

# Ensemble RXTX 10\_Driver/PA

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## Driver/PA Introduction

### General

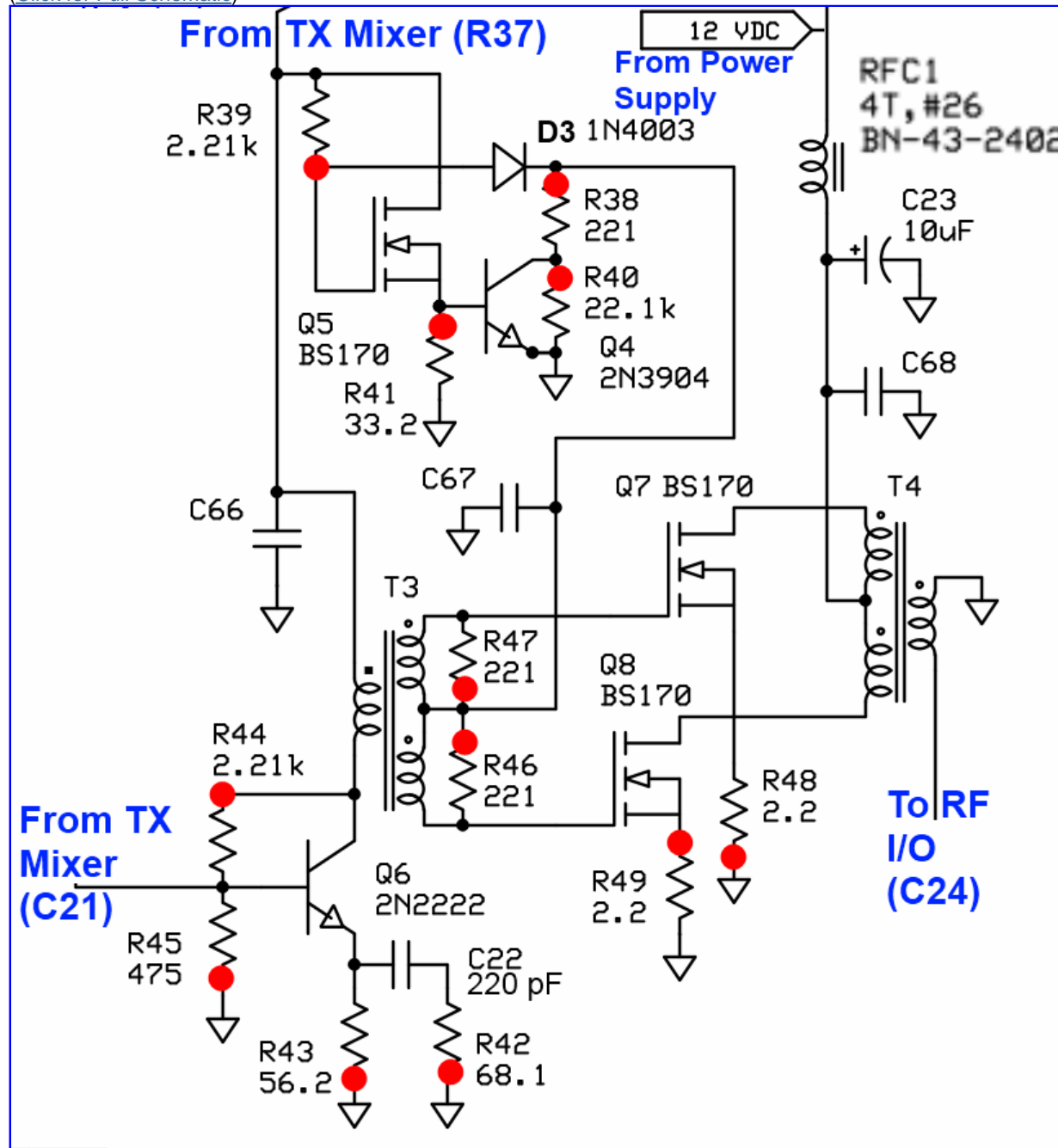
This is the final ( pun intended) stage of the build, where the excitation output (RF) from the [Mixer \(QSE\) Stage](#) is amplified and delivered to the antenna. When you have completed this stage, you are ready to set up the radio for actual tranceiving use.

This stage also competes the necessary circuitry for switching the transmit and transmit related circuits and logic ON or OFF, in conjunction with the switching for RX that was implemented in the [RX I/O Control Stage](#).

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

## Driver/PA Schematic

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

[\(Click for Full Schematic\)](#)










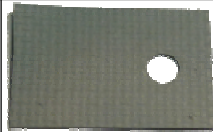


(above schematic has clickable areas that can be used for navigation)

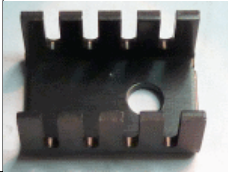
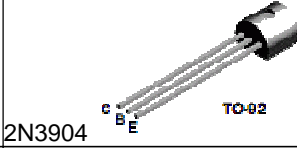

([go directly to build notes](#))

## Driver/PA 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	2.2 ohm 1/4W 5%	red-red-gld-gld 	1/4W
<input type="checkbox"/>	2	2.21 k 1/4W 1%	r-r-br-br-br 	1/4W
<input type="checkbox"/>	1	22.1 k 1/4W 1%	r-r-brn-r-br 	1/4W
<input type="checkbox"/>	3	221 1/4W 1%	red-red-brn-blk-brn 	1/4W
<input type="checkbox"/>	1	33.2 ohm 1%	ora-ora-red-gld-brn 	1/4W
<input type="checkbox"/>	1	475 1/4W 1%	y-v-grn-bl-br 	1/4W
<input type="checkbox"/>	1	56.2 1/4W 1%	grn-blu-red-gld-brn 	1/4W
<input type="checkbox"/>	1	<a href="#">1N4003</a>	1N4003 	Axial
<input type="checkbox"/>	1	BN-43-2402 (no markings!)	none 	Binocular core
<input type="checkbox"/>	1	4T #26 on BN-43-2402 (6")		Choke
<input type="checkbox"/>	1	10uF/16 VDC		Electrolytic
<input type="checkbox"/>	1	#4 nylon washer		HDW
<input type="checkbox"/>	1	#6 screw, hex nut, starwasher		HDW
<input type="checkbox"/>	1	band-specific		misc
<input type="checkbox"/>	7	band-specific		misc
<input type="checkbox"/>	1	band-specific		misc
<input type="checkbox"/>	1	TO-220 heatsink Silpad		Misc
<input type="checkbox"/>	1	2N2222 NPN transistor		TO-18
<input type="checkbox"/>	1	heatsink for driver transistor		TO-18

