



2N2/20

**A 20-Meter Discrete Component
CW Transceiver built
Manhattan-style**

**Designed by: Jim Kortge, K8IQY
(jokortge@prodigy.net)**



Discussion Topics

- **Background**
- **Transceiver Features and Performance**
- **Design Overview**
- **Construction Overview**
- **Q and A in remaining time**



Background

- **2N2/20 derived from 2N2/30**
- **Overcomes weak areas in original 2N2/40 design**
 - **2N2222 contest constraints removed**
 - **New circuits for RF T-R, RF Amp, Mixers, Xtal Filter, Audio Preamp, Rx Mute, & Final Amplifier**
 - **Revised circuits for VFO, Rx Mixer Amp, & IF Amp/Roofing Filter**
- **Project driven by builder interest**



Features and Performance

● Receiver

- Electronic attenuator/T-R switch
- Double-tuned input filter - 400 KHz BW
- “Noiseless” Norton RF Amp
- Commercial level 7 DBM
- 4+2 pole crystal filters ~ 500 Hz BW
- JFET audio mute
- 3 audio stages
- Varicap tuned VFO - drift < 200 Hz
- RIT



Features and Performance

- **Receiver (continued)**
 - Sensitivity (MDS) = -130 dBm
 - Blocking Dynamic Range = 107 dB
 - Intermod Dynamic Range = 91 dB
 - 3rd Order Intercept = 7 dB
 - IF Rejection = 91 dB
 - Image Rejection = 73 dB
 - Opposite Sideband Rejection = 75 dB
 - Rx Current = 185 ma



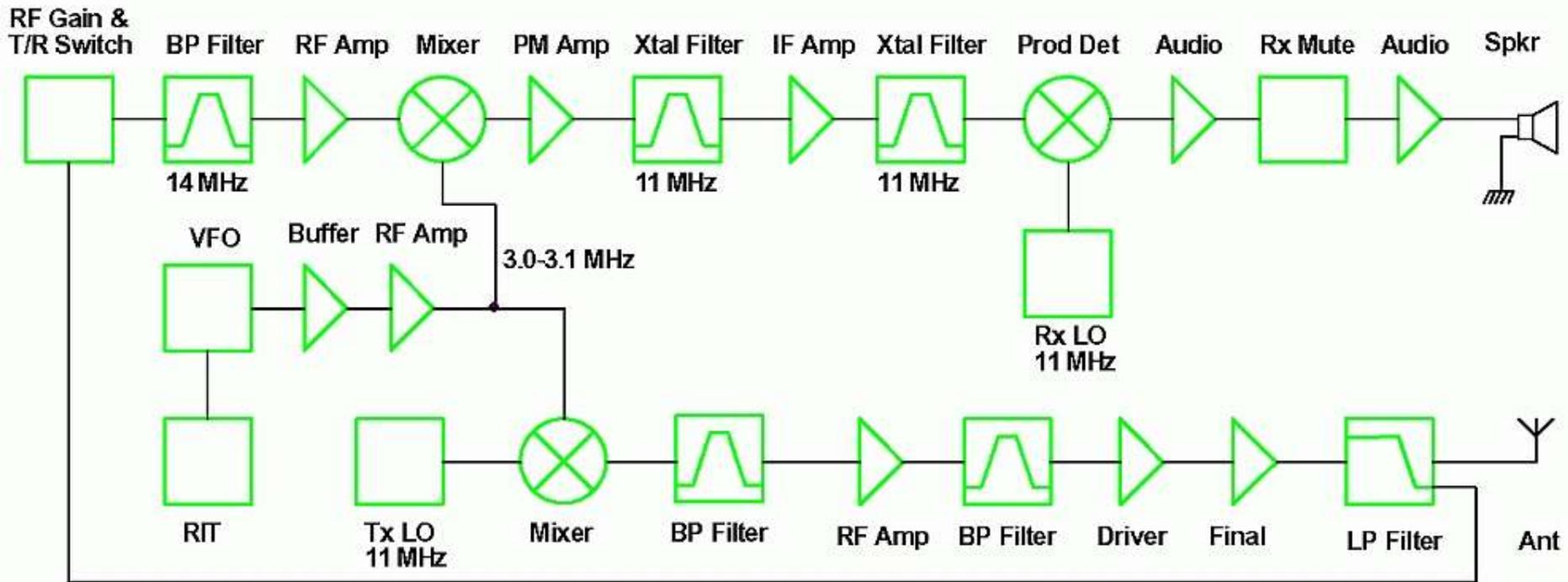
Features and Performance

- **Transmit**
 - Commercial level 7 DBM
 - Double-tuned Cascode RF Amp
 - 2SC2166 Final Transistor
 - Settable Output Power - 9 Watts Max
 - Spurious Output < -50 dBc
 - Solid State QSK Keying
 - Tx Current = 735 ma (3.5 watts output)

