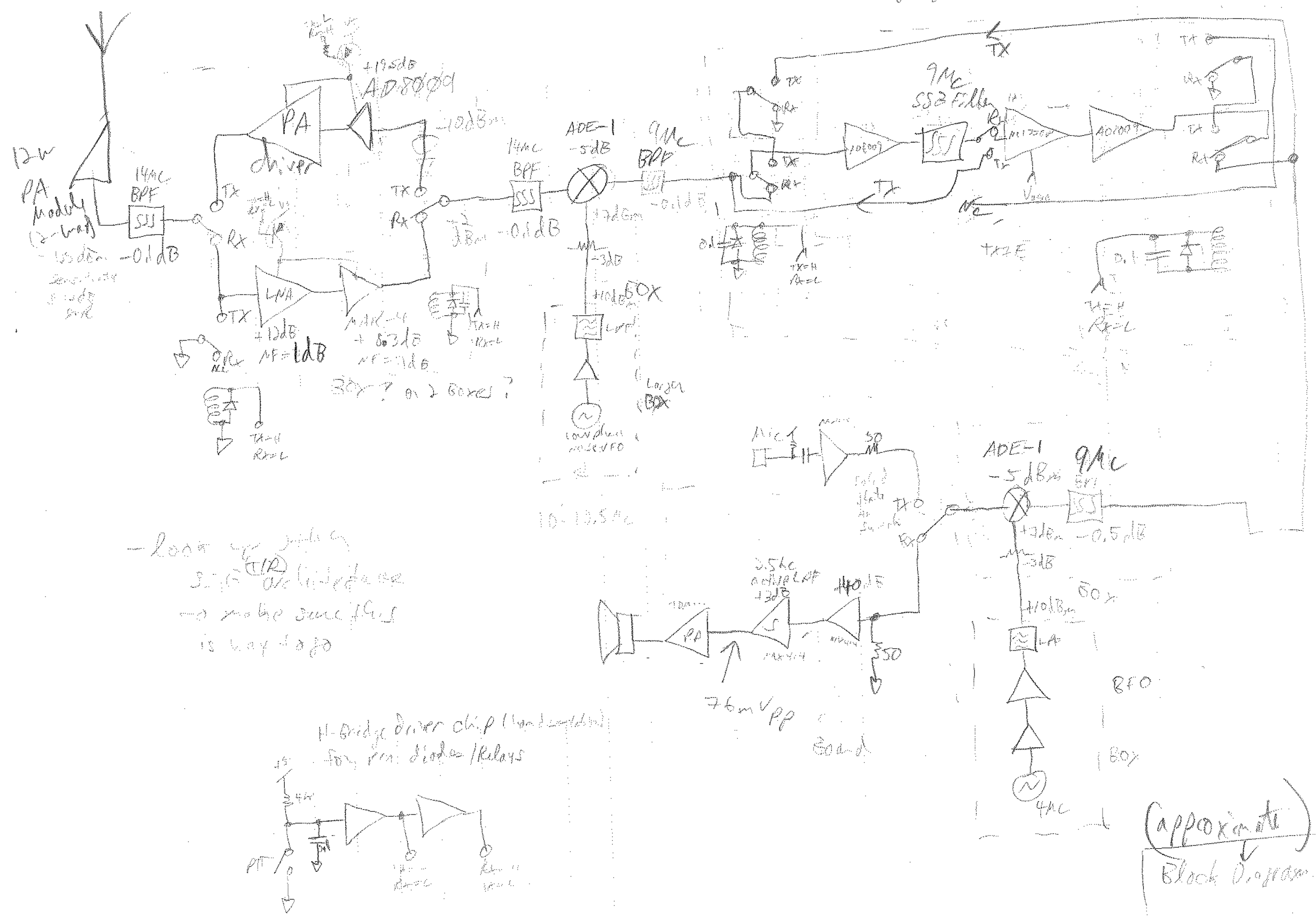
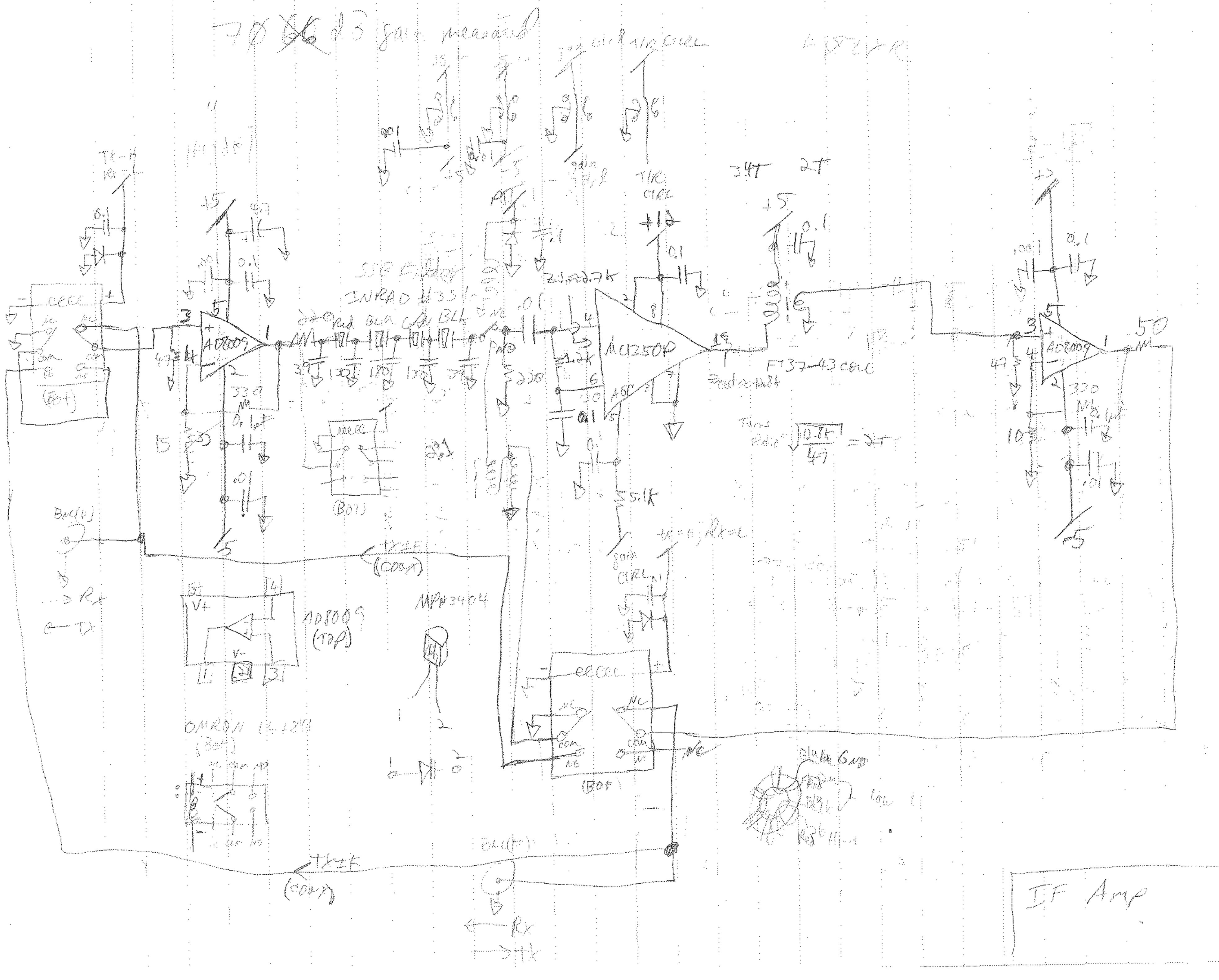