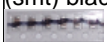




<input type="checkbox"/>	1	TO-220 heatsink for flat transistors		TO-220
<input type="checkbox"/>	1	<a href="#">2N3904 NPN Transistor</a>	 2N3904	TO-92
<input type="checkbox"/>	3	<a href="#">BS170 N-Channel Enhancement Mode FET</a>	 BS170	TO-92

**Band Specific Items for 160m Band**


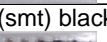

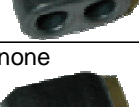
Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
<input type="checkbox"/>	C22	omit for this band		Omit			Driver/PA
<input type="checkbox"/>	C66	0.1 uF	(smt) black stripe	SMT 1206			Driver/PA
<input type="checkbox"/>	C67	0.1 uF	(smt) black stripe	SMT 1206			Driver/PA
<input type="checkbox"/>	C68	0.1 uF	(smt) black stripe	SMT 1206			Driver/PA
<input type="checkbox"/>	R42	omit for this band		Omit	flat-horiz	Omit for 160 and 80,40m	Driver/PA
<input type="checkbox"/>	T3	6T/3T bifilar #30 on BN-43-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T3-core	BN-43-2402 (no markings!)	none 	Binocular core		61 43, NOT	Driver/PA
<input type="checkbox"/>	T4	4T bifilar/5T #30 on BN-43-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T4-core	BN-43-2402 (no markings!)	none 	Binocular core		61 43, NOT	Driver/PA

**Band Specific Items for 80, 40m Band**

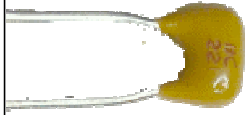

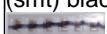
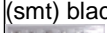





Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
<input type="checkbox"/>	C22	omit for this band		Omit			Driver/PA
<input type="checkbox"/>	C66	0.1 uF	(smt) black stripe	SMT 1206			Driver/PA
<input type="checkbox"/>	C67	0.1 uF	(smt) black stripe	SMT 1206			Driver/PA

<input type="checkbox"/>	C68	0.1 uF	(smt) black stripe 	SMT 1206			Driver/PA
<input type="checkbox"/>	R42	omit for this band		Omit	flat-horiz	Omit for 160 and 80,40m	Driver/PA
<input type="checkbox"/>	T3	6T/3T bifilar #30 on BN-43-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T3-core	BN-43-2402 (no markings!)	none 	Binocular core		61 43, NOT	Driver/PA
<input type="checkbox"/>	T4	4T bifilar/5T #30 On BN-43-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T4-core	BN-43-2402 (no markings!)	none 	Binocular core		61 43, NOT	Driver/PA

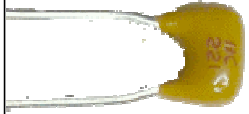

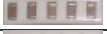
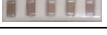
**Band Specific Items for 40, 30, 20m Band**

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
<input type="checkbox"/>	C22	omit for this band		Omit			Driver/PA
<input type="checkbox"/>	C66	0.1 uF	(smt) black stripe 	SMT 1206			Driver/PA
<input type="checkbox"/>	C67	0.1 uF	(smt) black stripe 	SMT 1206			Driver/PA
<input type="checkbox"/>	C68	0.1 uF	(smt) black stripe 	SMT 1206			Driver/PA
<input type="checkbox"/>	R42	omit for this band		Omit	flat-horiz	Omit for 160 and 80,40m	Driver/PA
<input type="checkbox"/>	T3	6T/3T bifilar #30 on BN-61-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T3-core	BN-61-2402 (no Markings!)	none 	Binocular core			Driver/PA
<input type="checkbox"/>	T4	3T bifilar/5T #30 On BN-61-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T4-core	BN-61-2402 (no Markings!)	none 	Binocular core			Driver/PA

**Band Specific Items for 30, 20, 17m Band**

Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
<input type="checkbox"/>	C22	220 pF 5%	221 	Ceramic			Driver/PA
<input type="checkbox"/>	C66	0.1 uF	(smt) black stripe 	SMT 1206			Driver/PA
<input type="checkbox"/>	C67	0.1 uF	(smt) black stripe 	SMT 1206			Driver/PA
<input type="checkbox"/>	C68	0.1 uF	(smt) black stripe 	SMT 1206			Driver/PA
<input type="checkbox"/>	R42	68.1 1/4W 1%	blu-gry-brn-gld-brn 	1/4W	flat-horiz	Omit for 160 and 80,40m	Driver/PA
<input type="checkbox"/>	T3	6T/3T bifilar #30 on BN-61-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T3-core	BN-61-2402 (no Markings!)	none 	Binocular core		61, NOT 43	Driver/PA
<input type="checkbox"/>	T4	3T bifilar/5T #30 On BN-61-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T4-core	BN-61-2402 (no Markings!)	none 	Binocular core		61, NOT 43	Driver/PA