Design Overview

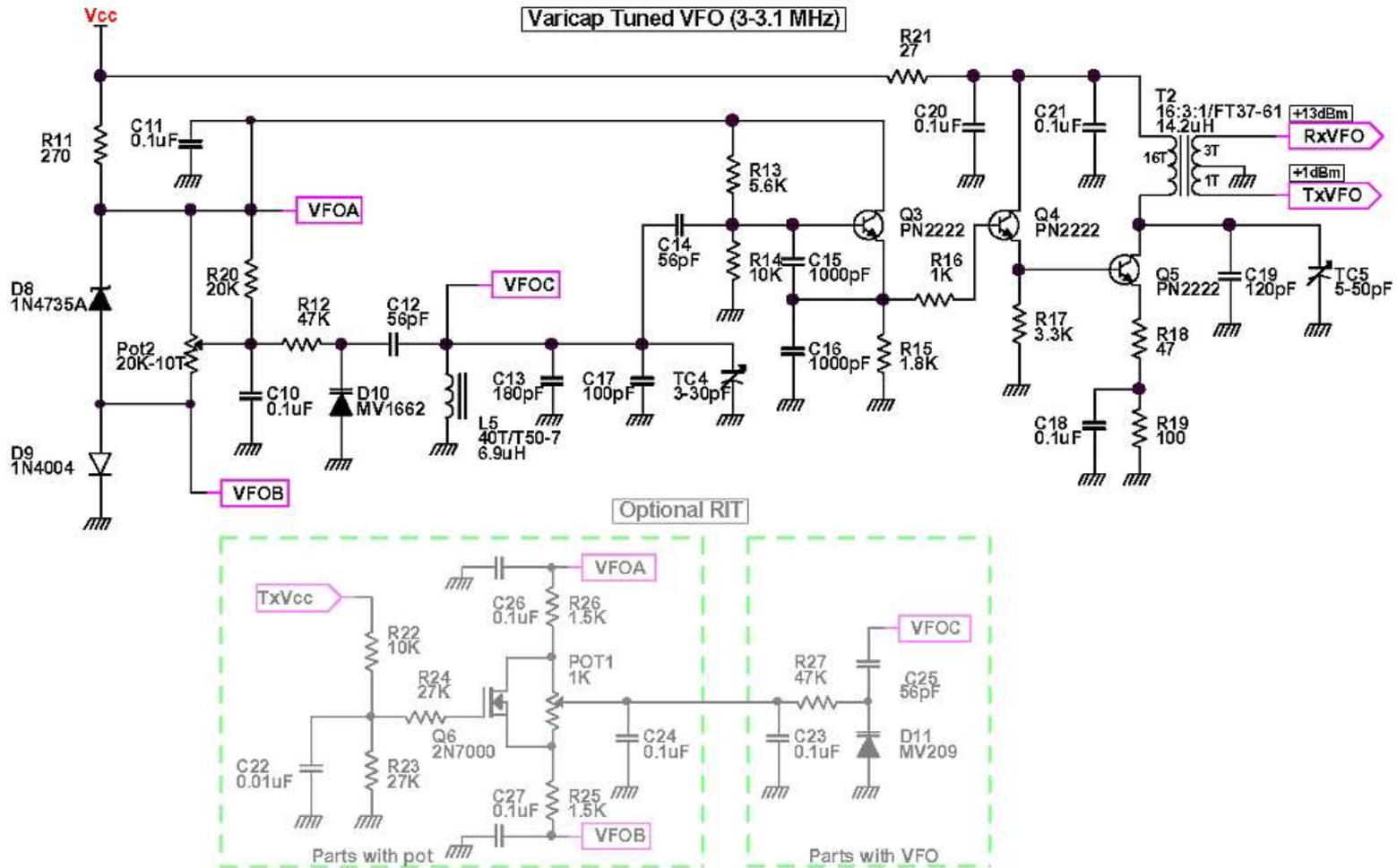
2N2/20 Block Diagram

Receive Strip



Transmit Strip

VFO Schematic



VFO Output Spectrum

2N2/20 VFO Output
REF 14.0 dBm
10dB/

ATT 10 dB

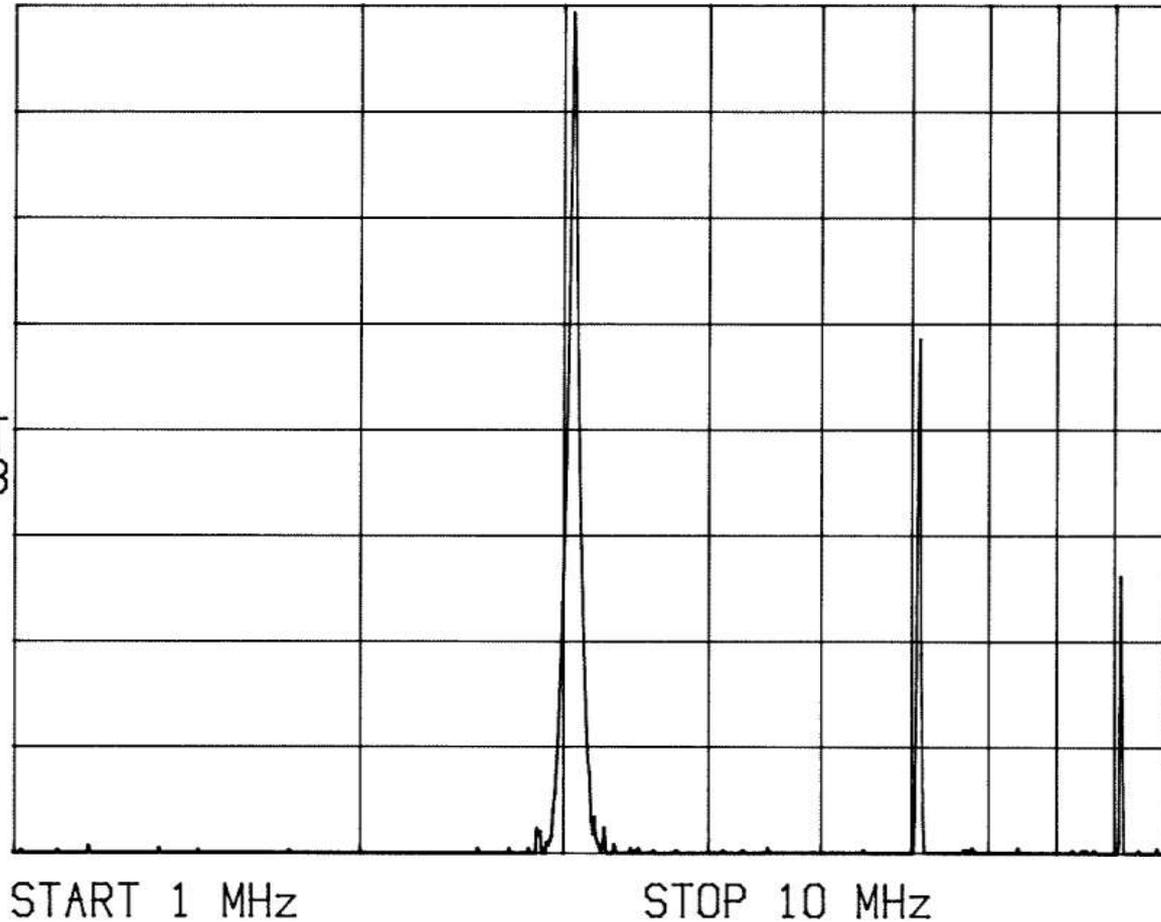
A_view B_blank

REF OFST
20.0 dB

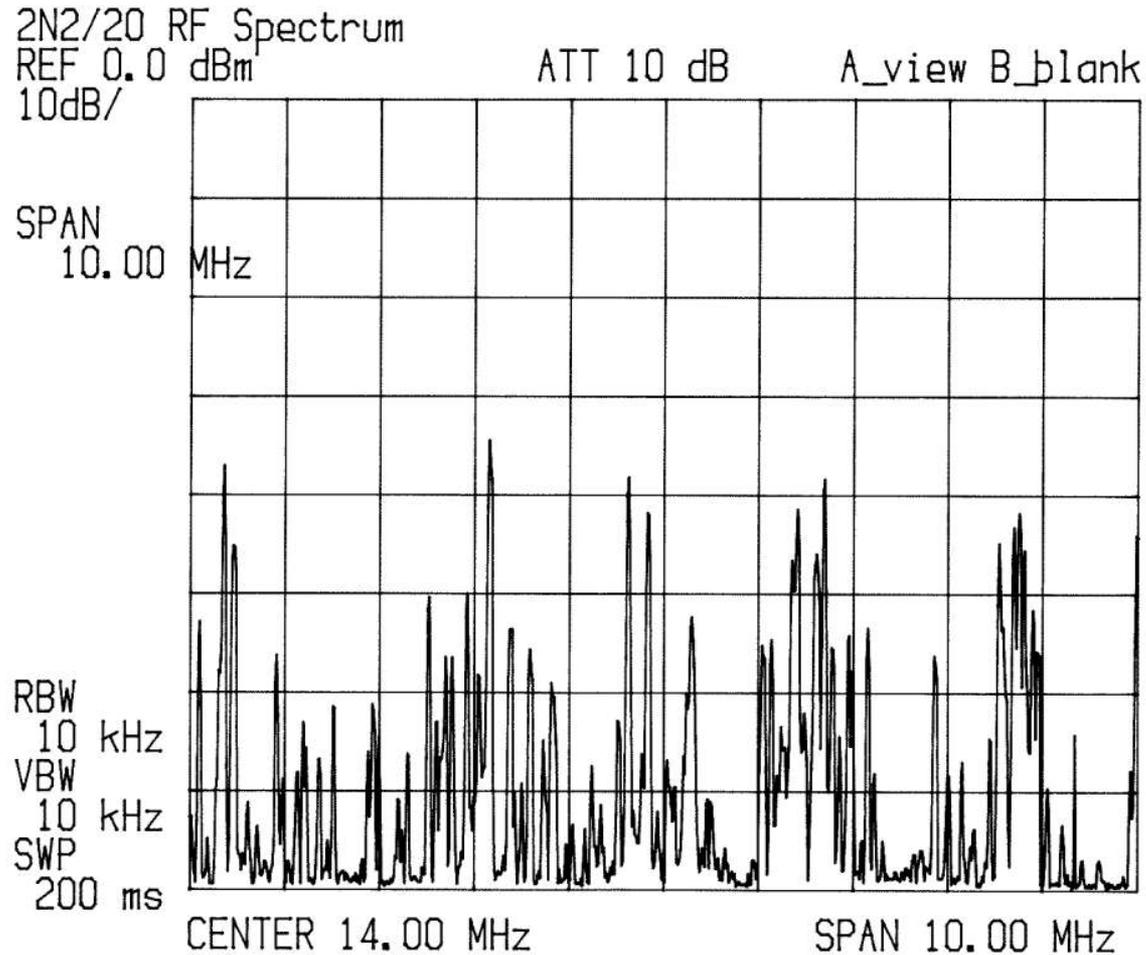
RBW
10 kHz

VBW
10 kHz

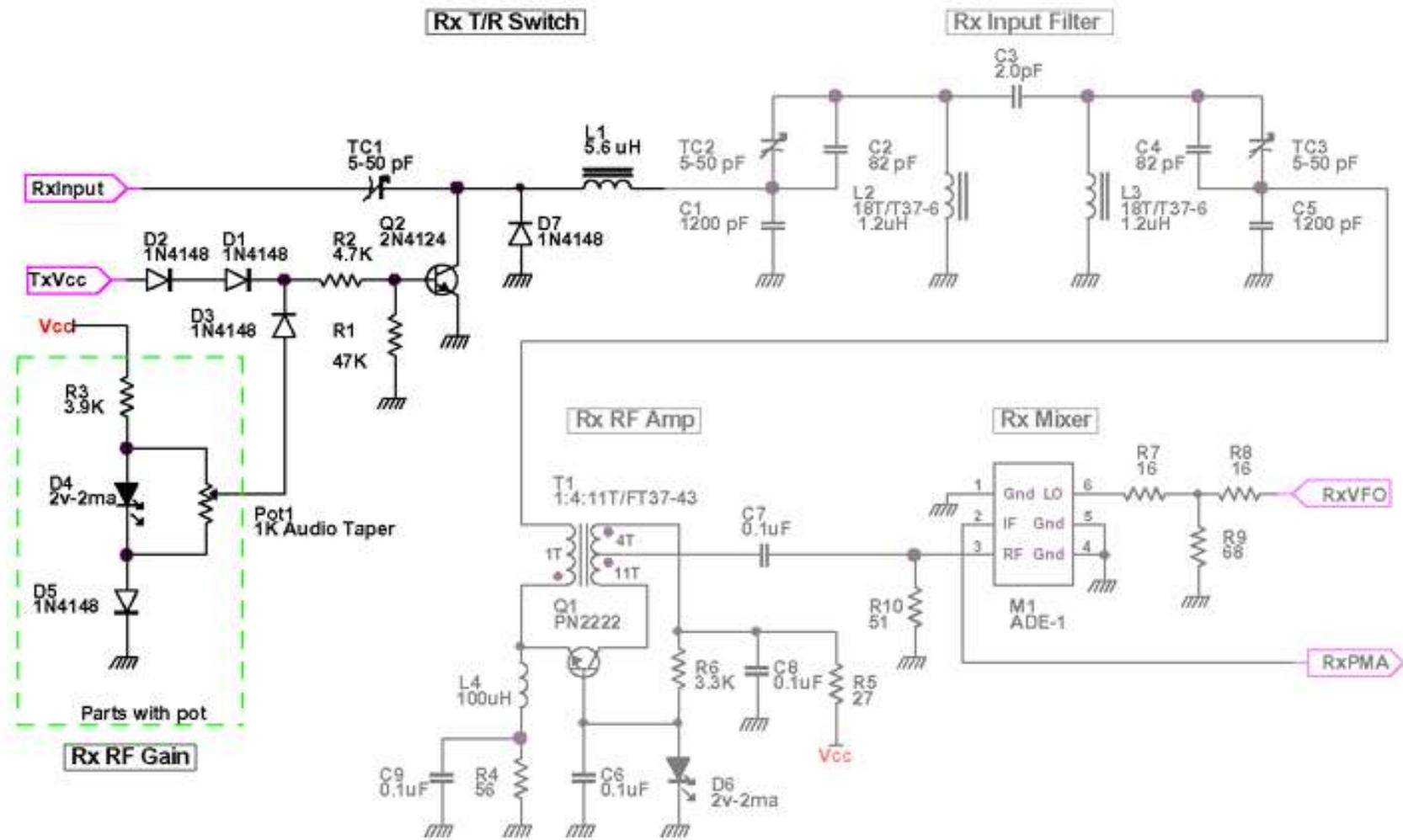
SWP
200 ms



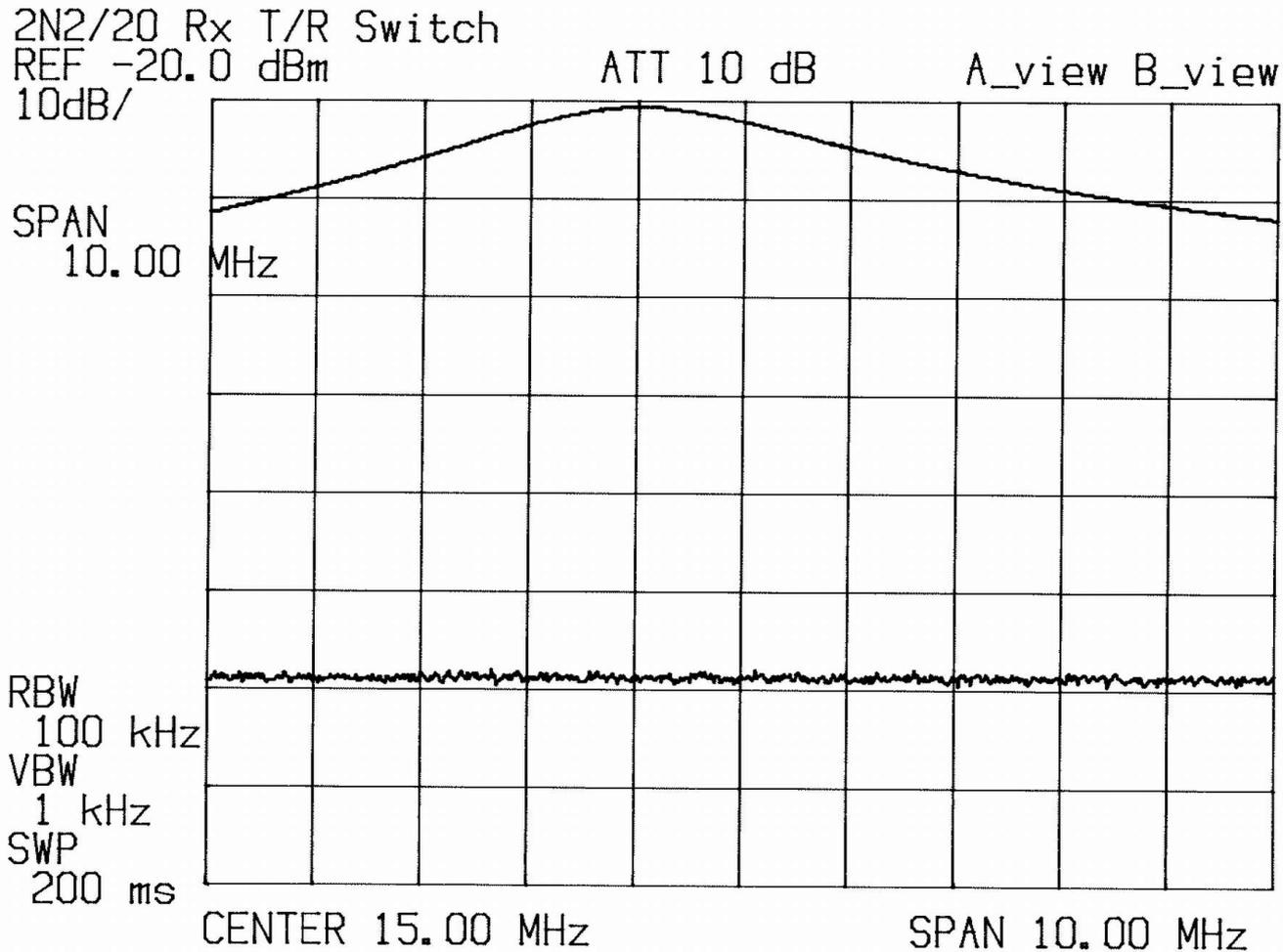
20 Meter RF Spectrum



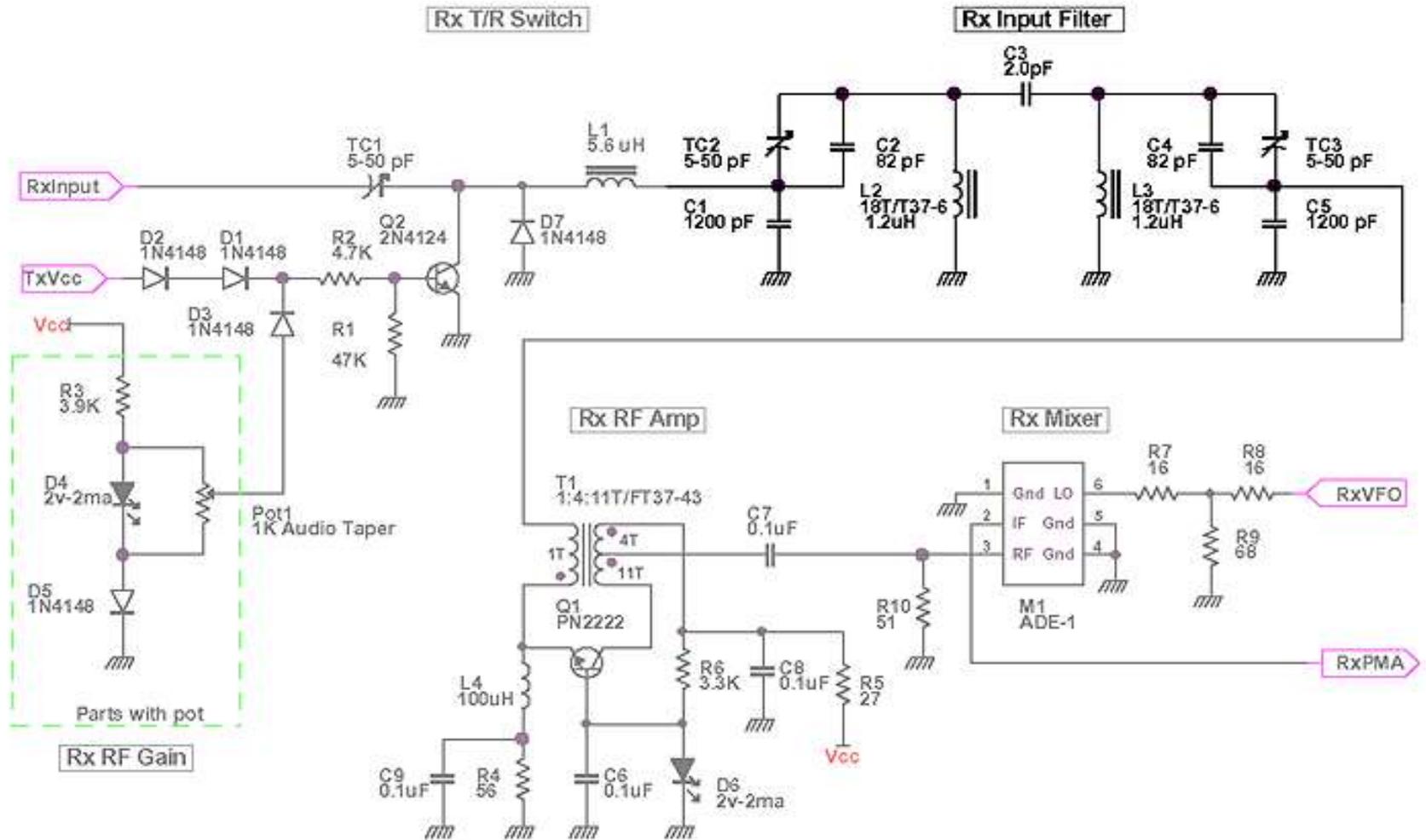