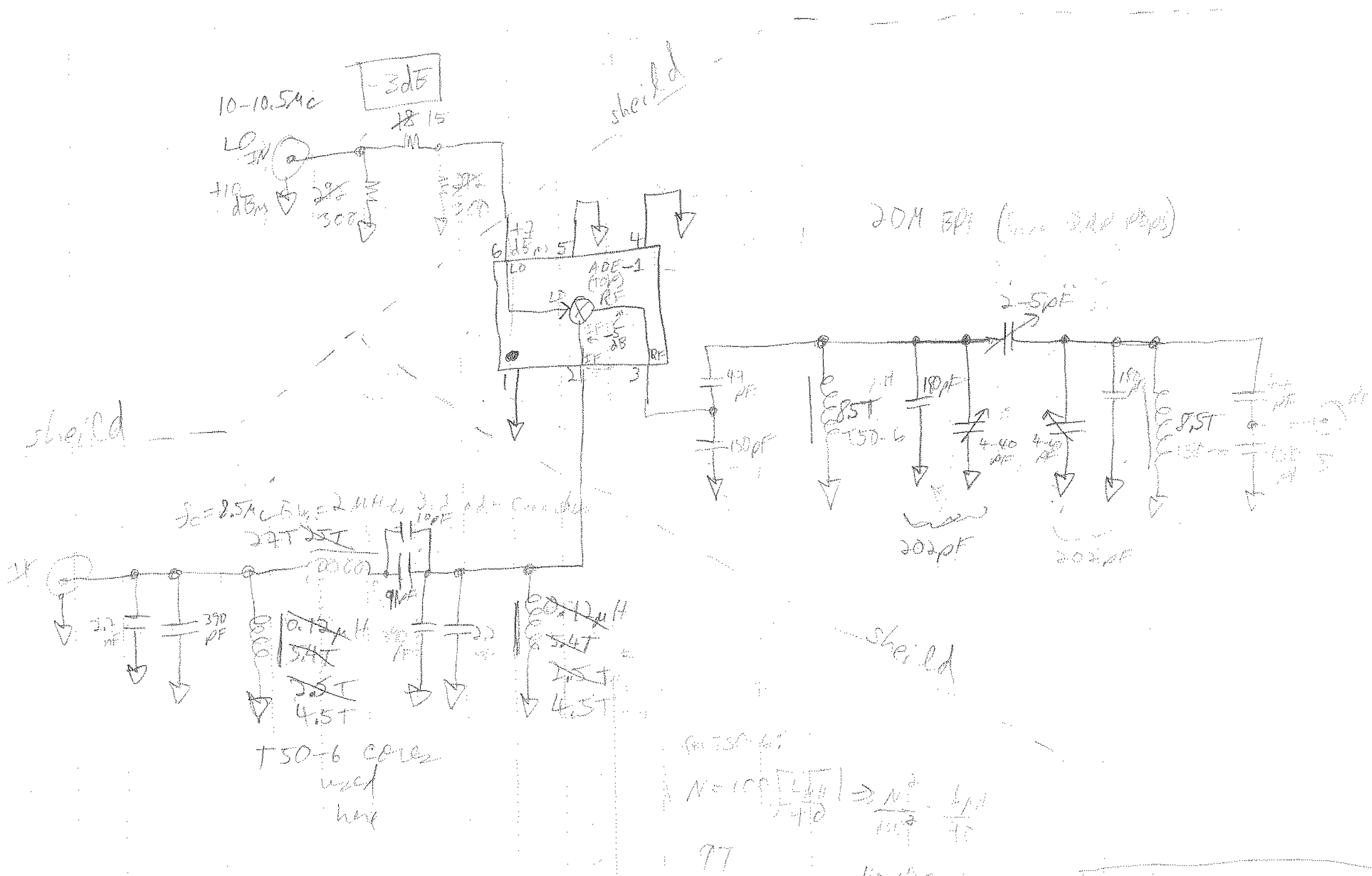
ERA-2 → 16.4dB gain, NF=3.7dB, IP1=13.1dBm
MAR-4 → 8.3dB gain, NF=7dB, IP1=12.5dBm