**Band Specific Items for 15, 12, 10m Band**

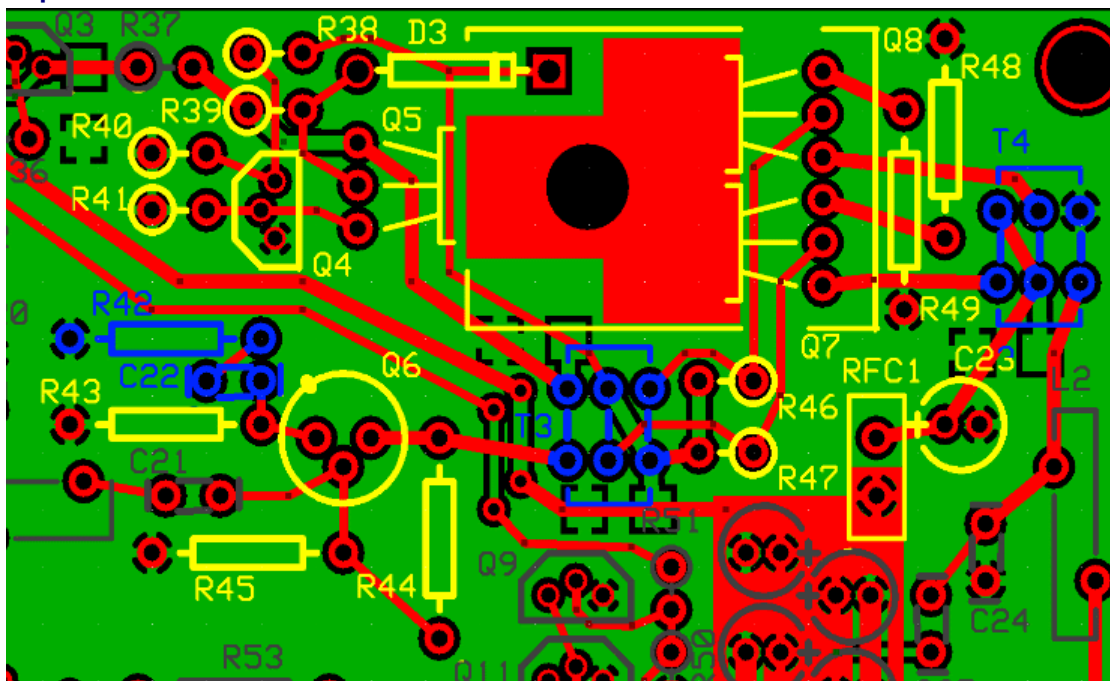
Check	Designation	Component	Marking	Category	Orientation	Notes	Circuit
<input type="checkbox"/>	C22	220 pF 5%	221 	Ceramic			Driver/PA
<input type="checkbox"/>	C66	0.01 uF	(smt) 	SMT 1206			Driver/PA
<input type="checkbox"/>	C67	0.01 uF	(smt) 	SMT 1206			Driver/PA
<input type="checkbox"/>	C68	0.01 uF	(smt) 	SMT 1206			Driver/PA

<input type="checkbox"/>	R42	68.1 1/4W 1%	blu-gry-brn-gld-brn 	1/4W	flat-horiz	Omit for 160 and 80,40m	Driver/PA
<input type="checkbox"/>	T3	5T/3T bifilar #30 on BN-61-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T3-core	BN-61-2402 (no Markings!)	none 	Binocular core		61, NOT 43	Driver/PA
<input type="checkbox"/>	T4	3T bifilar/5T #30 On BN-61-2402 (12")		Xfrmr			Driver/PA
<input type="checkbox"/>	T4-core	BN-61-2402 (no Markings!)	none 	Binocular core		61, NOT 43	Driver/PA

### Driver/PA Summary Build Notes

- Install Bottomside Components
- Wind and Install Choke RFC1
- Wind and Install Transformers T3 and T4
- Test T3 and T4 Continuity
- Install the FET Stack
- Install the 2N2222A Transistor
- Install Remaining Topside Components
- [Test the Stage](#)

## Top of the Board



## Wind and Install Choke RFC1

**Take care to distinguish the correct binocular core - there are two types in this kit: BN-43-2402 and BN-61-2402; They are bagged and marked separately. This step (RFC choke) uses the BN-43-2402**

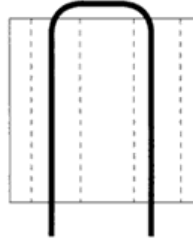
See [WB5RVZ Inductor Construction Hints](#) for hints on winding and installing inductors.

**RFC1 needs 4 turns (6") of #26 wire on a BN-43-2402 bino core.**

- 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. Better yet, if you have access to a mounted stone from a Dremel type tool (just held in your fingers - not powered), use that to smooth the rough edges (TX to iain MW0XEN for the tip).




- 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.



One Binocular Turn

- Use fine grit emery cloth to remove the enamel from the magnet wire up to within 1/8 inch of the core
- Solder the leads of RFC1
- Once soldered, verify continuity by applying 12V power to the board and measuring the voltage at the via for the positive lead of C23. If you see the 12V rail value, then RFC1 was likely soldered correctly.
- Remove power from the board

Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	RFC1	4T #26 on BN-43-2402 (6")		Choke		

#### Wind and Install Transformers T3 and T4

See [WB5RVZ Inductor Construction Hints](#) for hints on winding and installing inductors.

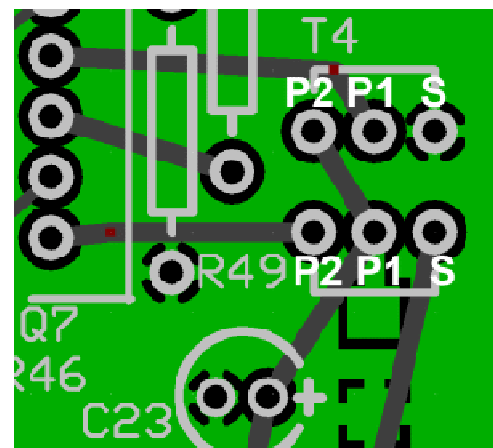
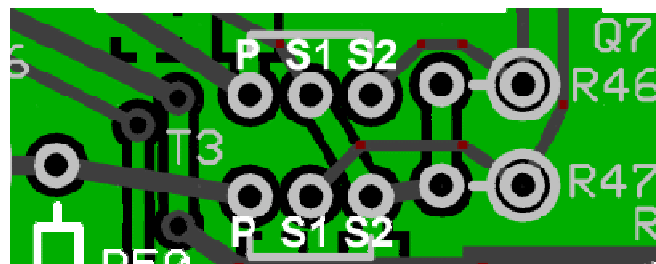
If you are unfamiliar with winding and installing inductors, you may want to refer to the WB5RVZ construction hints for [coils \(toroidal\)](#) and transformers ([toroidal](#) and [binocular](#)). Click [here](#) for details on identifying toroid cores.

Decoding the transformer specifications:






Transformers' windings are specified using the pattern "nnT/wXmmT" or "wXmmT/nnT", where:

- "nn" is the number of turns in the single winding
- "mm" is the number of turns in the multiple windings
- "w" = the number of multiple windings (e.g., 2 = bifilar; 3 = trifilar, etc.)