RF Gain/T-R Switch Sch



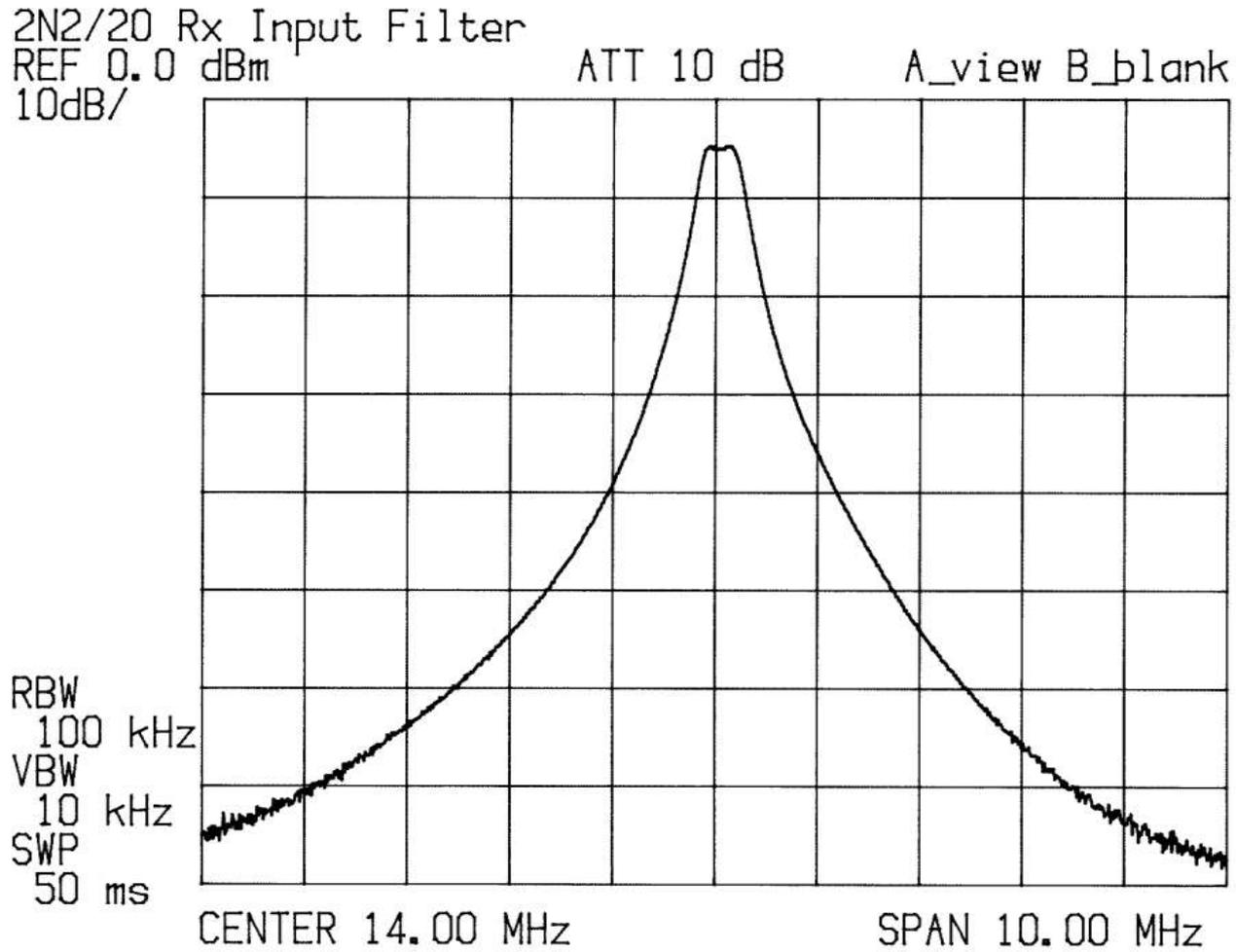
RF Gain/T-R Switch Resp



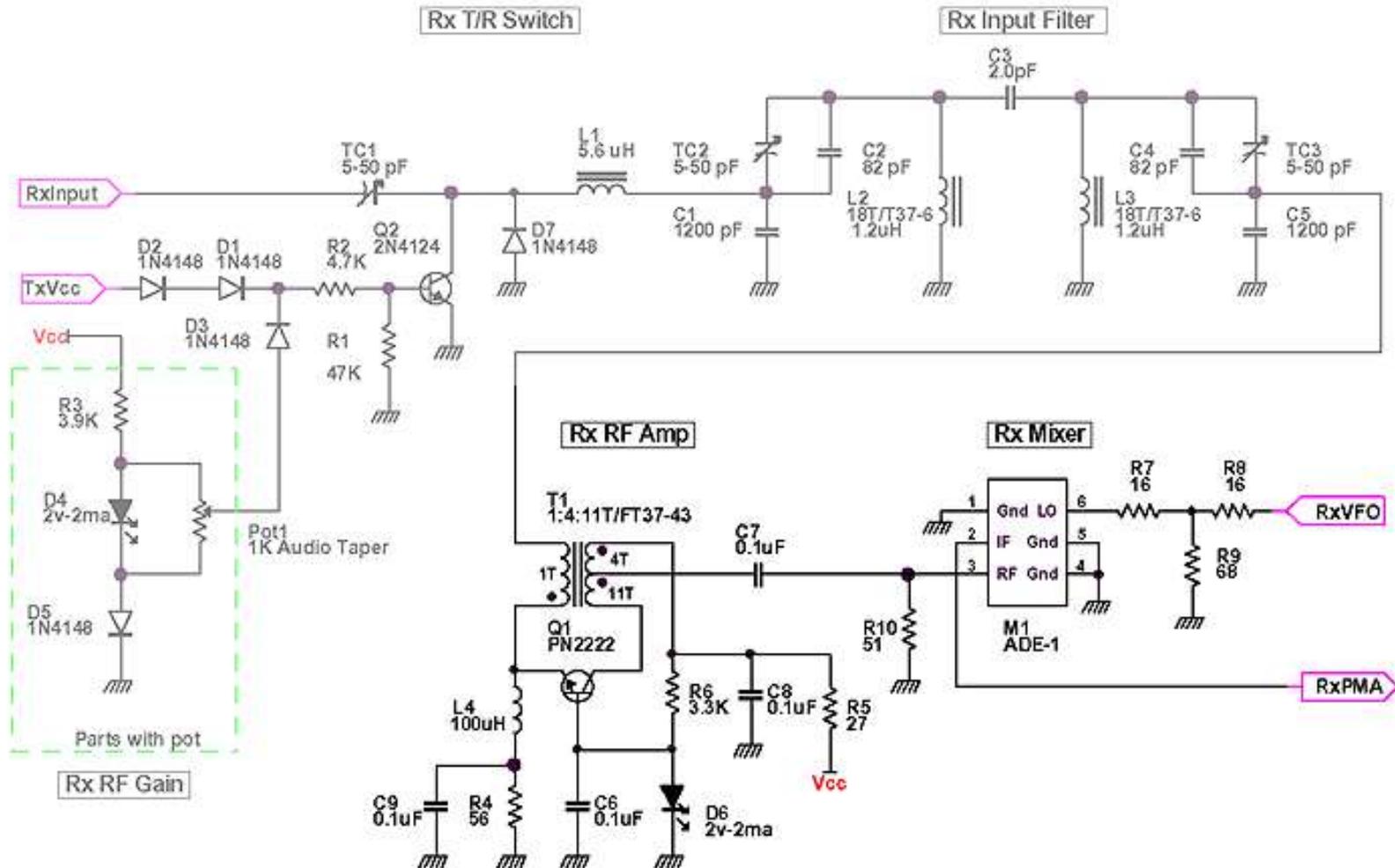
Input BP Filter Sch



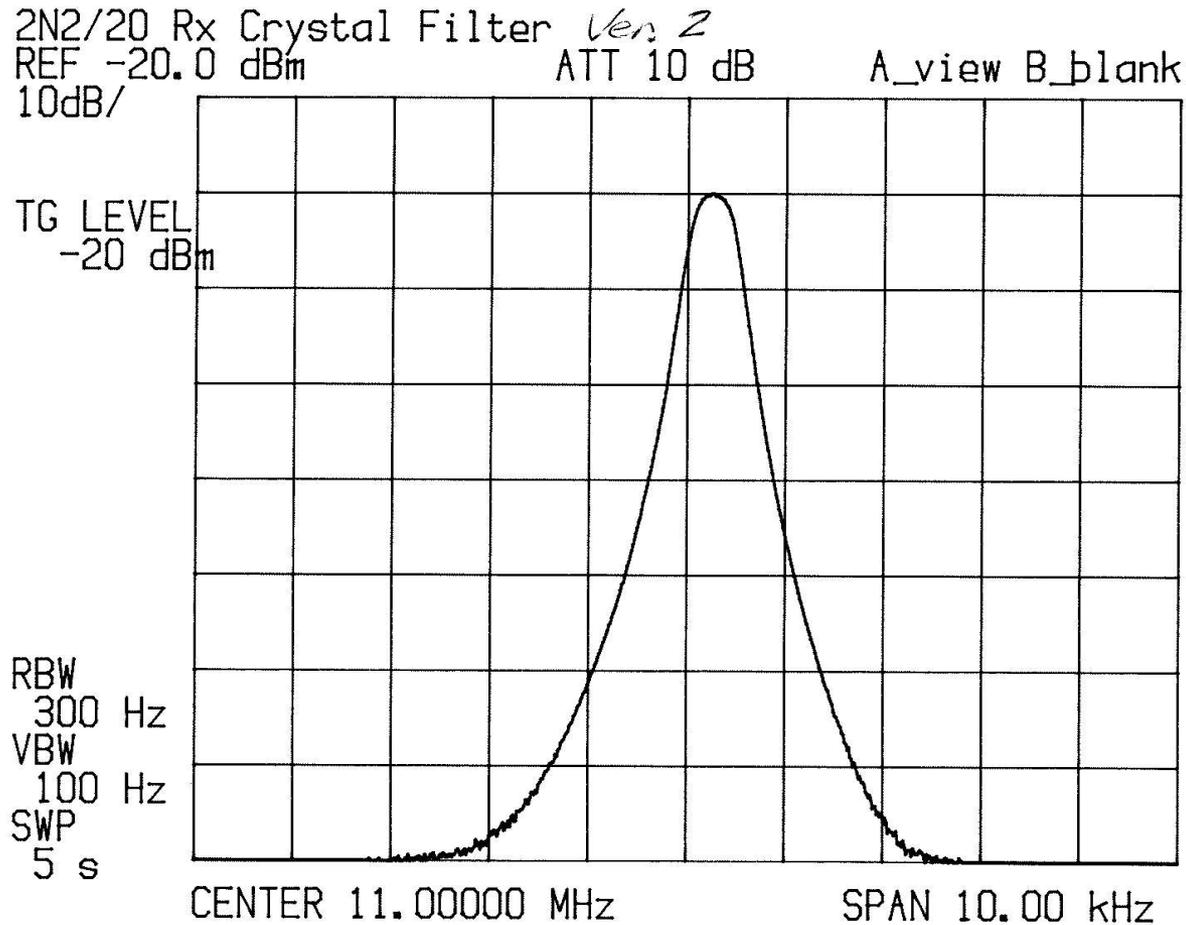
Input BP Filter Response



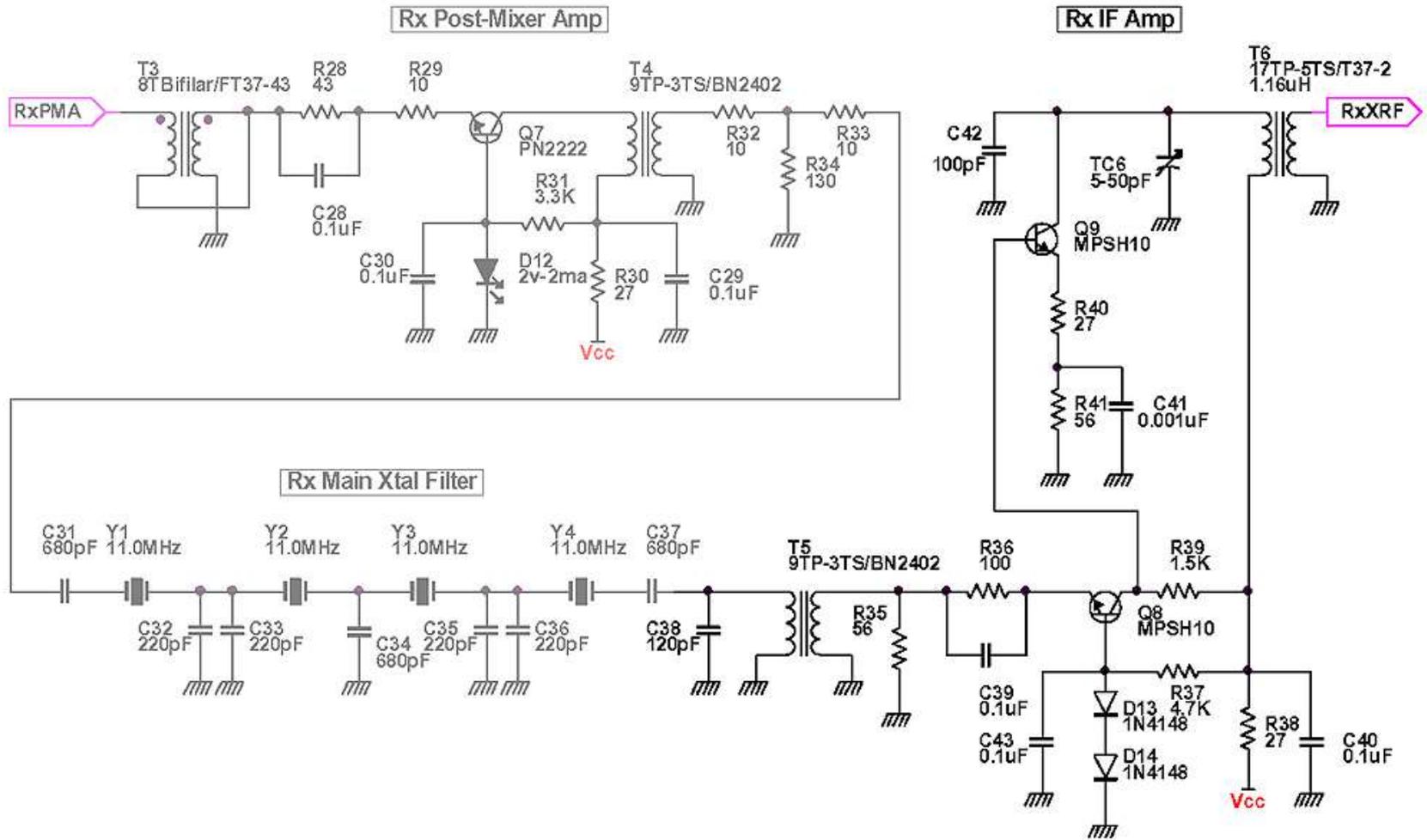
RF Amp & DBM Sch



Main Xtal Filter Resp



IF Amp Sch



IF Amp Resp

2N2/20 Rx IF Amplifier
REF 0.0 dBm
10dB/

ATT 10 dB

A_blank B_write

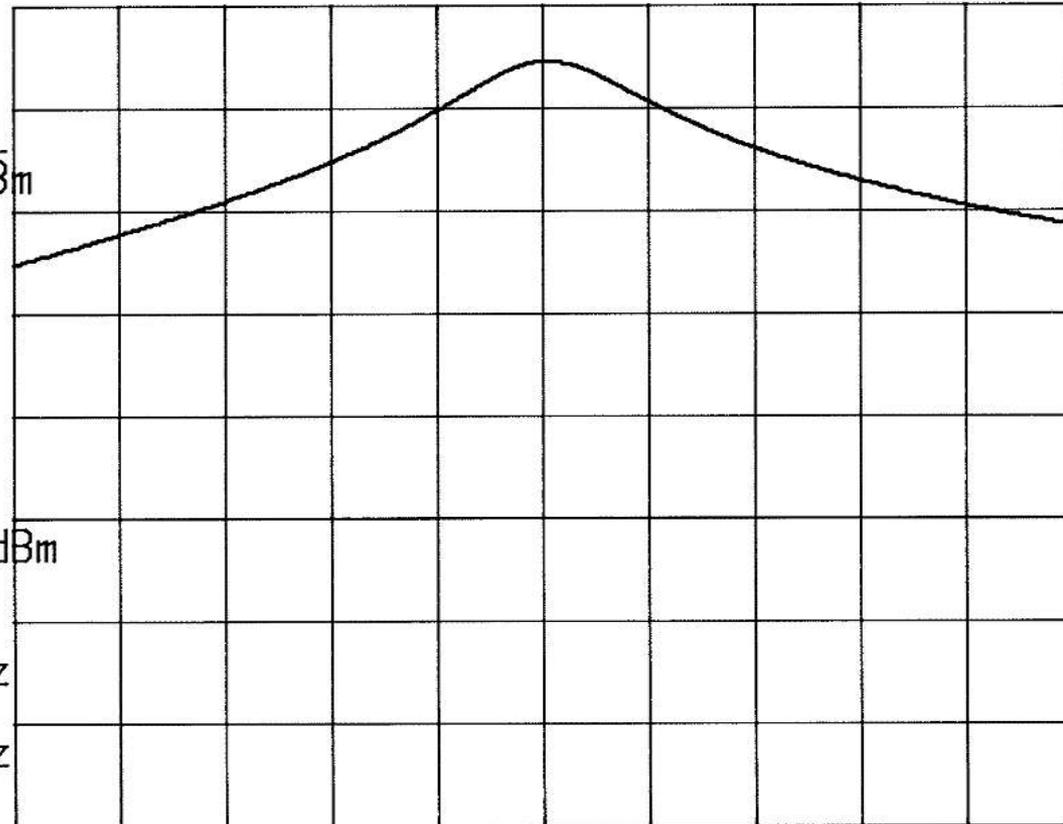
TG LEVEL
-50 dBm

DL
-50.0 dBm

