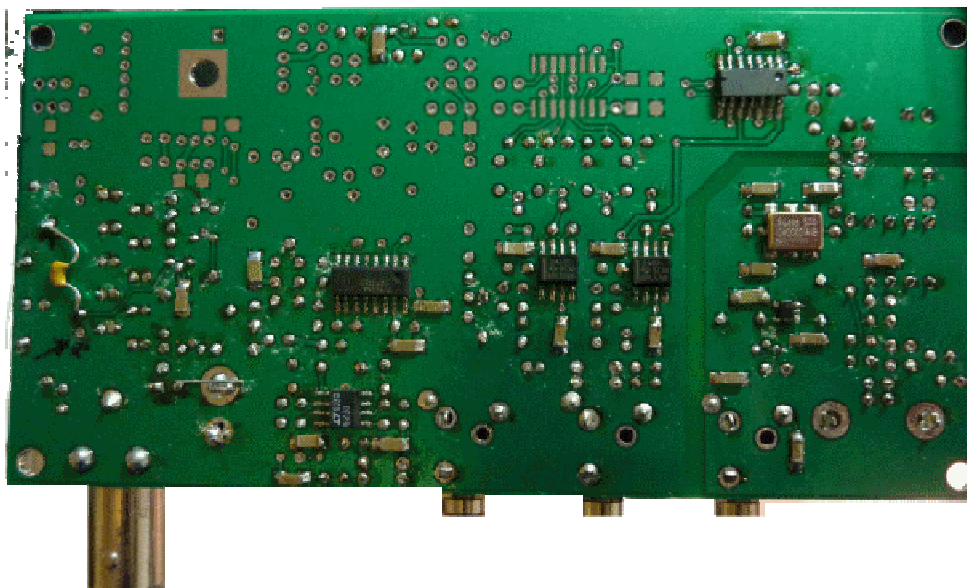
<input type="checkbox"/>	C61	0.1 uF	(smt) black stripe 	SMT 1206		
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TX Opamps Completed Stage

Top of the Board



Bottom of the Board



TX Opamps Testing

Current Draw

Test Setup

Measure the current drawn by the 12V power supply with the 12V power connected. (if you have both the 12 V and the USB connected, the current draw will be a little less than it would be without the USB connected).

Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Current draw	mA	< 35	26.6	

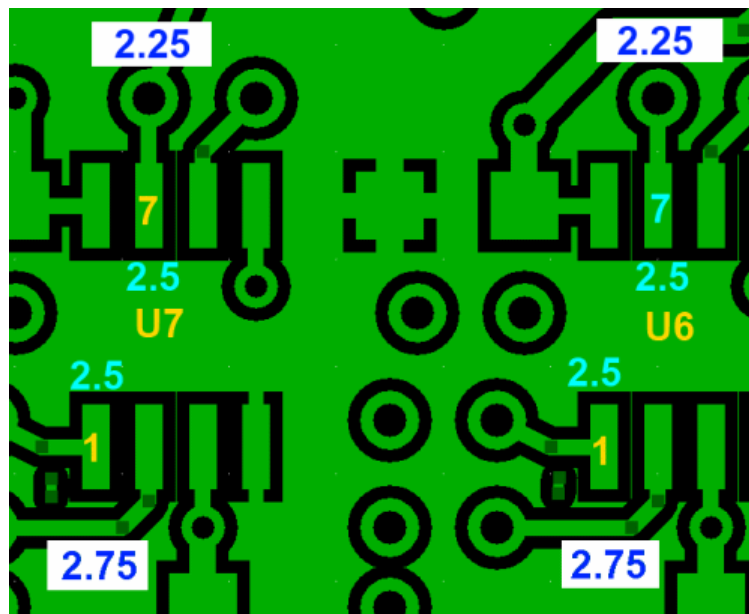
OpAmps Functional Test

Test Setup

This test is similar to the test performed on the RX OpAmps.

You will need a 100k ohm resistor (not supplied with the kit) to perform the test. It involves connecting the 100k ohm resistor between pin 2 and ground for each Tx Opamp chip and measuring the output voltages at pins 1 and 7.

- First, you measure the normal output voltages at pins 1 and 7
- Then you connect the 100k ohm resistor between pin 2 (R15 hairpin) and ground
- Then you remeasure the voltages at pins 1 and 7
- And repeat the process for the second OpAmp, with its pin 2 (R18 hairpin) unbridged and bridged to ground



Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
U6-pin1 (R17 hairpin) - not bridged	V dc	2.5		
U6-pin7 - not bridged	V dc	2.5		
U6-pin1 (R17 hairpin) - R15 hairpin bridged 100k to ground	V dc	2.75		
U6-pin7 - R15 hairpin bridged 100k to ground	V dc	2.25		
U7-pin1 (R20 hairpin) - not bridged	V dc	2.5		
U7-pin7 not bridged	V dc	2.5		
U7-pin1 (R20 hairpin) - R18 hairpin bridged 100k to ground	V dc	2.75		
U7-pin7 - R18 hairpin bridged 100k to ground	V dc	2.25		

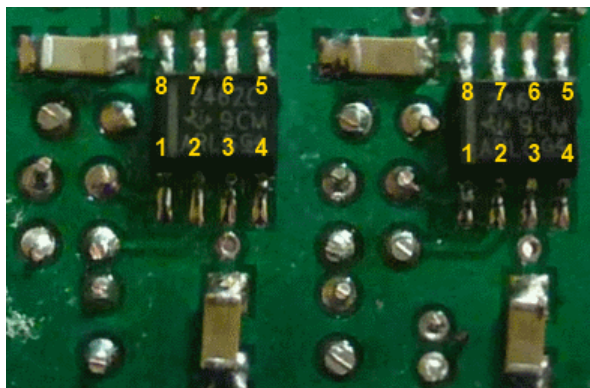
Pin Voltages

Test Setup

Power up the board and then measure the voltages at each of the pins of the two OpAmp Ics.