Thus, e.g., "18T/2x9T bifilar #30" means, using #30 wire, produce a single 18 turn primary winding and two 9-turn secondary windings; "2x9T bifilar/ 18T #30" means, using #30 wire, produce two 9-turn primary windings and a single 18 turn secondary winding.



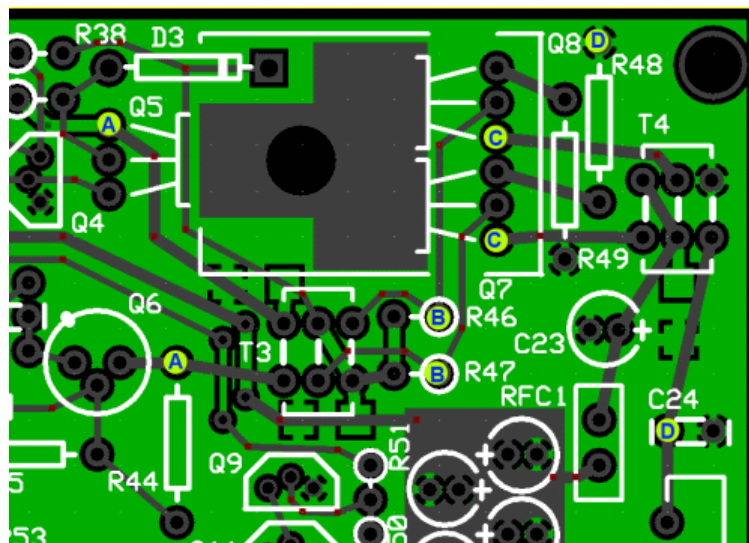
Check	Designation	Component	Marking		Category	Orientation	Notes
<input type="checkbox"/>	T3	band-specific	Band	Component	Marking	misc	
			160m	6T/3T bifilar #30 on BN-43-2402 (12") (Xfrmr)			
			80, 40m	6T/3T bifilar #30 on BN-43-2402 (12") (Xfrmr)			
			40, 30, 20m	6T/3T bifilar #30 on BN-61-2402 (12") (Xfrmr)			
			30, 20, 17m	6T/3T bifilar #30 on BN-61-2402 (12") (Xfrmr)			
			15, 12, 10m	5T/3T bifilar #30 on BN-61-2402 (12") (Xfrmr)			
<input type="checkbox"/>	T3-core	band-specific			misc		
<input type="checkbox"/>	T4	band-specific	Band	Component	Marking	misc	
			160m	4T bifilar/5T #30 On BN-43-2402			

			80, 40m	(12") (Xfrmr) 4T bifilar/5T #30 0n BN- 43-2402 (12") (Xfrmr)			
			40, 30, 20m	3T bifilar/5T #30 0n BN- 61-2402 (12") (Xfrmr)			
			30, 20, 17m	3T bifilar/5T #30 0n BN- 61-2402 (12") (Xfrmr)			
			15, 12, 10m	3T bifilar/5T #30 0n BN- 61-2402 (12") (Xfrmr)			
	T4-core	band- specific			misc		

### Test T3 and T4 Continuity

Test the continuity of T3 and T4 primaries and secondaries using the points shown in the graphic below:

Point Pair	Expected Ohms	Measured
A-to-A	0	
B-to-B	0	
C-to-C	0	
D-to-D	0	



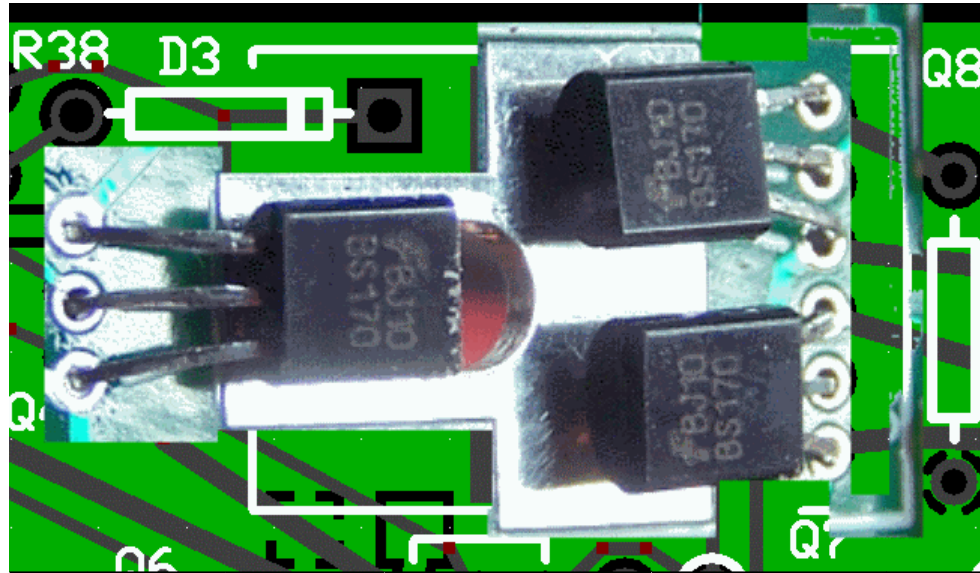
### Install the FET Stack


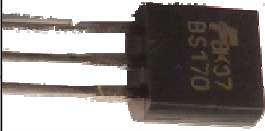
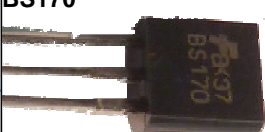
Installing the three FET transistors and their heatsinking components is performed in the same fashion as it was in the RXTX V6.3 (FET Transistor/Heatsink Stack). See the [instructions for the RXTX PAF Stage](#).

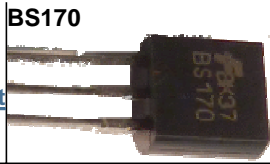
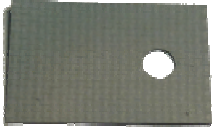
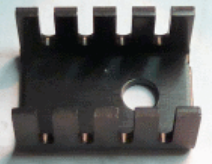



Transistors Q5, Q7, and Q8 are mounted with their flat side facing upward so that the entire flat side of each transistor will be under an aluminum TO220 heat sink.

- Bend the leads of Q5, Q7, and Q8 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
- After Q5, Q7, and Q8 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. 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.



Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	R49	2.2 ohm 1/4W 5%	red-red-gld-gld	1/4W	flat-vert	
<input type="checkbox"/>	R48	2.2 ohm 1/4W 5%	red-red-gld-gld	1/4W	flat-vert	
<input type="checkbox"/>	D3	<a href="#">1N4003</a>	1N4003 	Axial	horiz - cathode (band) to right	
<input type="checkbox"/>	Q05	<a href="#">BS170 N-Channel Enhancement Mode FET</a>	BS170 	TO-92		Take <a href="#">ESD precautions</a>
<input type="checkbox"/>	Q07	<a href="#">BS170 N-Channel Enhancement Mode FET</a>	BS170 	TO-92		Take <a href="#">ESD precautions</a>

<input type="checkbox"/>	Q08	<a href="#">BS170 N-Channel Enhancement Mode FET</a>		TO-92		Take <a href="#">ESD precautions</a>
<input type="checkbox"/>	PA-sil	TO-220 heatsink Silpad		Misc		
<input type="checkbox"/>	PA-hs	TO-220 heatsink for flat transistors		TO-220		
<input type="checkbox"/>	hdw-hs	#6 screw, hex nut, starwasher		HDW		Used to mount TO-220heatsink
<input type="checkbox"/>	R44	2.21 k 1/4W 1%	r-r-br-br-br 	1/4W	flat-vert	
<input type="checkbox"/>	R46	221 1/4W 1%	red-red-brn-blk-brn 	1/4W	E-W	
<input type="checkbox"/>	R47	221 1/4W 1%	red-red-brn-blk-brn 	1/4W	E-W	

### Install the 2N2222A Transistor

#### Install Surrounding Components

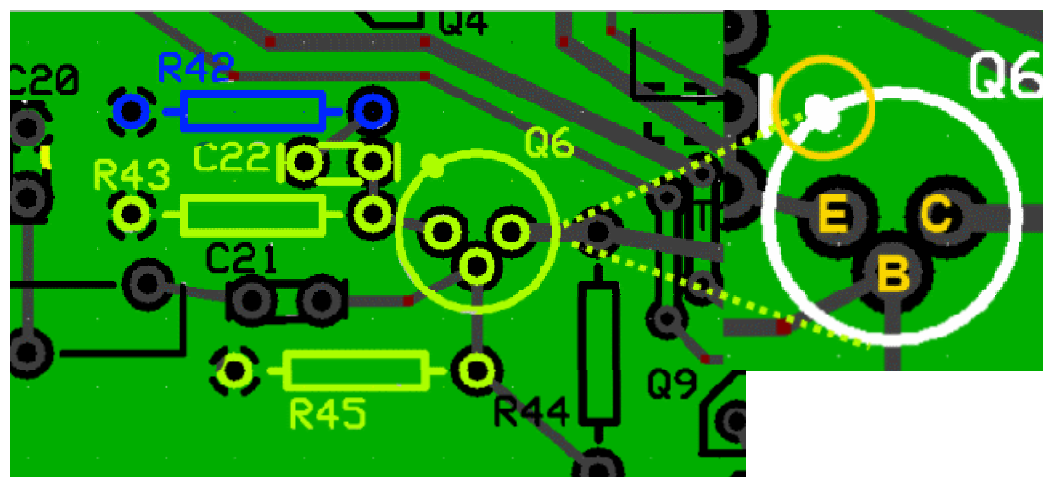
Before actually installing the 2N2222A transistor, you need to install the surrounding components (which will fall under the "shadow" of the transistor's heatsink once it is installed.




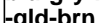

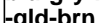

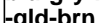
#### Install Transistor and Heatsink


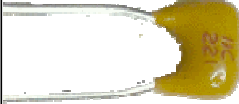


Installation of the 2N2222 driver transistor is done similarly to the [2N2222 in the RXTX V6.3 kit](#).

1. Prepare the heat sink for installation by placing the heat sink on a flat surface, flat-side down. Align the small tab on the transistor case with the slit in the side of the heat sink.
2. Press the TO-18 heat sink onto Q6 by pressing uniformly on the lower rim of the transistor to fully insert it into the heat sink.
3. A #4 nylon washer is included in the kit as a spacer between the bottom of the transistor and the circuit board. 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.
4. Slip the leads of the transistor through the nylon washer's hole
5. Snug the transistor to the circuit board.
6. Exercise care to make sure the emitter lead of Q6 (by the metal tab on the transistor case) goes to the hole closest to the corresponding silkscreen emitter mark on the circuit board.