RBW
100 kHz

VBW
100 kHz

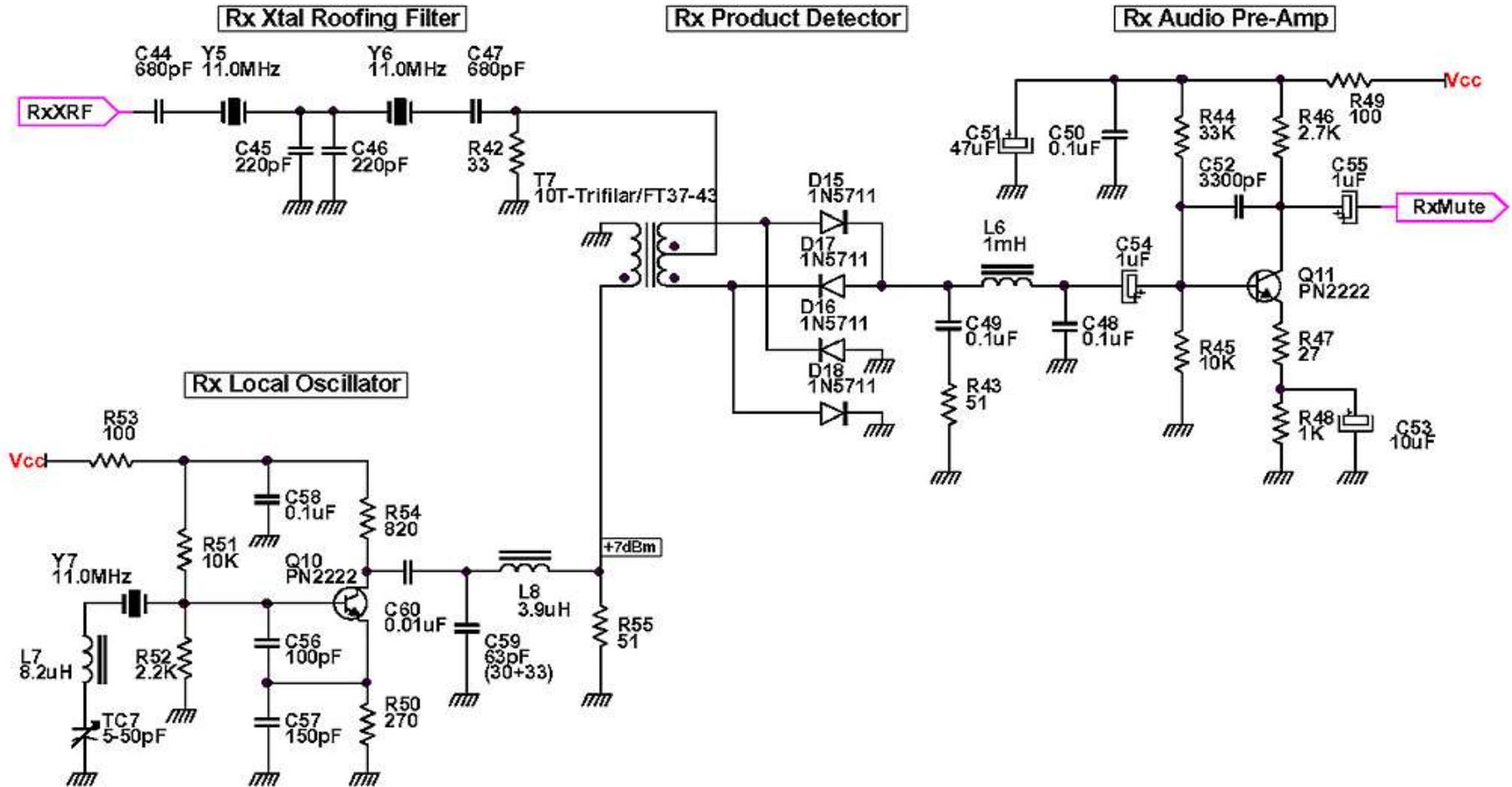
SWP
50 ms



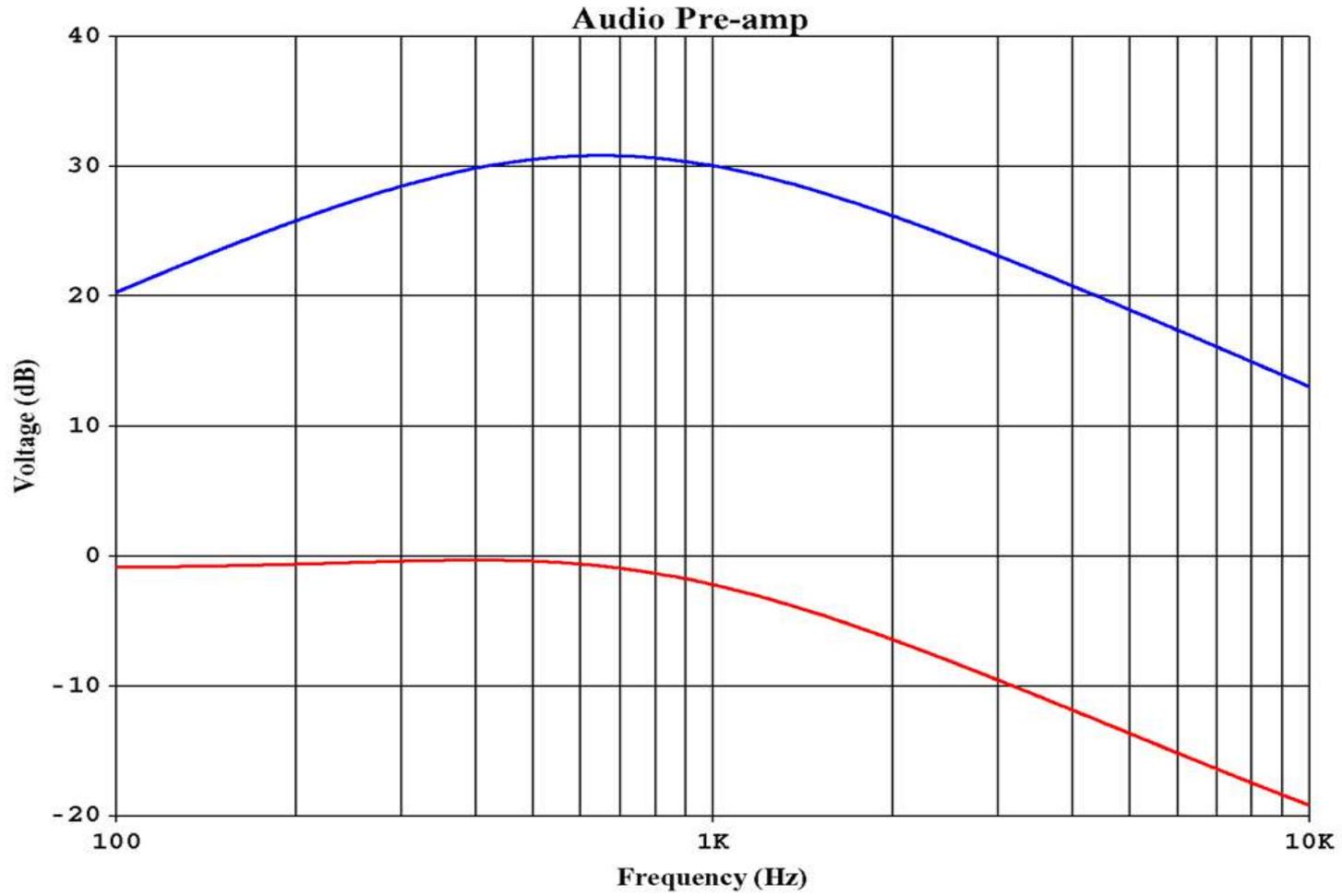
CENTER 11.00 MHz

SPAN 10.00 MHz

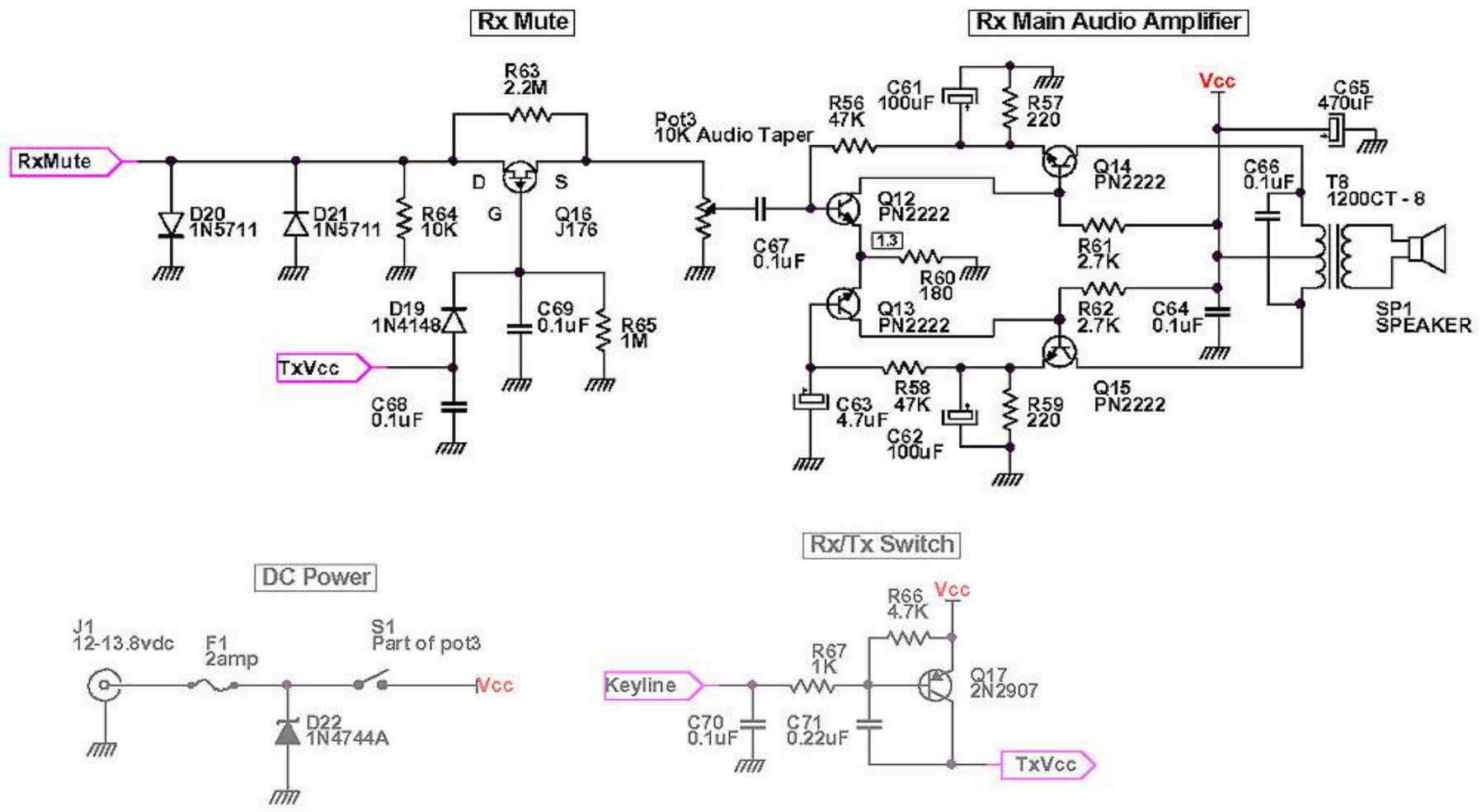
Roofing Filter - Preamp Sch



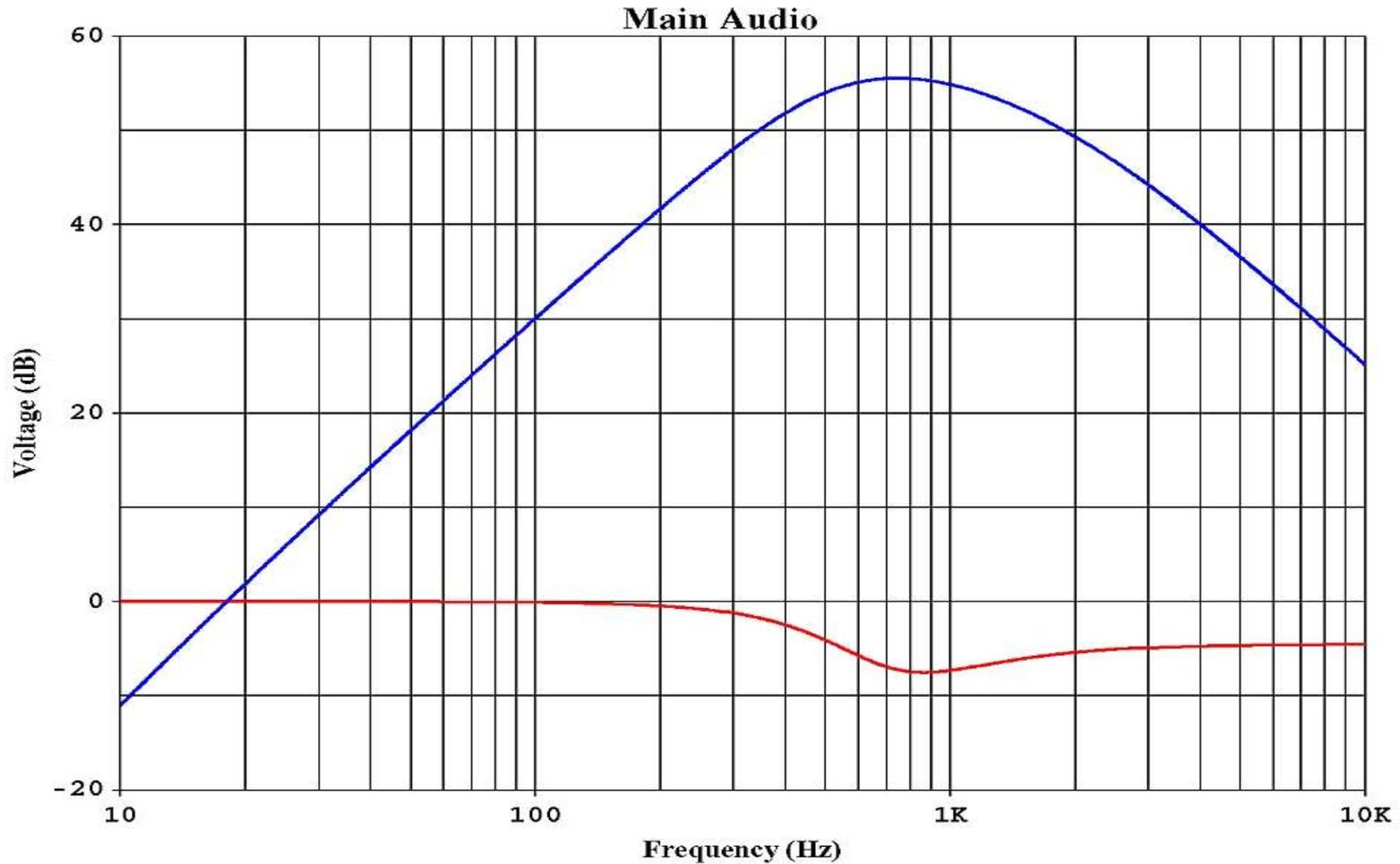
Audio Preamp Res



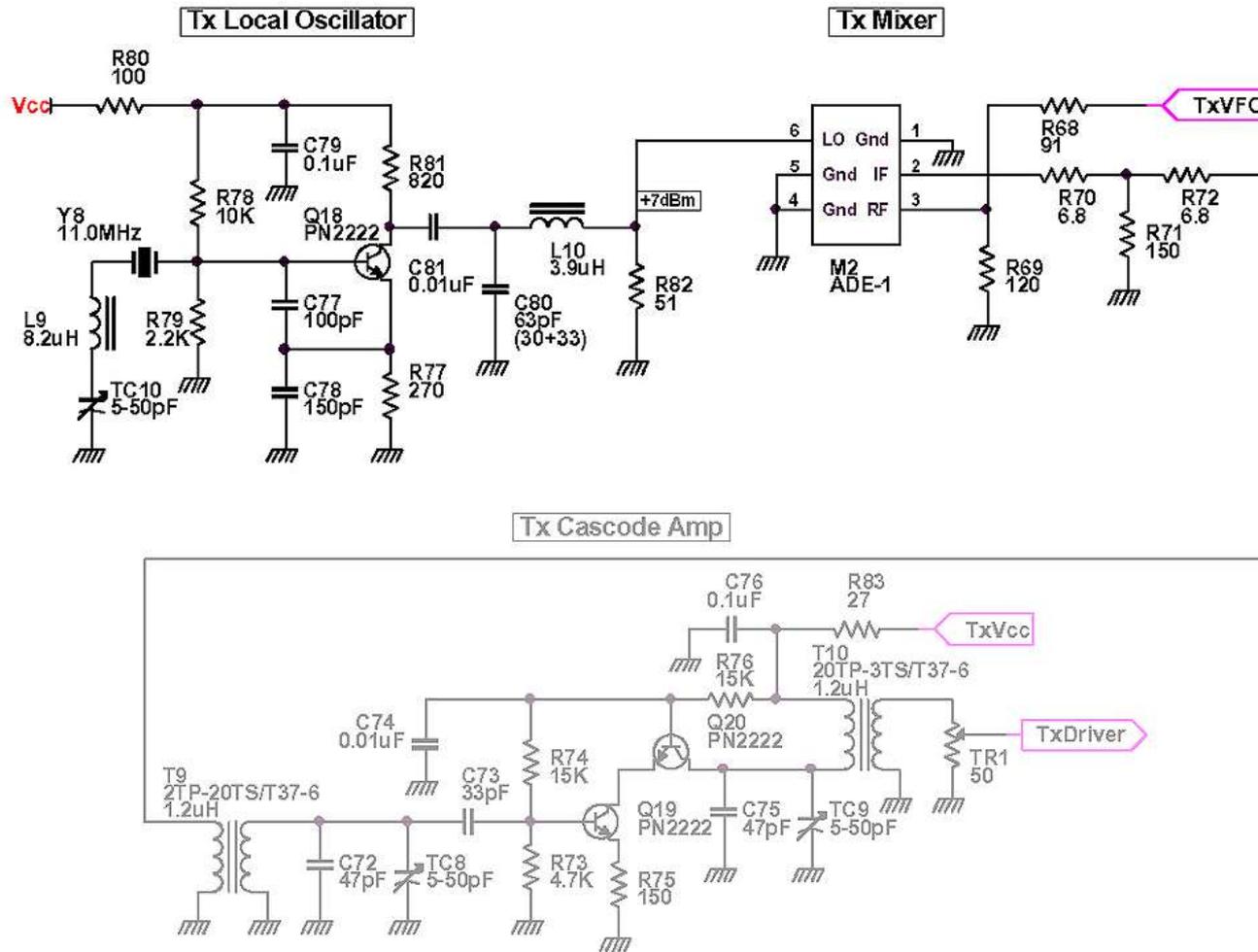
Rx Mute - Main Audio Sch



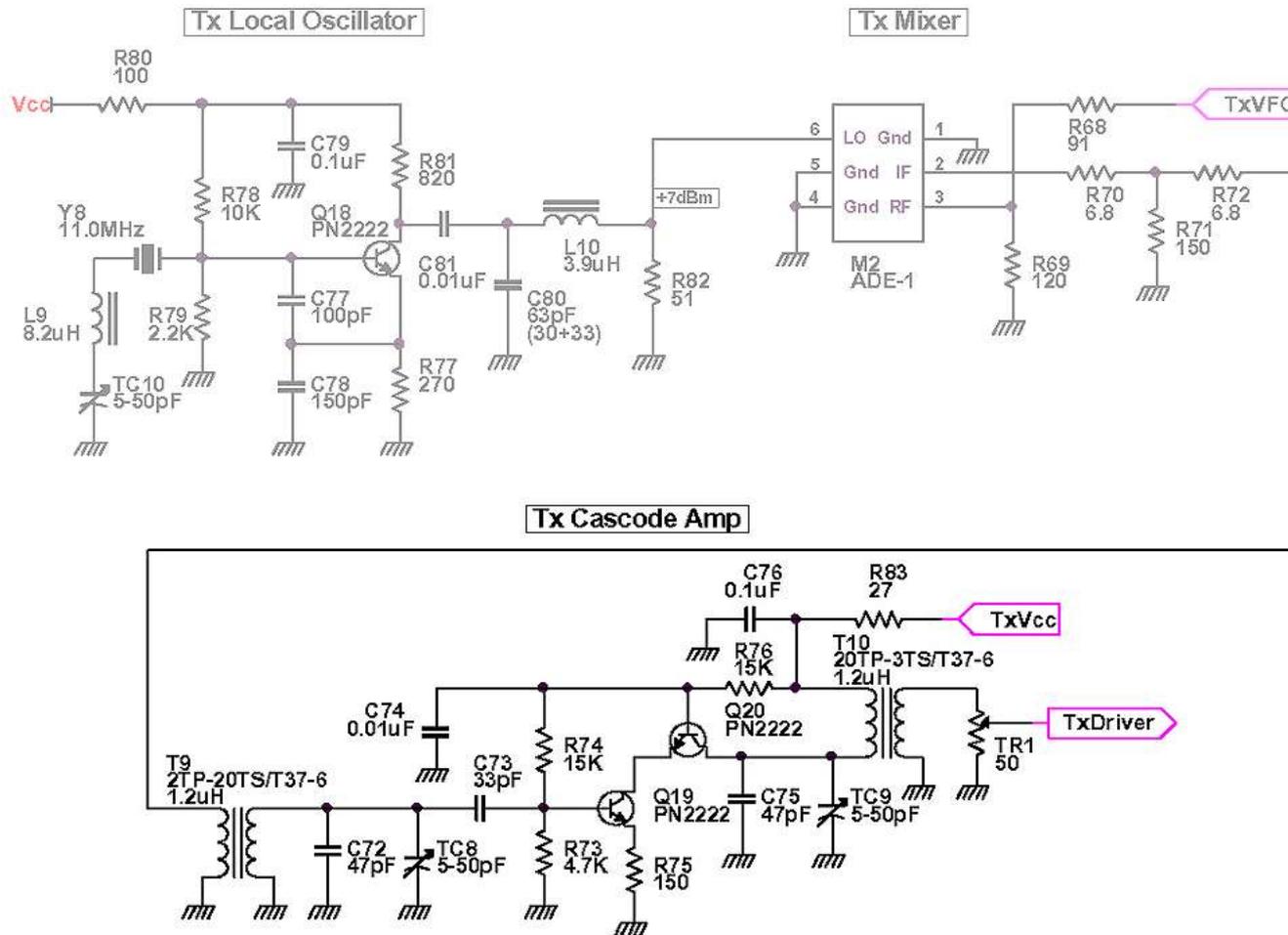
Main Audio Amp Resp



Tx LO & DBM Sch

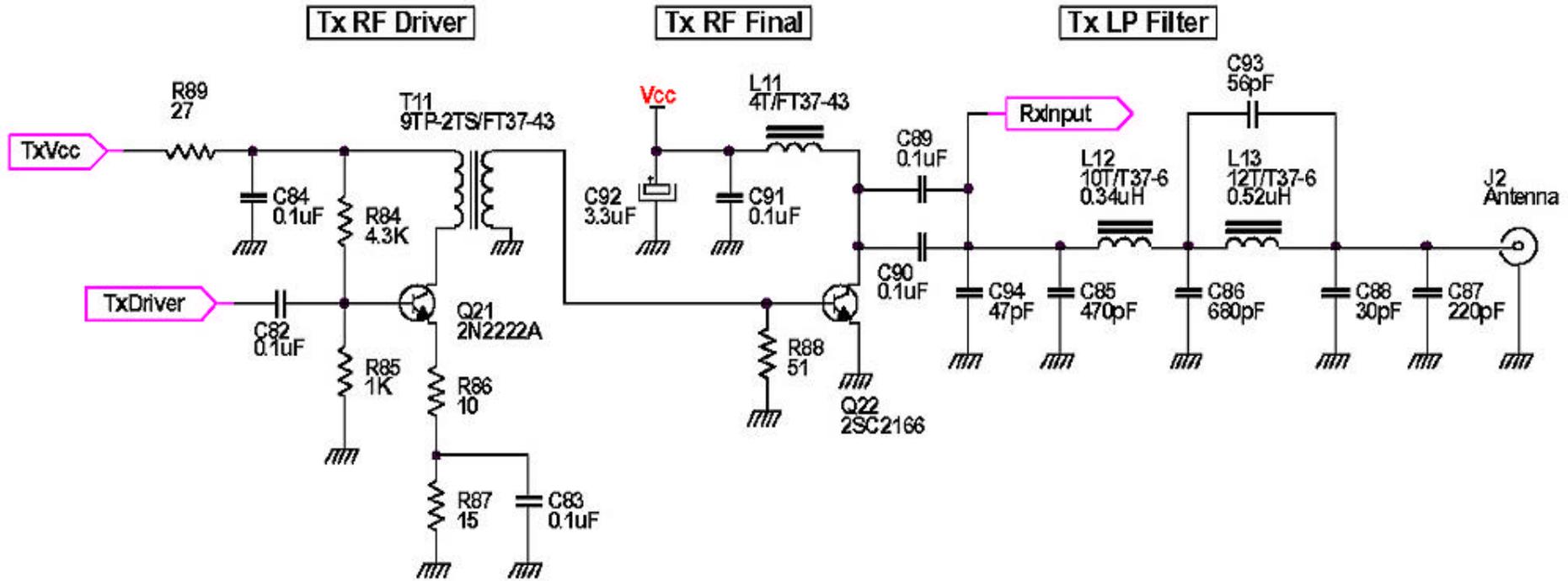


Cascode Amp Sch