You should see the 5V rail voltage at pins 8, 0 Vdc at pins 4, and one half the 5 Volt rail at all other pins

If you do not get these voltages, carefully take and compare the measurements on both the pin itself AND the pin PAD. If you get a different voltage on the pin vs. the pad, re-check your soldering.



Test Measurements

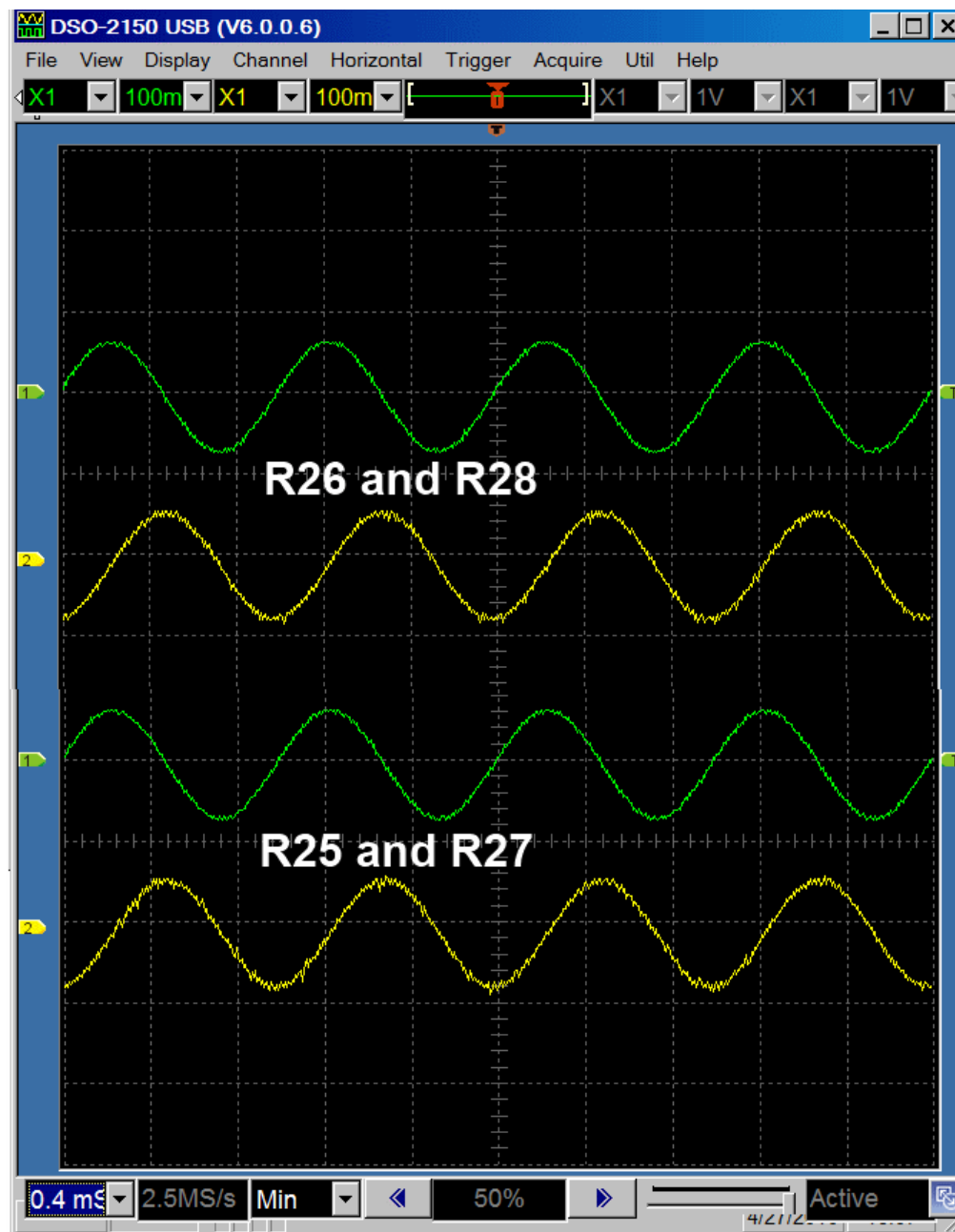
Testpoint	Units	Nominal Value	Author's	Yours
Left IC, Pin 1	Vdc	2.5	2.48	
Left IC, Pin 2	Vdc	2.5	2.48	
Left IC, Pin 3	Vdc	2.5	2.48	
Left IC, Pin 4	Vdc	0	0	
Left IC, Pin 5	Vdc	2.5	2.48	
Left IC, Pin 6	Vdc	2.5	2.48	
Left IC, Pin 7	Vdc	2.5	2.48	
Left IC, Pin 8	Vdc	5	4.96	
Right IC, Pin 1	Vdc	2.5	2.48	
Right IC, Pin 2	Vdc	2.5	2.48	
Right IC, Pin 3	Vdc	2.5	2.48	
Right IC, Pin 4	Vdc	0	0	
Right IC, Pin 5	Vdc	2.5	2.48	
Right IC, Pin 6	Vdc	2.5	2.48	
Right IC, Pin 7	Vdc	2.5	2.48	
Right IC, Pin 8	Vdc	5	4.96	

OpAmp Outputs

Test Setup

If you have (access to) a dual channel scope, you may want to download Michael Keller, DL6iAK's [IQ Gen](#) and generate a dual tone quadrature signal for feeding into the "Line Out" Jack.

You can then probe the output resistors (R25-R28) to see the two anti-phase signals produced by this stage.



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