## 7. Solder the three leads



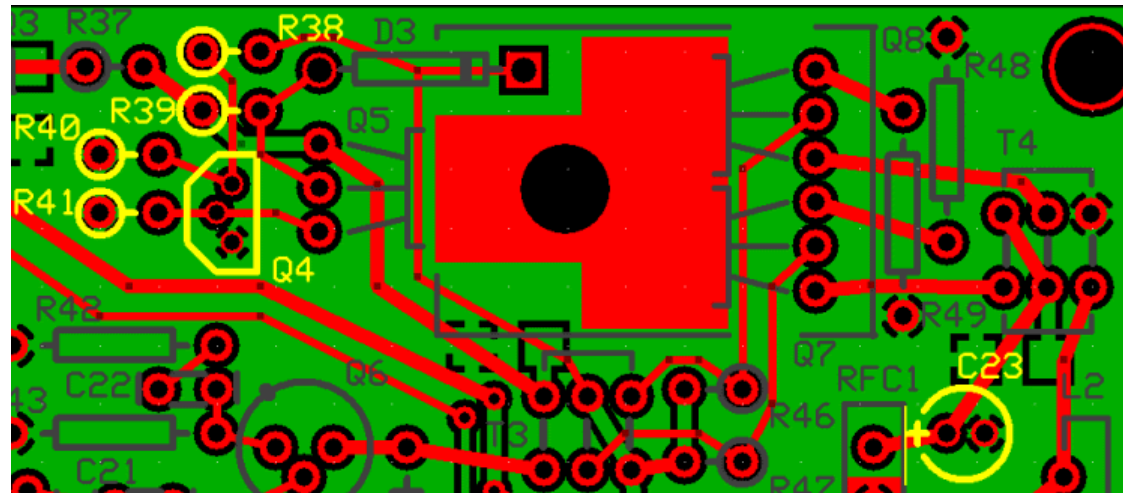
Check	Designation	Component	Marking			Category		Orientation	Notes															
<input type="checkbox"/>	R43	56.2 1/4W 1%	grn-blu-red-gld-brn 			1/4W	flat-horiz																	
<input type="checkbox"/>	R45	475 1/4W 1%	y-v-grn-bl-br 			1/4W	flat-horiz																	
<input type="checkbox"/>	R42	band-specific	<table><tr><th>Band</th><th>Component</th><th>Marking</th></tr><tr><td>160m</td><td>omit for this band (Omit)</td><td></td></tr><tr><td>80, 40m</td><td>omit for this band (Omit)</td><td></td></tr><tr><td>40, 30, 20m</td><td>omit for this band (Omit)</td><td></td></tr><tr><td>30, 20, 17m</td><td>68.1 1/4W 1% (1/4W)</td><td>blu-gry-brn-gld-brn </td></tr><tr><td>15, 12, 10m</td><td>68.1 1/4W 1% (1/4W)</td><td>blu-gry-brn-gld-brn </td></tr></table>	Band	Component	Marking	160m	omit for this band (Omit)		80, 40m	omit for this band (Omit)		40, 30, 20m	omit for this band (Omit)		30, 20, 17m	68.1 1/4W 1% (1/4W)	blu-gry-brn-gld-brn 	15, 12, 10m	68.1 1/4W 1% (1/4W)	blu-gry-brn-gld-brn 	misc	flat-horiz	Omit for 160 and 80,40m
Band	Component	Marking																						
160m	omit for this band (Omit)																							
80, 40m	omit for this band (Omit)																							
40, 30, 20m	omit for this band (Omit)																							
30, 20, 17m	68.1 1/4W 1% (1/4W)	blu-gry-brn-gld-brn 																						
15, 12, 10m	68.1 1/4W 1% (1/4W)	blu-gry-brn-gld-brn 																						
<input type="checkbox"/>	C22	band-specific	<table><tr><th>Band</th><th>Component</th><th>Marking</th></tr><tr><td>160m</td><td>omit for this band (Omit)</td><td></td></tr><tr><td>80, 40m</td><td>omit for this band (Omit)</td><td></td></tr><tr><td>40, 30, 20m</td><td>omit for this band (Omit)</td><td></td></tr></table>	Band	Component	Marking	160m	omit for this band (Omit)		80, 40m	omit for this band (Omit)		40, 30, 20m	omit for this band (Omit)		misc								
Band	Component	Marking																						
160m	omit for this band (Omit)																							
80, 40m	omit for this band (Omit)																							
40, 30, 20m	omit for this band (Omit)																							

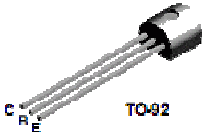

☐	Q06	2N2222 NPN transistor	30, 20, 17m	220 pF 5% (Ceramic)	221 	TO-18	
			15, 12, 10m	220 pF 5% (Ceramic)	221 		
							
☐	Q06-hs	heatsink for driver transistor				TO-18	
☐	hs_wshr	#4 nylon washer				HDW	slipped over leads of 2N2222

#### Install Remaining Topside Components

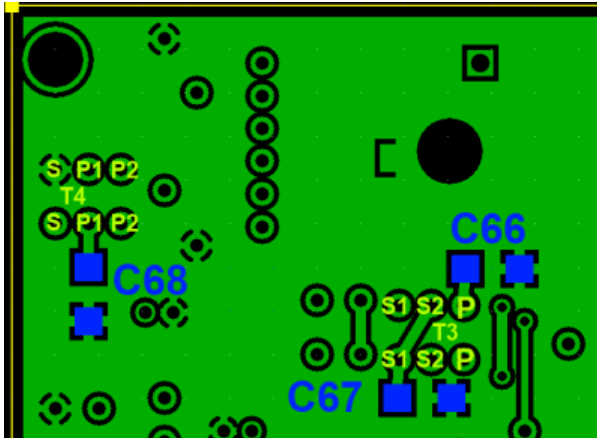
*Be careful with the resistors. There are resistors (221, 2.21k, 21.1k) whose color codes are extremely easy to get mixed up. Even Leonardo DaVinci would have used an ohmmeter on these had he had one! Those reds and browns are really close.*













Check	Designation	Component	Marking	Category	Orientation	Notes
<input type="checkbox"/>	Q04	<a href="#">2N3904 NPN Transistor</a>	2N3904  TO-92	TO-92		
<input type="checkbox"/>	R41	33.2 ohm 1%	ora-ora-red-gld-brn	1/4W	W-E	
<input type="checkbox"/>	R40	22.1 k 1/4W 1%	r-r-brn-r-br	1/4W	W-E	
<input type="checkbox"/>	R39	2.21 k 1/4W 1%	r-r-br-br-br	1/4W	W-E	
<input type="checkbox"/>	R38	221 1/4W 1%	red-red-brn-blk-brn	1/4W	W-E	
<input type="checkbox"/>	C23	10uF/16 VDC		Electrolytic		