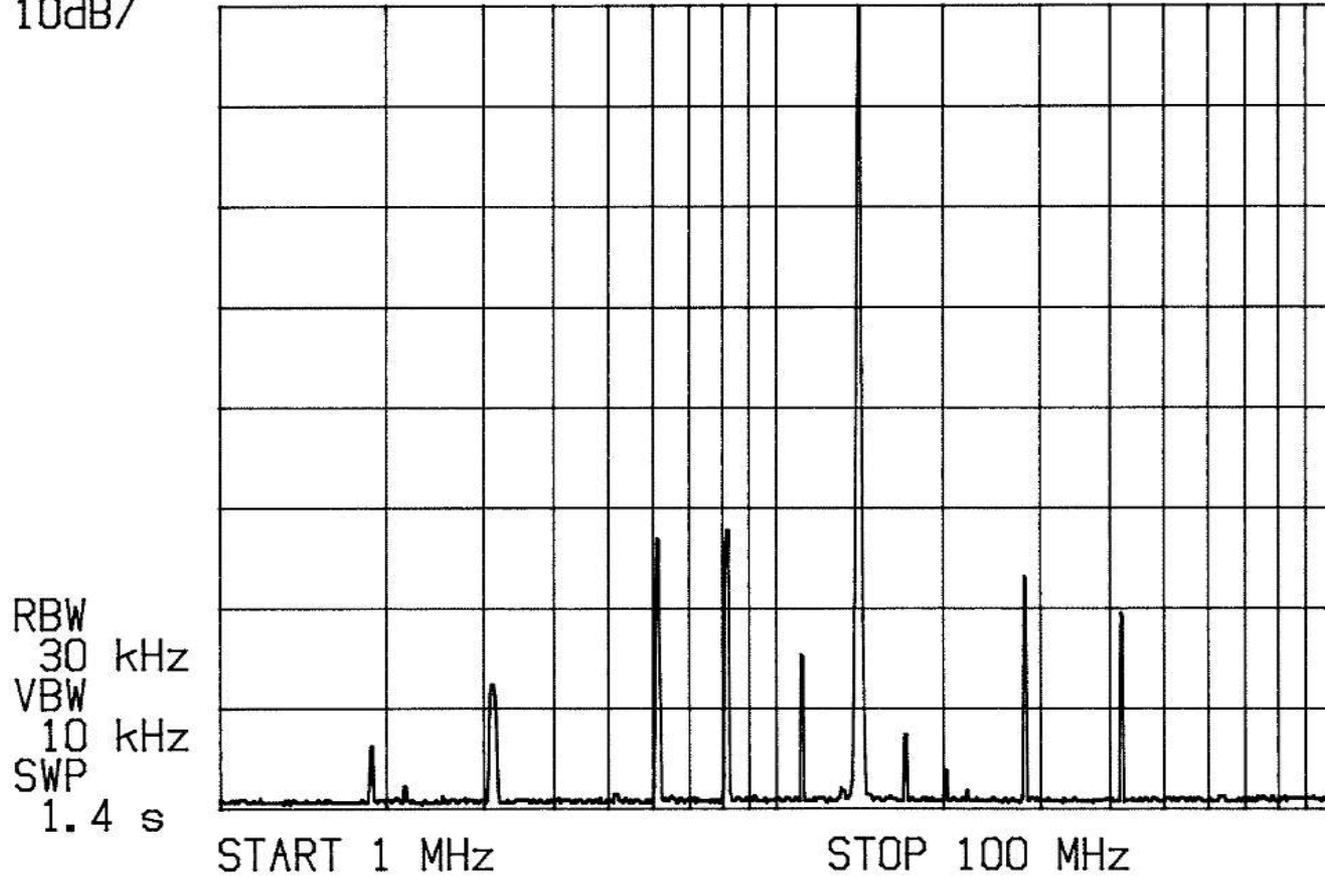


Driver – LP Filter Sch



Tx Output Spectrum

2N2/20 Tx Output = 4 Watts
REF 0.0 dBm ATT 10 dB A_view B_blank
10dB/

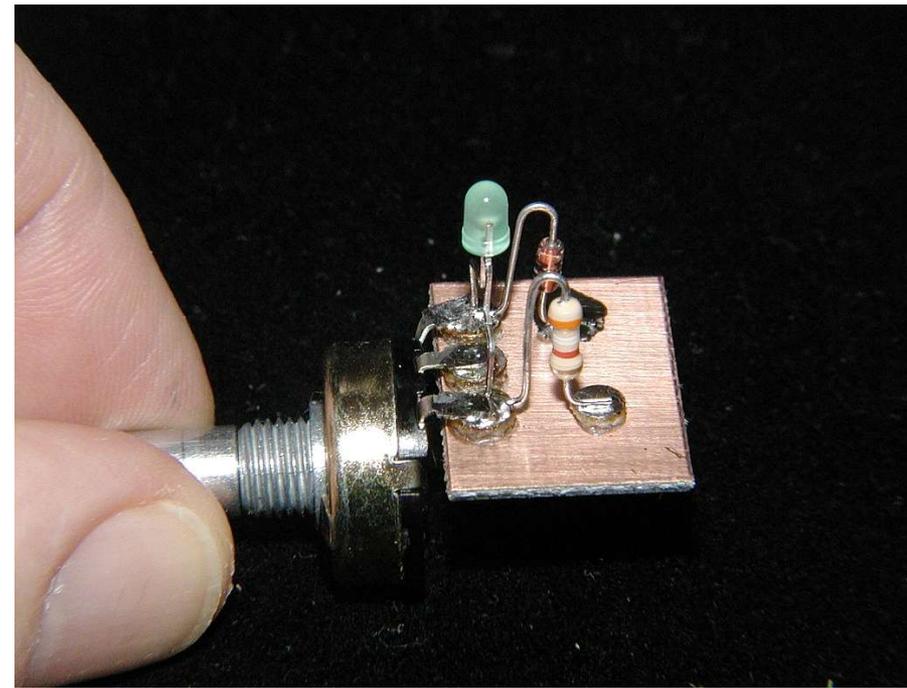
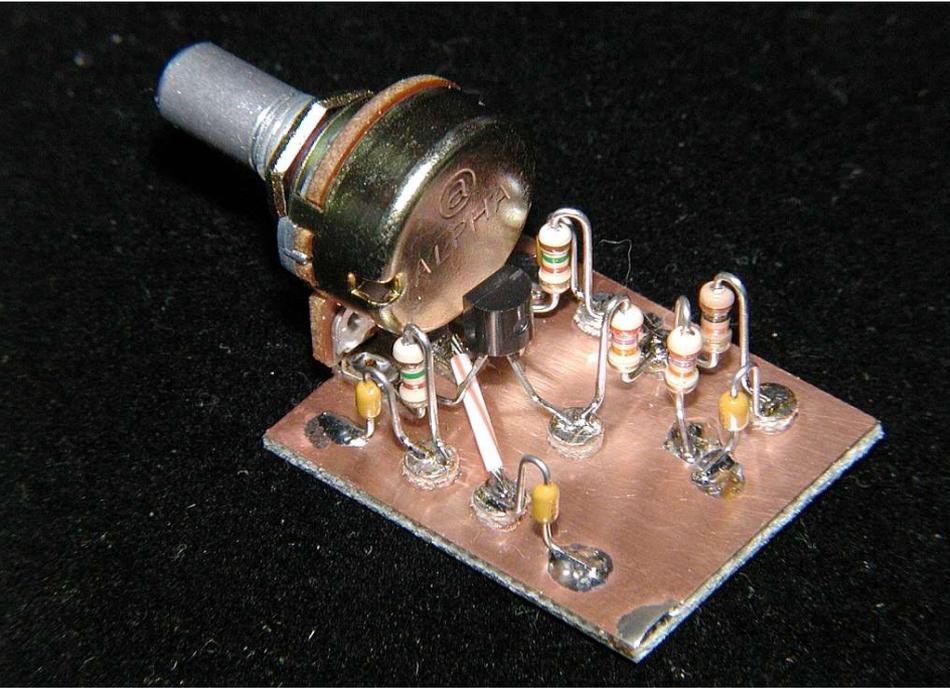




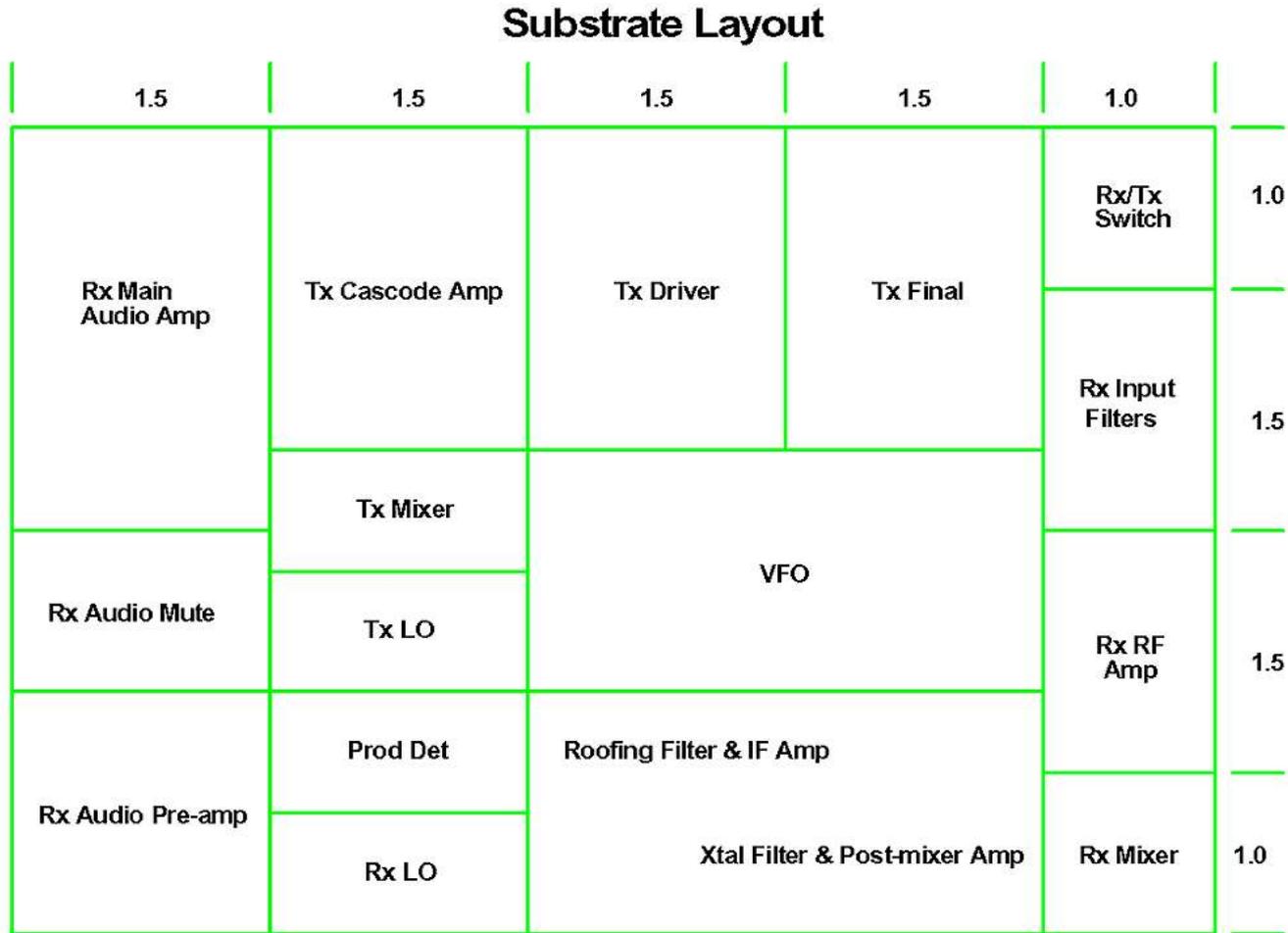
Construction Overview

- Manhattan-style construction
- 5 X 7 inch substrate footprint
- Sub-modules used where advantageous
- Custom case
- KD1JV frequency readout
- Digital photo documentation