## Bottom of the Board



## Install Bottomside Components

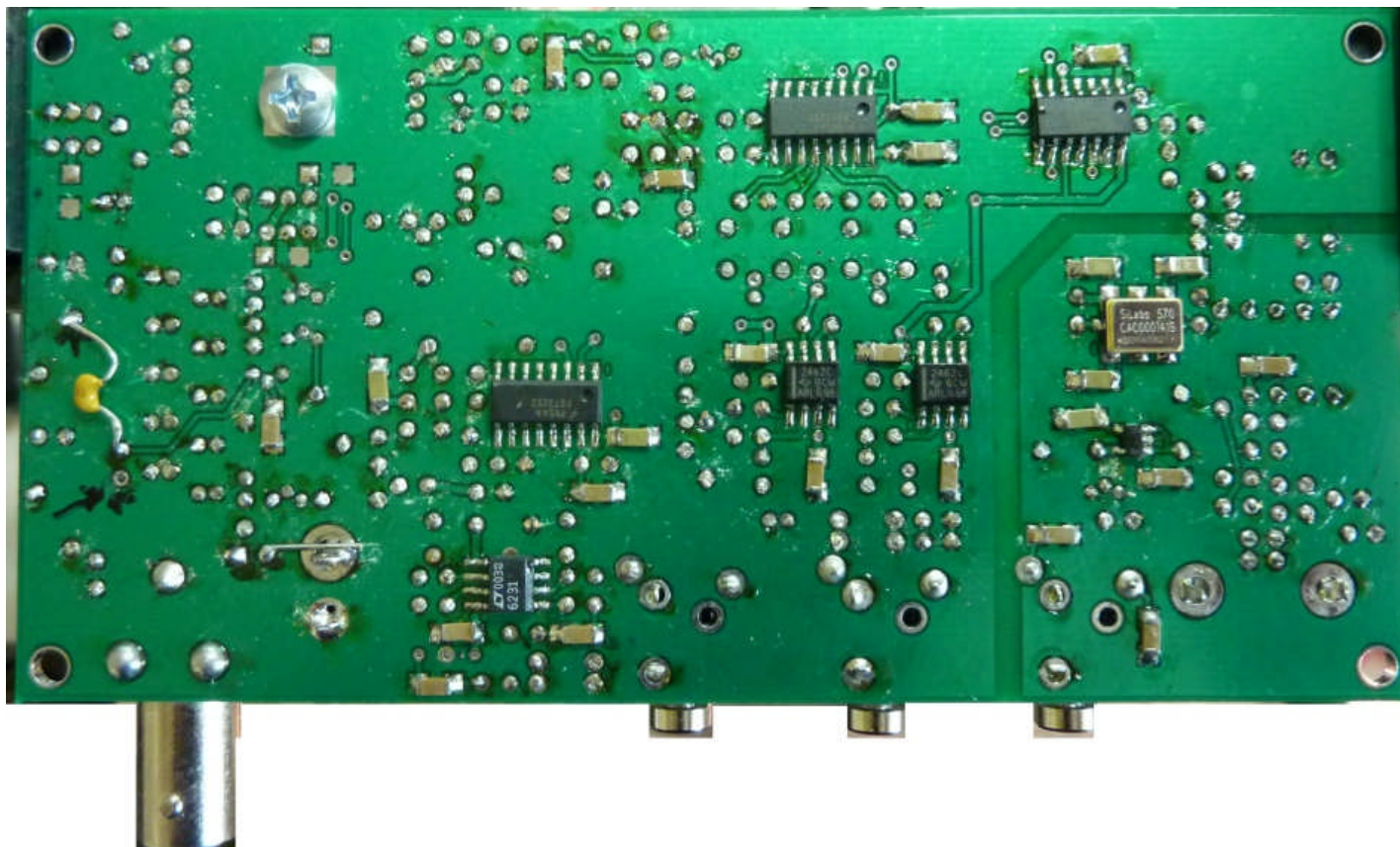
Check	Designation	Component	Marking		Category	Orientation	Notes
☐	C66	band-specific	Band	Component	Marking	misc	
			160m	0.1 uF (SMT 1206)	(smt) black stripe		
			80, 40m	0.1 uF (SMT 1206)	(smt) black stripe		
			40, 30, 20m	0.1 uF (SMT 1206)	(smt) black stripe		
			30, 20, 17m	0.1 uF (SMT 1206)	(smt) black stripe		
☐	C67	band-specific	15, 12, 10m	0.01 uF (SMT 1206)	(smt)	misc	
			Band	Component	Marking		
			160m	0.1 uF (SMT 1206)	(smt) black stripe		
			80, 40m	0.1 uF (SMT 1206)	(smt) black stripe		

□	C68	band-specific	40, 30, 20m	0.1 uF (SMT 1206)	(smt) black stripe 	misc
			30, 20, 17m	0.1 uF (SMT 1206)	(smt) black stripe 	
			15, 12, 10m	0.01 uF (SMT 1206)	(smt) 	
			Band Component Marking			
			160m	0.1 uF (SMT 1206)	(smt) black stripe 	
			80, 40m	0.1 uF (SMT 1206)	(smt) black stripe 	
			40, 30, 20m	0.1 uF (SMT 1206)	(smt) black stripe 	
			30, 20, 17m	0.1 uF (SMT 1206)	(smt) black stripe 	
			15, 12, 10m	0.01 uF (SMT 1206)	(smt) 	

## Top of the Board



## Bottom of the Board



## Driver/PA Testing

### Current Draw

#### Test Setup

Connect the USB cable and power up the board, measuring the RX current draw.

Then activate PTT and measure the current draw again.

To activate PTT, use clip leads to connect pins 3 and 4 of U4.

#### Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
PTT NOT activated	mA	< 35	25.2	
PTT activated	mA	< 150	126.7	



## PA Standing Current and Forward Bias

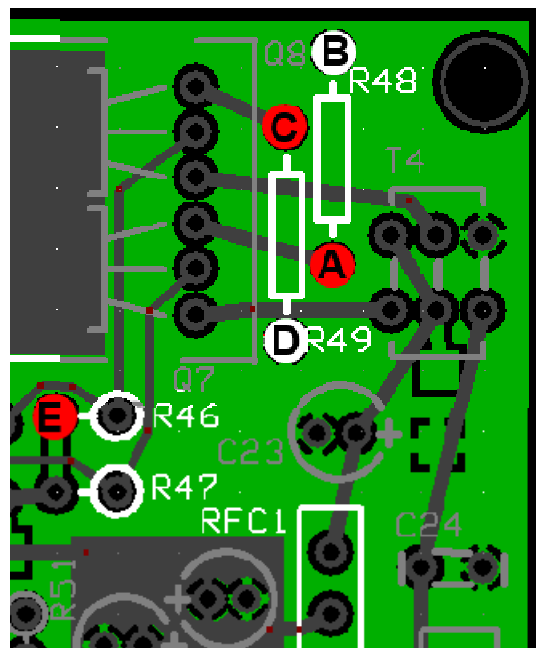
### Test Setup

Connect the USB cable, and Power. Activate PTT.

Measure PA standing current by activating PTT and measuring the voltages across resistors R48 and R49. The DC voltage across each resistor should be 55 mVDC. +/- 10mVDC. If the voltages are different from each other, the difference should not be more +/- 10% of the average of the two voltages.

Then check the forward bias voltage at the junction of R46 and R47.

Check the voltage at the R35 hairpin. With PTT active you should get the "S12V" value approximately equal to the 12 V rail. With PTT InActive that same testpoint should yield near 0 volts



### Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
Voltage between Testpoints "A" and "B" (across R48)	mV dc	55	54.3	
Voltage between Testpoints "C" and "D" (across R49)	mV dc	55	54.4	
Voltage (WRT regular ground) at Test Point "E"	V dc	2.2	2.68	
Voltage (WRT regular ground) at R35 hairpin (PTT Active)	V dc	12	tbd	
Voltage (WRT regular ground) at R35 hairpin (PTT InActive)	V dc	0	tbd	

## RF Output

### Test Setup

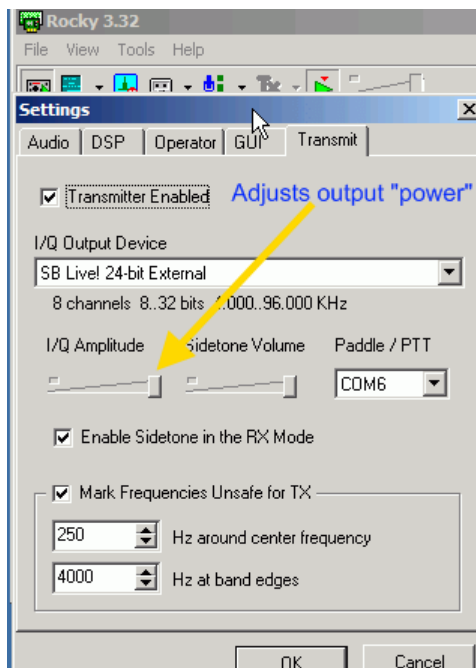
A quadrature audio source can be used for initial testing of the transmit function. Quadrature audio can be provided from a PC soundcard line-out if a program such as [IQ GEN by DL6IAK](#) or [Rocky](#) is installed on the PC.

Rocky can also be used.

This tests requires Rocky to be set up for transmit. If you are using Rocky on Vista or Windows 7, as opposed to Windows XP, you will need two external, USG soundcards. The author uses a Soundblaster Live 24 USB soundcard for the RX and TX I and Q signals and a cheap in-line usb "dongle-type" soundcard for Mic input and speaker/phone output.

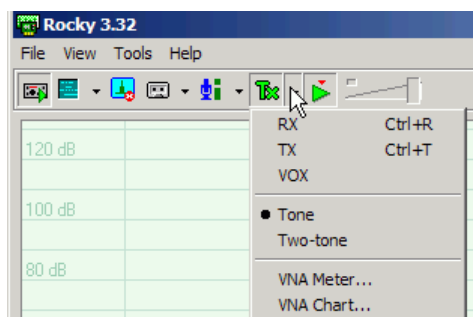
If you have Windows XP, then you will still need an external sound card for the I and Q for RX and TX, but you can use the on-board card for the mike and speaker in/outputs.

- Use the same Rocky setup from the [RX Opamps Stage](#) Testing section
- Set up Rocky to transmit (i.e., send out I and Q signals) .

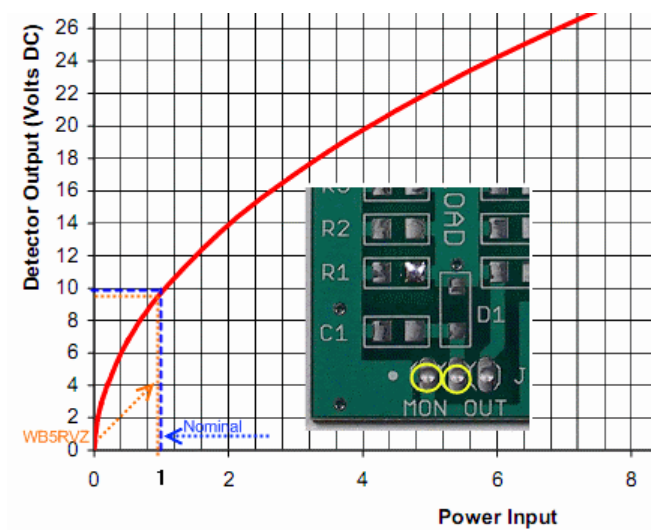


- 
- Connect the soundcard's Line Out corresponding jack (J3) on the Ensemble RXTX board.
- Connect your antenna jack (J6) to a 50 ohm load - for illustration we are using the [Norcal Dummy Load](#)
- Power up the RXTX with PTT activated

- *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 (e.g., 14.065 MHz when the center frequency is set for 14.050 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 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).
- If the output power is about 1/2 what it should be, you should check the Winding and installation of T3 or T4.
- If the output is much over 10V (as the author experienced) you need to back off of the amplitude in Rocky's "transmit" tab until the voltage approximates 10.

#### Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
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DC Output at dummy load	V dc	~10	12.2 (a littl too hot!)	_____
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## PA Output Reception Test

### Test Setup

In the test setup above, tune an external radio to the TX output frequency (approximetaly 15 kHz above the Softrock's center frequency, e.g., 14.065 MHz when the center frequency is tuned to 14.050 MHz.). Loosely couple the receiver to the dummy load.

You should see/hear the signal on the receiver.

## PA Output - Scope Test

### Test Setup

(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 activated
- 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 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..
- 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-p and 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:  

$$[ (V_{pk})^2 * 0.125 ] / 50$$

$$= [ (21.5)^2 * 0.125 ] / 50$$

$$= 1.16 \text{ W (1156 mW)}$$

### Test Measurements

Testpoint	Units	Nominal Value	Author's	Yours
RF Voltage (across 50 ohm dummy load)	V p-p	~20	29.1 (a little too hot!)	_____

## TX I/Q Balancing

### Test Setup

Before going on the air and after [balancing the RX I and Q signals](#), the builder must balance the Transmit I and Q signals to remove the images on transmit and avoid the embarrassment of inadvertently causing QRM at the image frequency.

[Click here](#) to view the page on this procedure (from the RXTX V6.3 builders' notes).

*Please note that the TX I/Q balancing must be done for each frequency range in which you will operate. Rocky will save the settings (except for the slider values); however, these may change over time. There is a very helpful discussion of this topic on the Yahoo Softrock40 reflector at [message #45816](#).*

[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](#)