RIT & RF Gain Modules



Substrate Layout



VFO



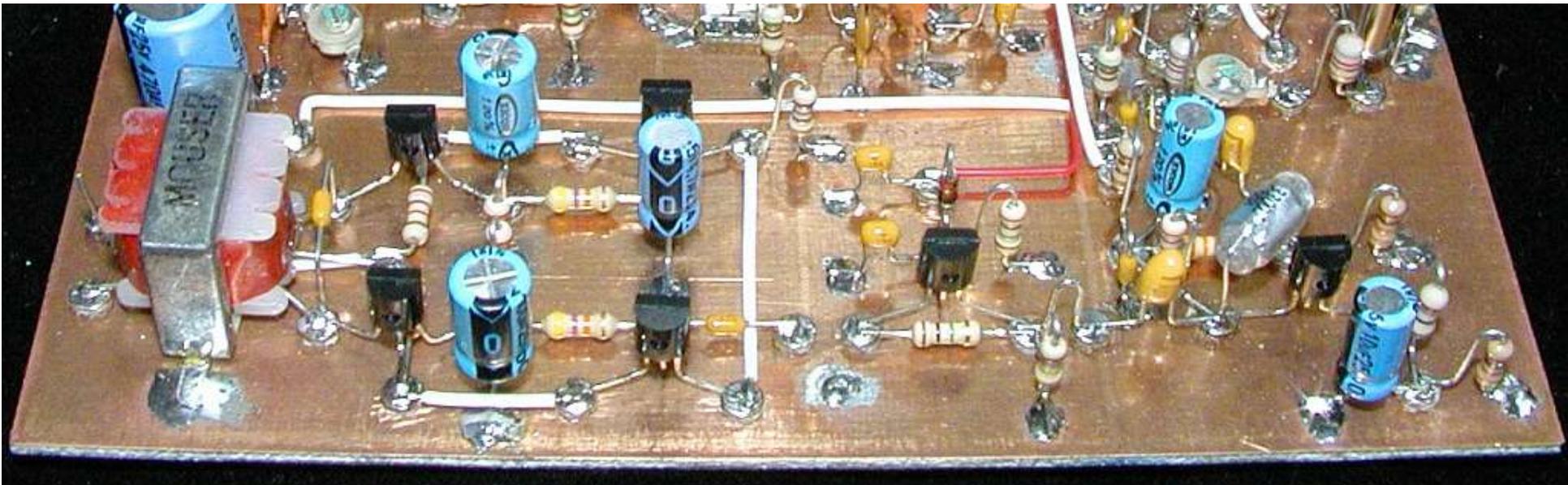
RxTx Switch - DBM



PM Amp - Prod Det



Audio Preamp - Main Amp



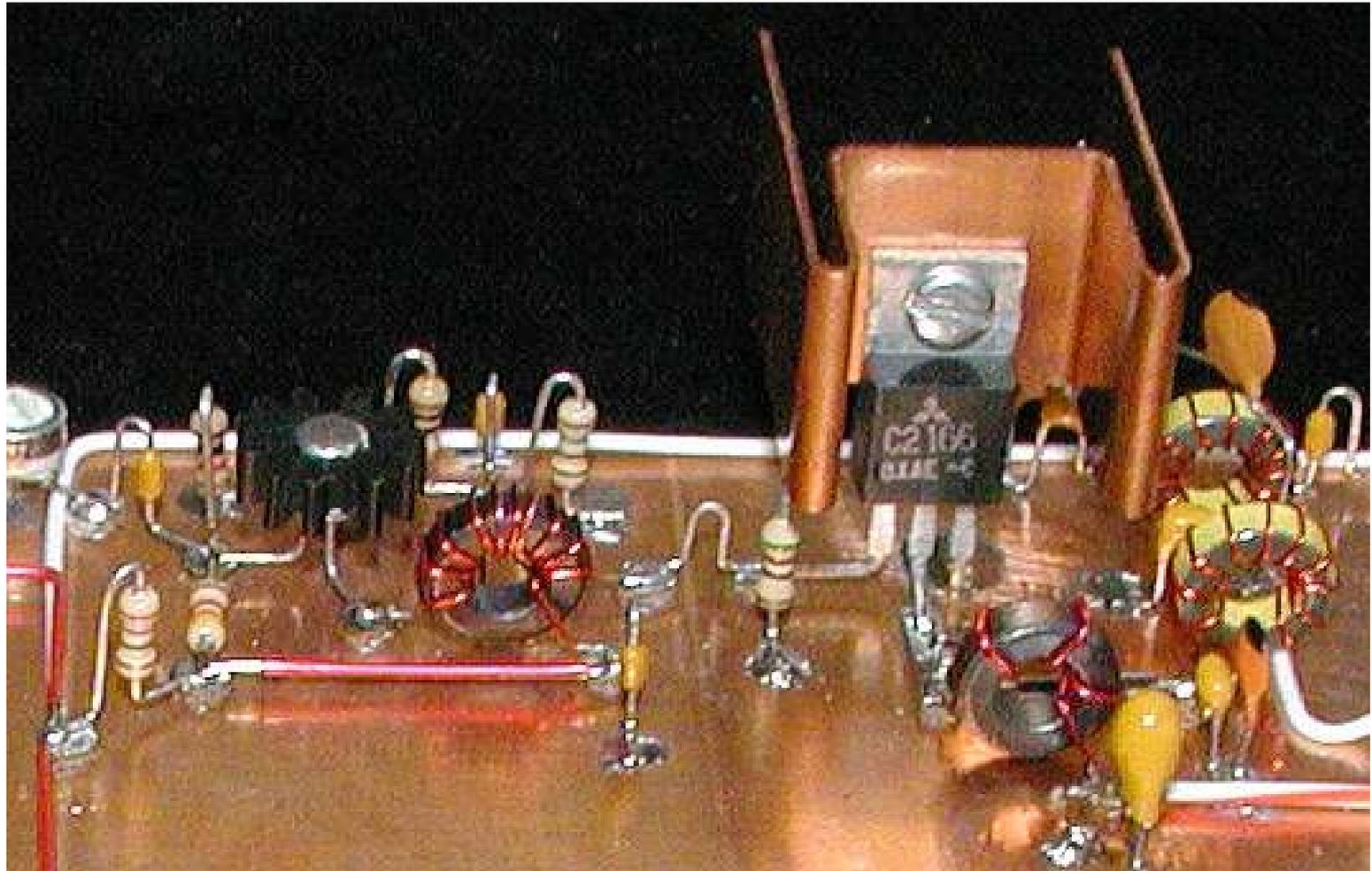
Receiver Overall



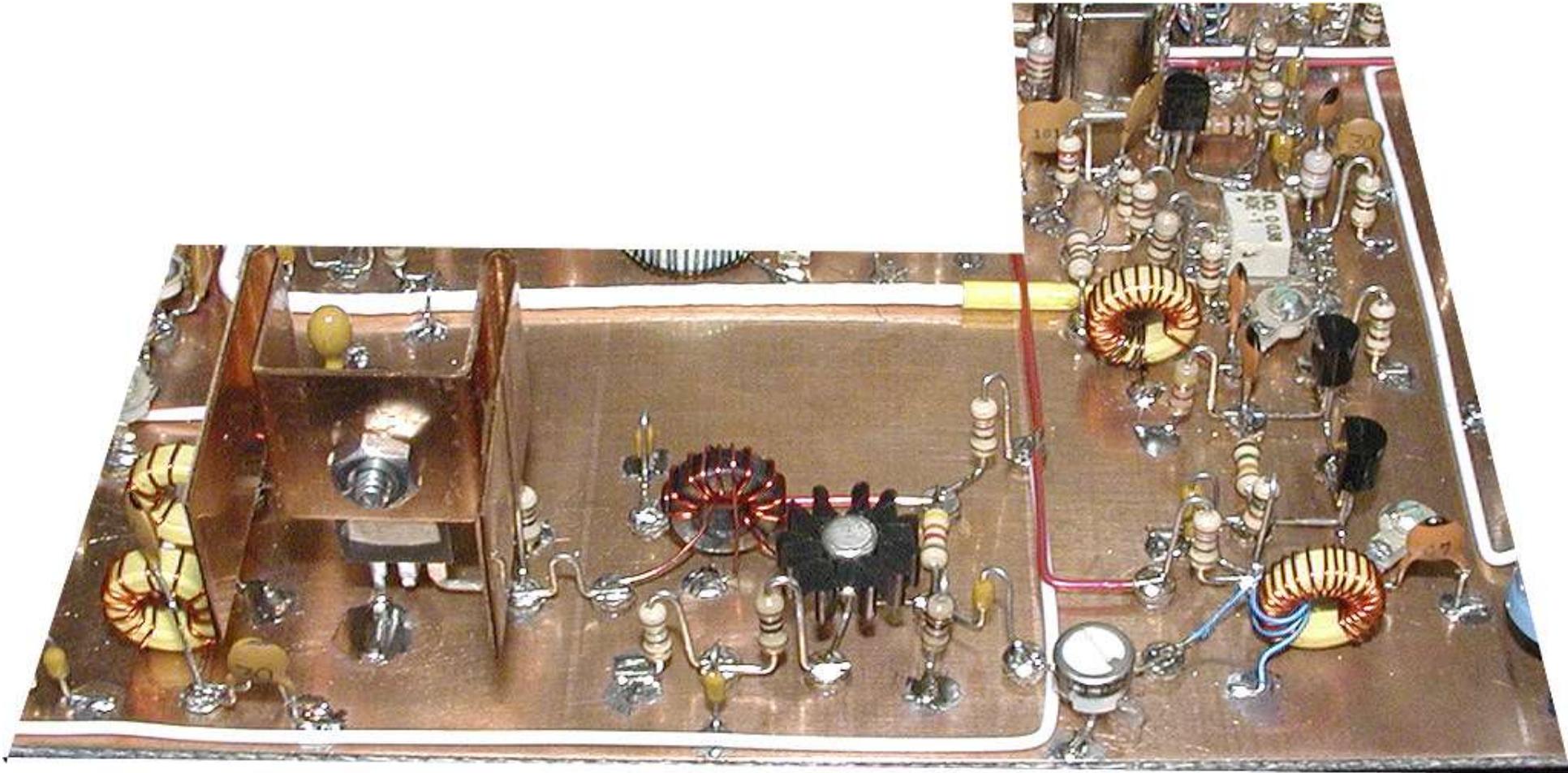
Tx LO - Cascode Amp



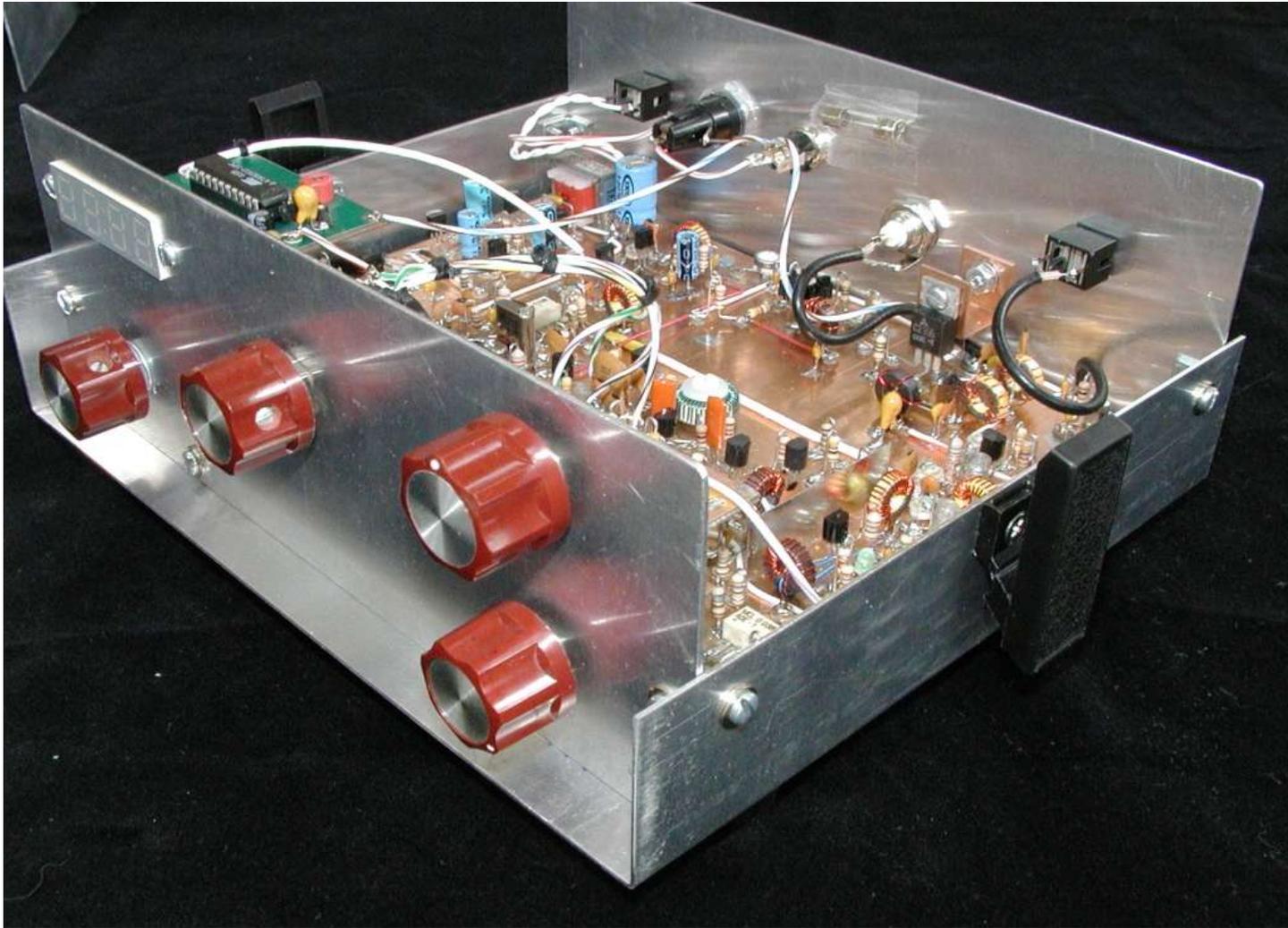
Driver - LP Filter



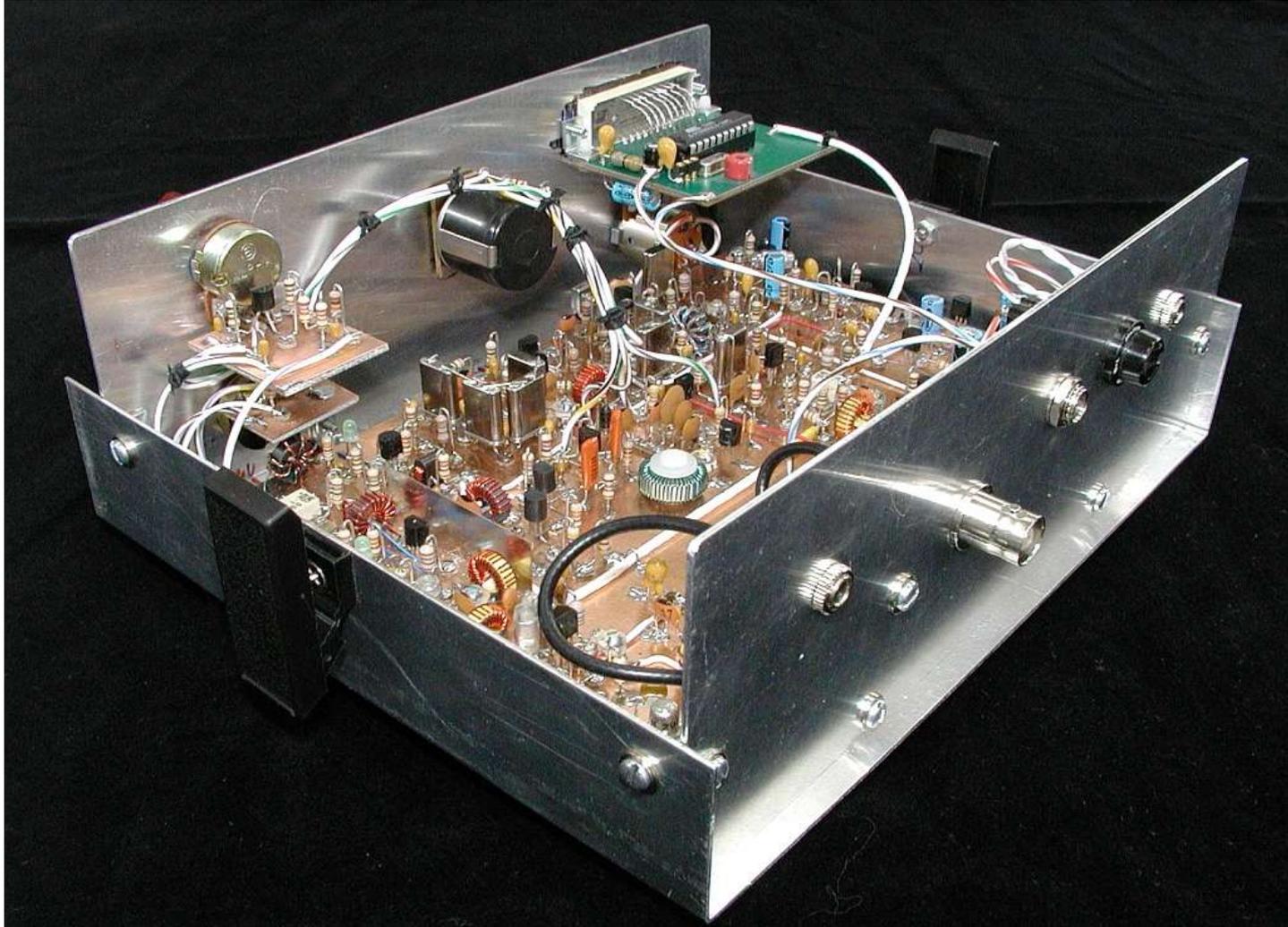
Transmitter Overall



Packaged 2N2/20 - Front



Packaged 2N2/20 - Rear





Question/Answer

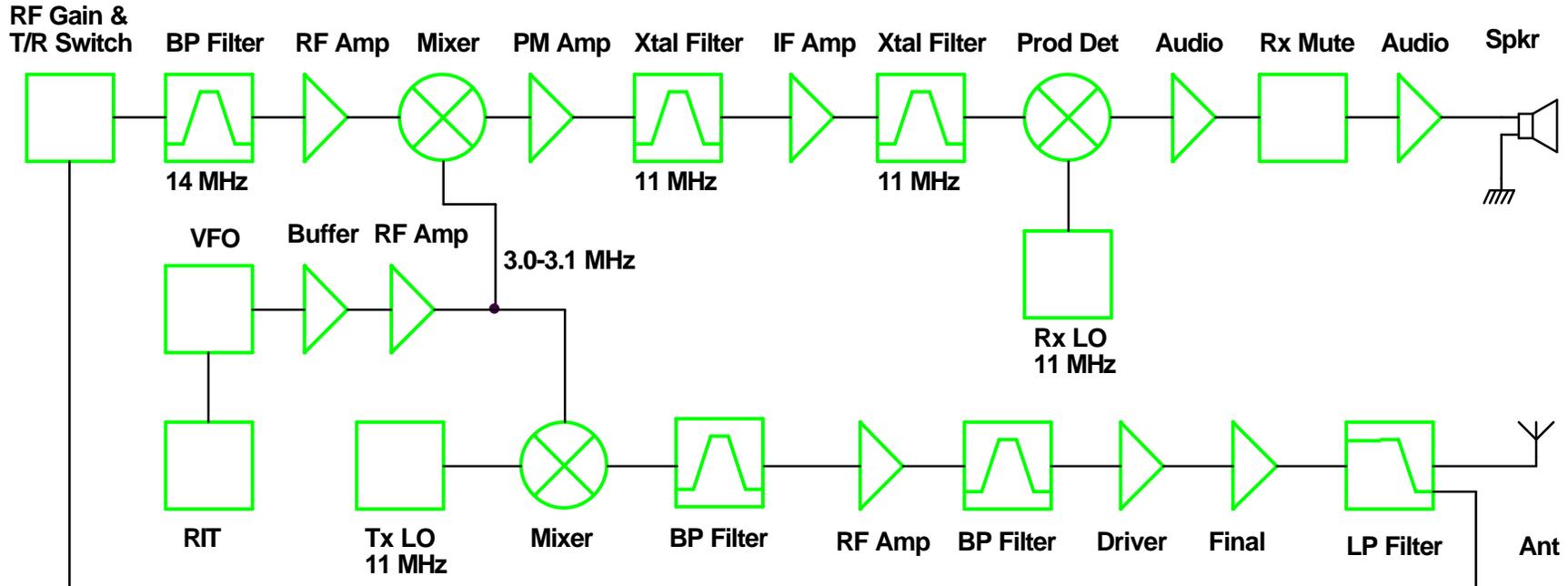
- What did you not understand?
- What item(s) need more discussion?

Substrate Layout

	1.5	1.5	1.5	1.5	1.0	
	Rx Main Audio Amp	Tx Cascode Amp	Tx Driver	Tx Final	Rx/Tx Switch	1.0
		Tx Mixer	VFO		Rx Input Filters	1.5
Rx Audio Mute	Tx LO	Roofing Filter & IF Amp			Rx RF Amp	1.5
Rx Audio Pre-amp	Prod Det			Xtal Filter & Post-mixer Amp		Rx Mixer
	Rx LO					

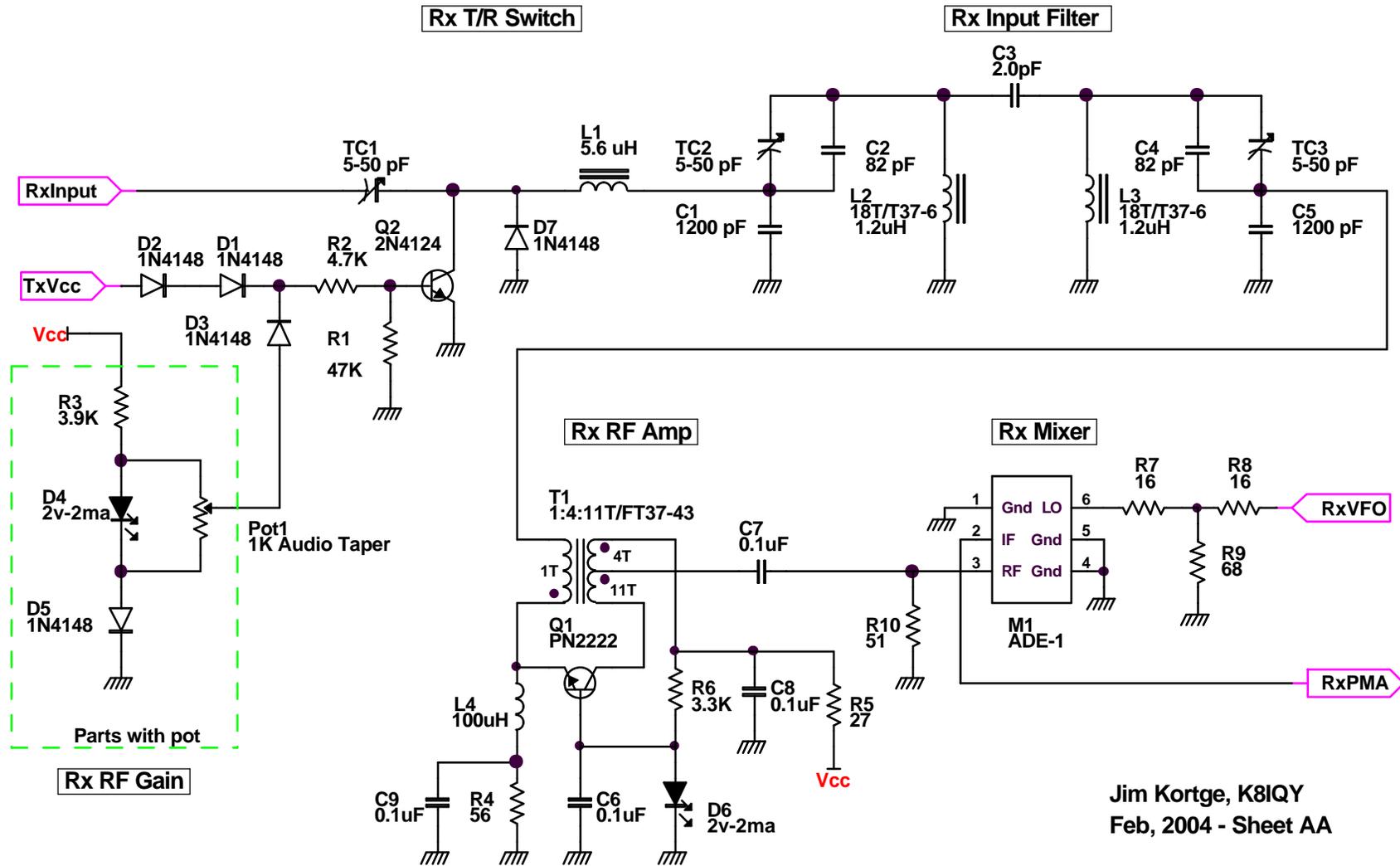
2N2/20 Block Diagram

Receive Strip



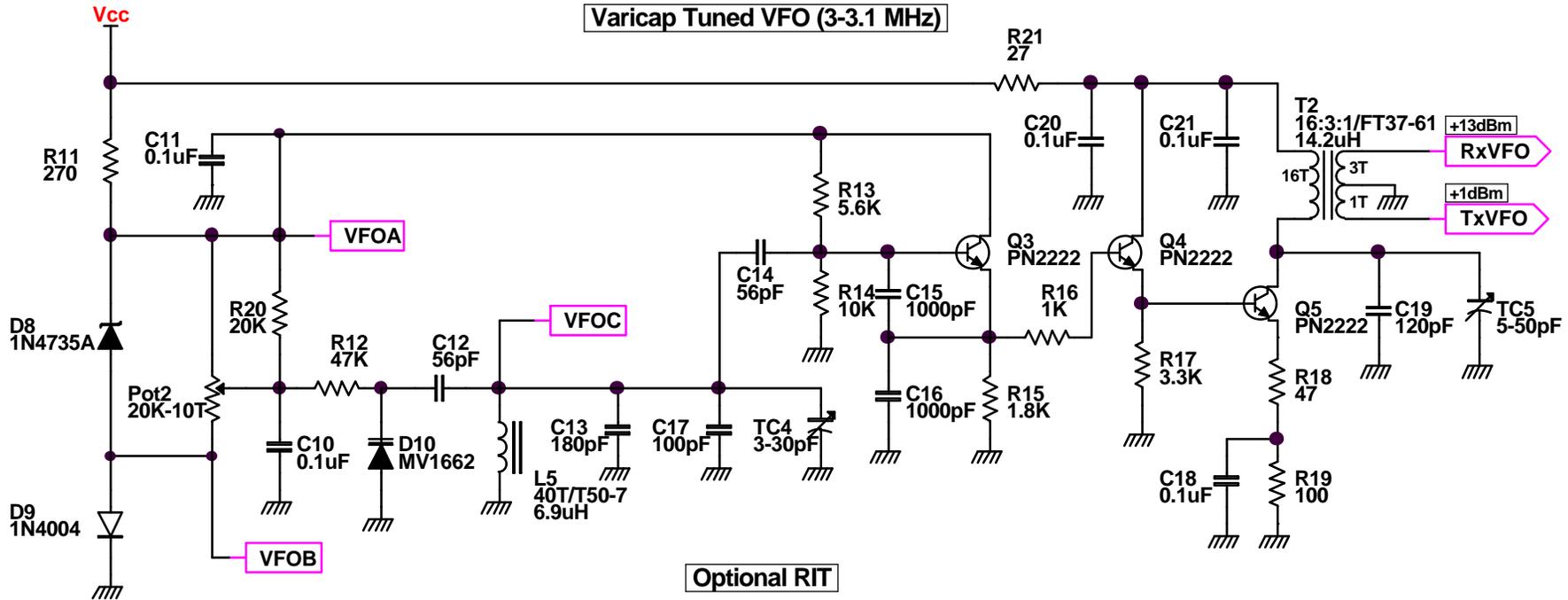
Transmit Strip

K8IQY's 2N2/20, 20 Meter CW Transceiver

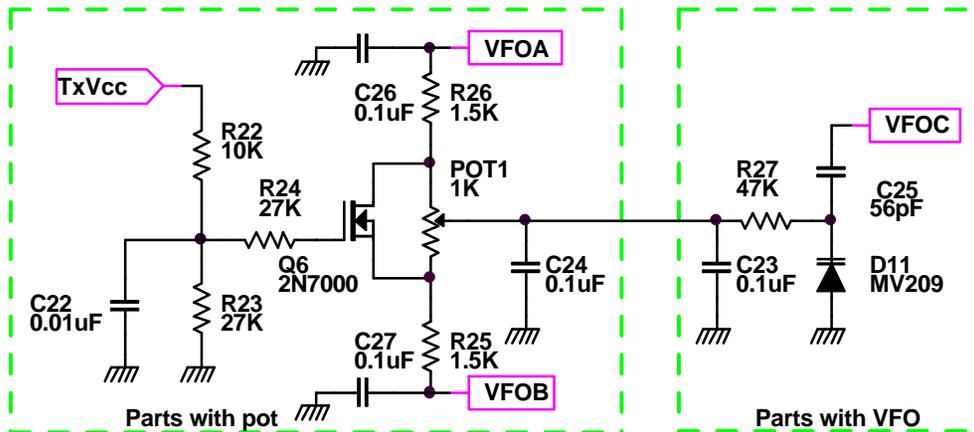


Jim Kortge, K8IQY
Feb, 2004 - Sheet AA

K8IQY's 2N2/20, 20 Meter CW Transceiver

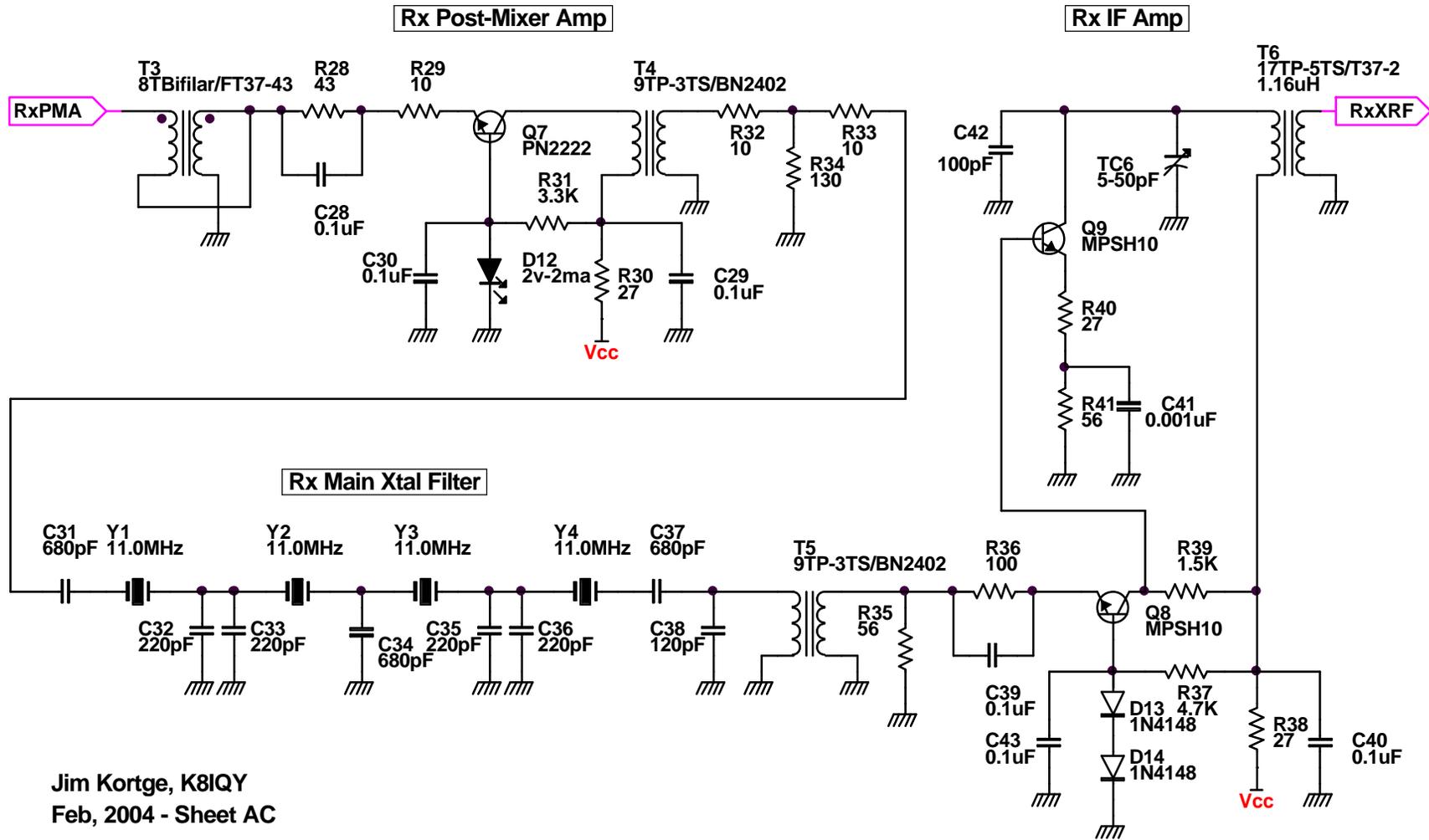


Optional RIT



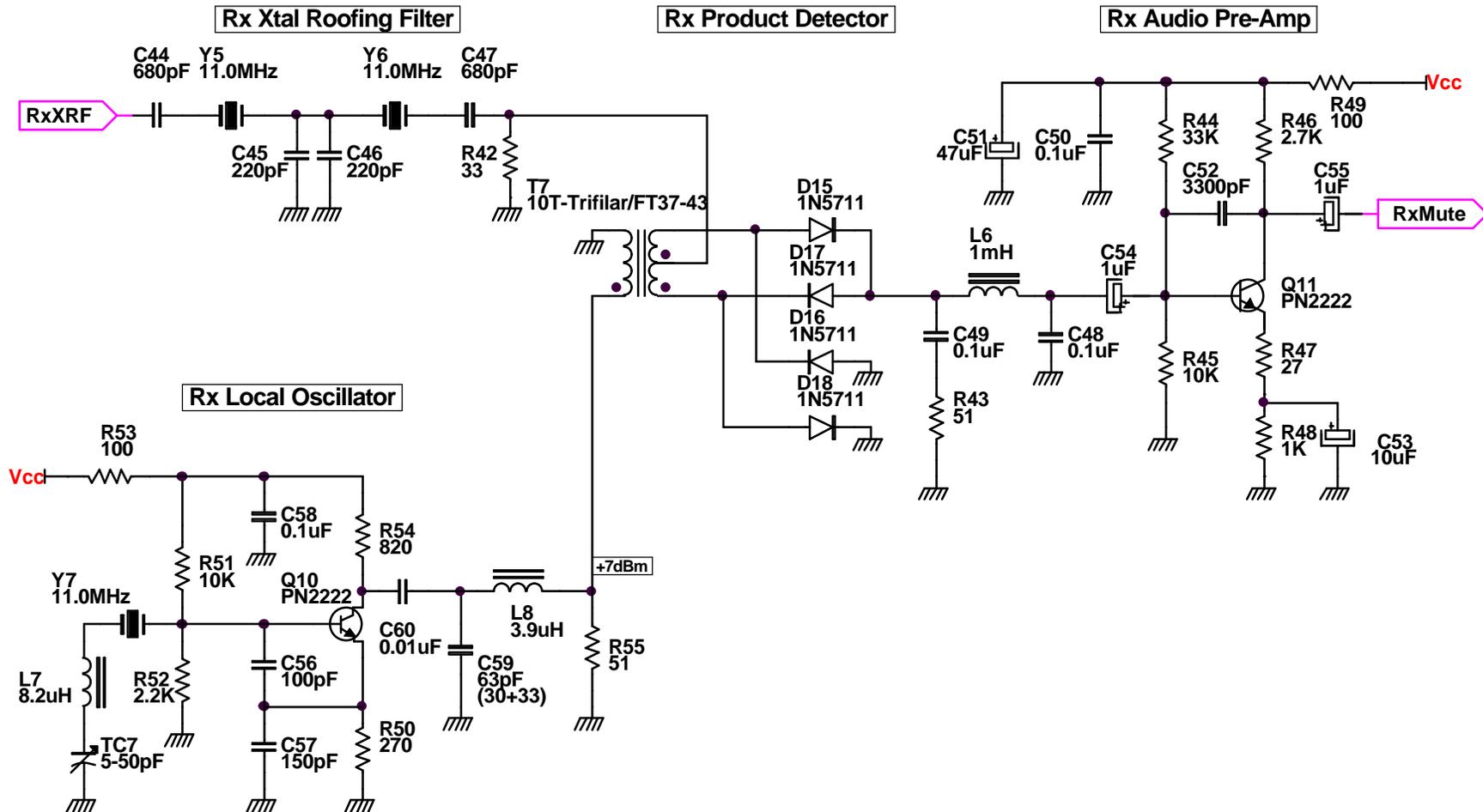
Jim Kortge, K8IQY
Feb, 2004 - Sheet AB

K8IQY's 2N2/20, 20 Meter CW Transceiver



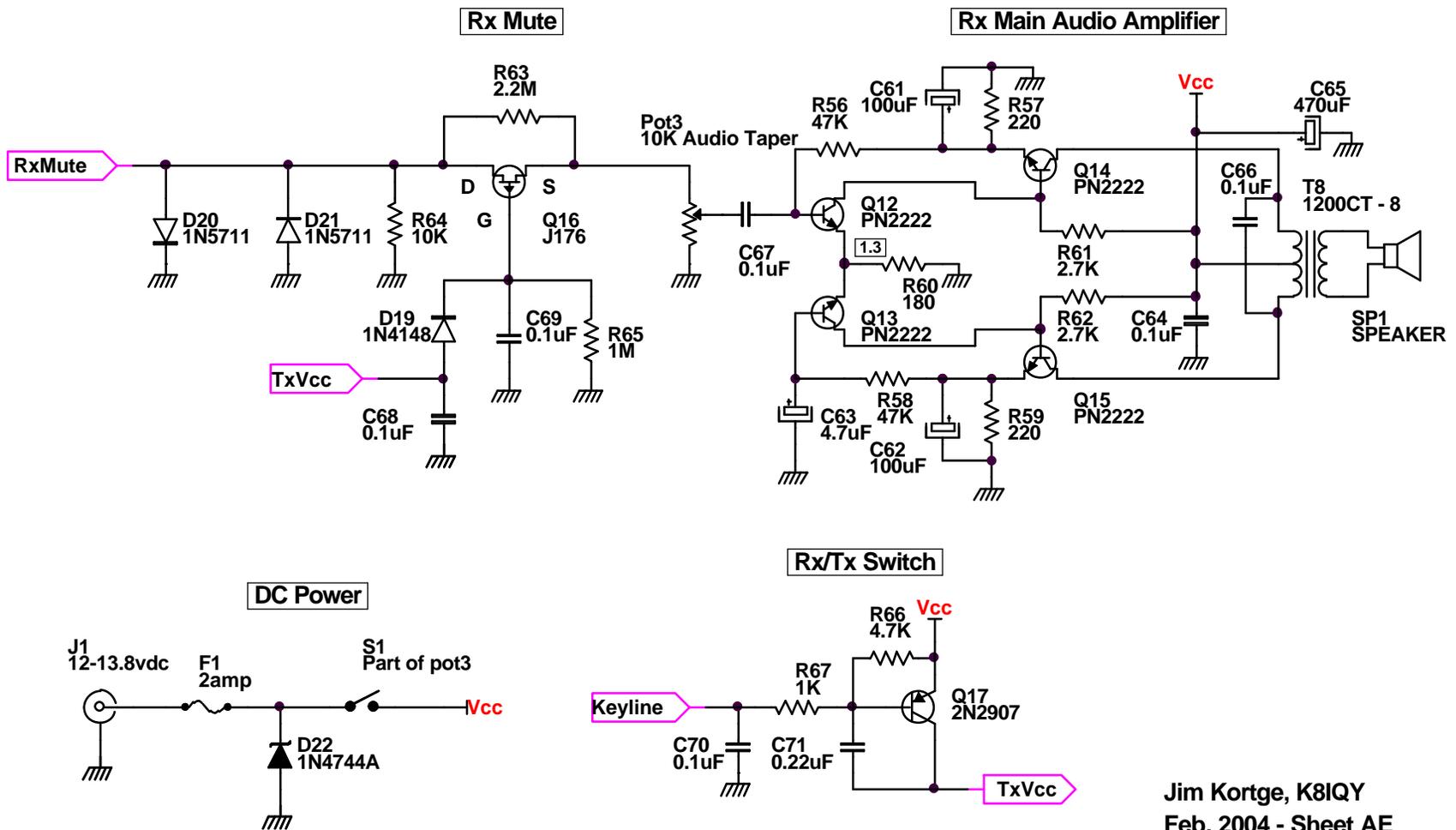
Jim Kortge, K8IQY
Feb, 2004 - Sheet AC

K8IQY's 2N2/20, 20 Meter CW Transceiver



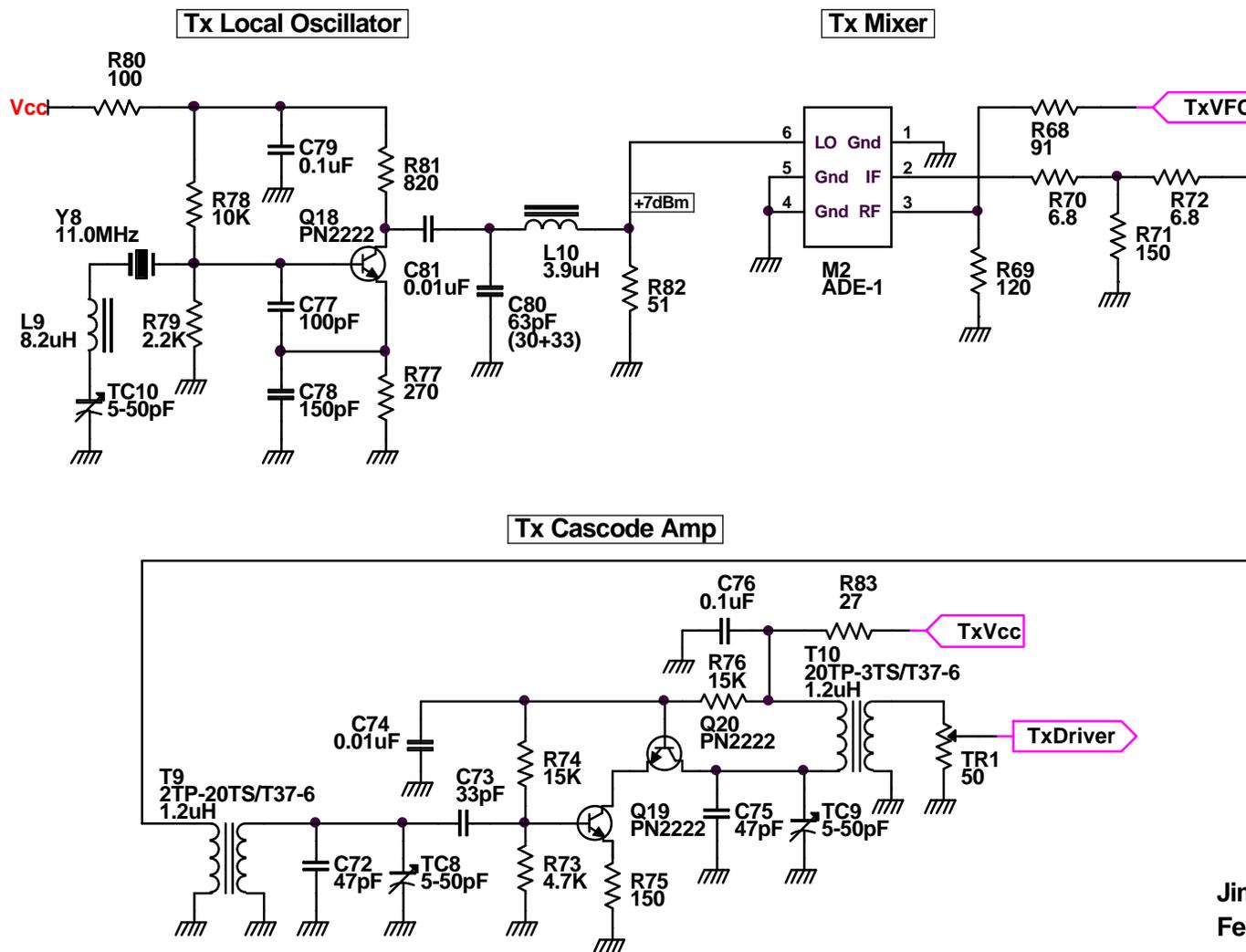
Jim Kortge, K8IQY
Feb, 2004 - Sheet AD

K8IQY's 2N2/20, 20 Meter CW Transceiver



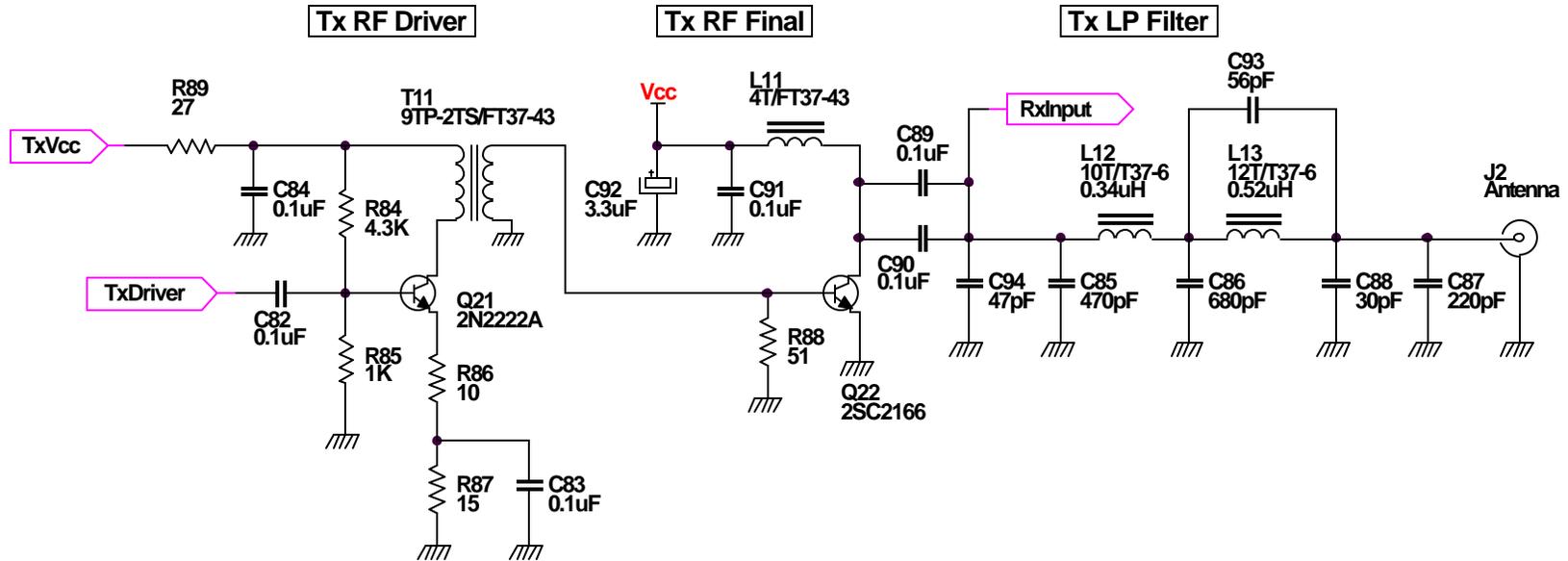
Jim Kortge, K8IQY
Feb, 2004 - Sheet AE

K8IQY's 2N2/20, 20 Meter CW Transceiver



Jim Kortge, K8IQY
Feb, 2004 - Sheet AF

K8IQY's 2N2/20, 20 Meter CW Transceiver



Jim Kortge, K8IQY
Oct, 2004 - Sheet BG

2N2/20 Bill of Materials - Version 092704			
Item	Qty	References	Value
1	2	C1,C5	1200 pF
2	4	C12,C14,C25,C93	56pF
3	1	C13	180pF
4	2	C15,C16	1000pF
5	4	C17,C42,C56,C77	100pF
6	2	C19,C38	120pF
7	2	C2,C4	82 pF
8	4	C22,C60,C74,C81	0.01uF
9	1	C3	2.0pF
10	6	C31,C34,C37,C44,C47,C86	680pF
11	7	C32,C33,C35,C36,C45,C46,C87	220pF
12	1	C41	0.001uF
13	1	C51	47uF
14	1	C52	3300pF
15	1	C53	10uF
16	2	C54,C55	1uF
17	2	C57,C78	150pF
18	2	C59,C80	63pF
19	37	C6,C7,C8,C9,C10,C11,C18,C20,C21,C23,C24,C26,C27,C28,C29,C30,C39,C40,C43,C48,C49,C50,C58,C64,C66,C67,C68,C69,C70,C76,C79,C82,C83,C84,C89,C90,C91	0.1uF
20	2	C61,C62	100uF
21	1	C63	4.7uF
22	1	C65	470uF
23	1	C71	0.22uF
24	3	C72,C75,C94	47pF
25	1	C73	33pF
26	1	C85	470pF
27	1	C88	30pF
28	1	C92	3.3uF
29	8	D1,D2,D3,D5,D7,D13,D14,D19	1N4148
30	1	D10	MV1662
31	1	D11	MV209
32	6	D15,D16,D17,D18,D20,D21	1N5711
33	1	D22	1N4744A
34	3	D4,D6,D12	2v-2ma
35	1	D8	1N4735A
36	1	D9	1N4004
37	1	F1	2amp
38	1	J1	12-13.8vdc
39	1	J2	Antenna
40	1	L1	5.6 uH
41	1	L11	4T/FT37-43
42	1	L12	10T/T37-6
43	1	L13	12T/T37-6
44	2	L2,L3	18T/T37-6
45	1	L4	100uH
46	1	L5	6.9uH
47	1	L6	1mH
48	2	L7,L9	8.2uH
49	2	L8,L10	3.9uH
50	2	M1,M2	ADE-1
51	1	Pot1	1K Audio Taper
52	1	Pot2	20K-10T
53	1	Pot3	10K Audio Taper
54	14	Q1,Q3,Q4,Q5,Q7,Q10,Q11,Q12,Q13,Q14,Q15,Q18,Q19,Q20	PN2222
55	1	Q16	J176
56	1	Q17	2N2907

57	1	Q2	2N4124
58	1	Q21	2N2222A
59	1	Q22	2SC2166
60	1	Q6	2N7000
61	2	Q8,Q9	MPSH10
62	5	R1,R12,R27,R56,R58	47K
63	5	R10,R43,R55,R82,R88	51
64	3	R11,R50,R77	270
65	1	R13	5.6K
66	6	R14,R22,R45,R51,R64,R78	10K
67	1	R15	1.8K
68	5	R16,R48,R67,R85,POT1	1K
69	1	R18	47
70	5	R19,R36,R49,R53,R80	100
71	4	R2,R37,R66,R73	4.7K
72	1	R20	20K
73	2	R23,R24	27K
74	3	R25,R26,R39	1.5K
75	1	R28	43
76	4	R29,R32,R33,R86	10
77	1	R3	3.9K
78	1	R34	130
79	3	R4,R35,R41	56
80	1	R42	33
81	1	R44	33K
82	3	R46,R61,R62	2.7K
83	8	R5,R21,R30,R38,R40,R47,R83,R89	27
84	2	R52,R79	2.2K
85	2	R54,R81	820
86	2	R57,R59	220
87	3	R6,R17,R31	3.3K
88	1	R60	180
89	1	R63	2.2M
90	1	R65	1M
91	1	R68	91
92	1	R69	120
93	2	R7,R8	16
94	2	R70,R72	6.8
95	2	R71,R75	150
96	2	R74,R76	15K
97	1	R84	4.3K
98	1	R87	15
99	1	R9	68
100	1	S1	Part of pot3
101	1	SP1	SPEAKER
102	1	T1	1:4:11T/FT37-43
103	1	T10	20TP-3TS/FT37-6
104	1	T11	9TP-2TS/FT37-43
105	1	T2	16:3:1/FT37-61
106	1	T3	8TBifilar/FT37-43
107	2	T4,T5	9TP-3TS/BN2402
108	1	T6	17TP-5TS/FT37-2
109	1	T7	10T-Trifilar/FT37-43
110	1	T8	1200CT - 8
111	1	T9	2TP-20TS/FT37-6
112	3	TC1,TC2,TC3	5-50 pF
113	1	TC4	3-30pF
114	6	TC5,TC6,TC7,TC8,TC9,TC10	5-50pF
115	1	TR1	50

116	8	Y1,Y2,Y3,Y4,Y5,Y6,Y7,Y8	11.0MHz
-----	---	-------------------------	---------