VAM-6 → 19.5dB gain, NF=3dB, IP1=2dBm



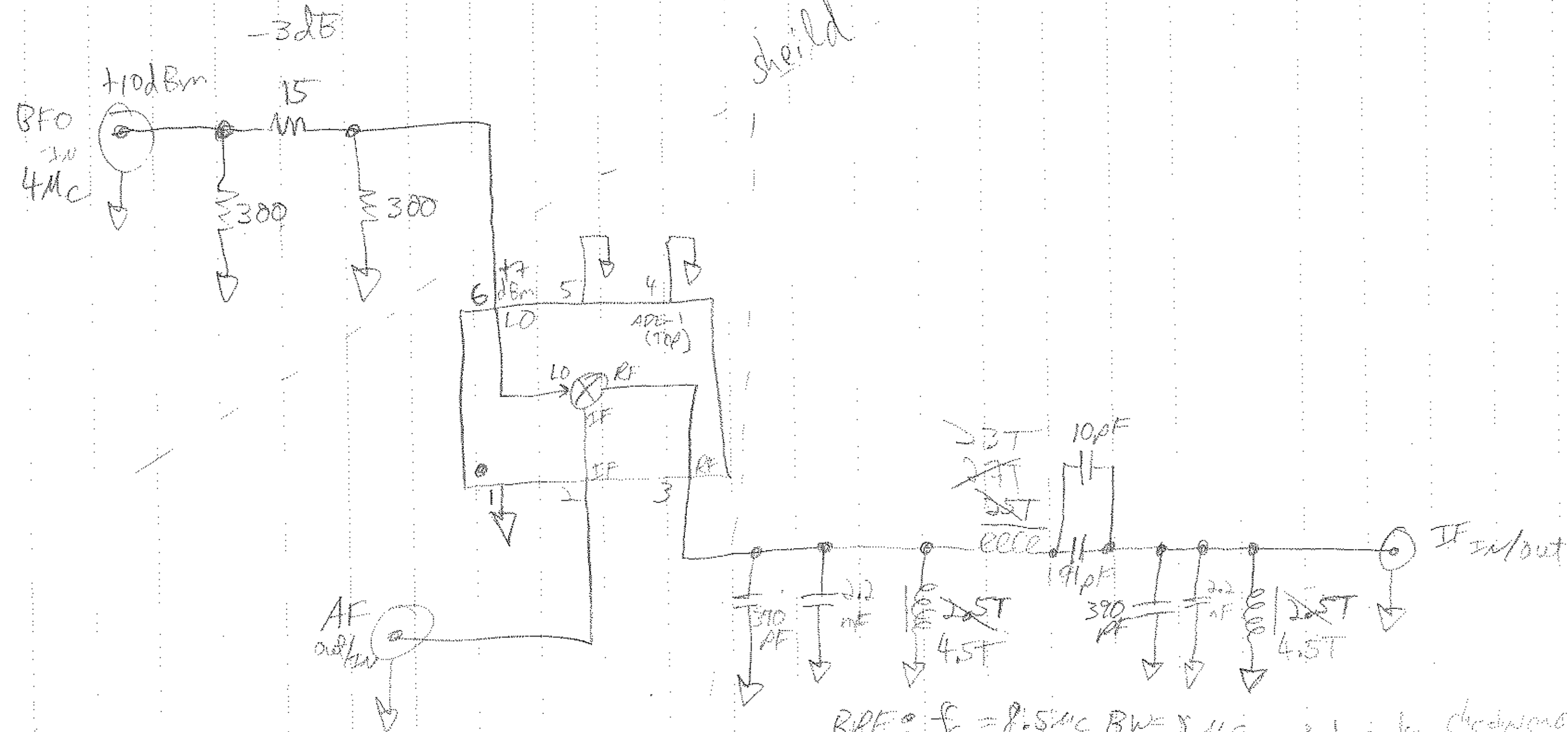


70 dB gain measured
AD8009
AD8009
AD8009 (TOP)
AD8009
AD8009
AD8009
AD8009 (TOP)
AD8009 (TOP)

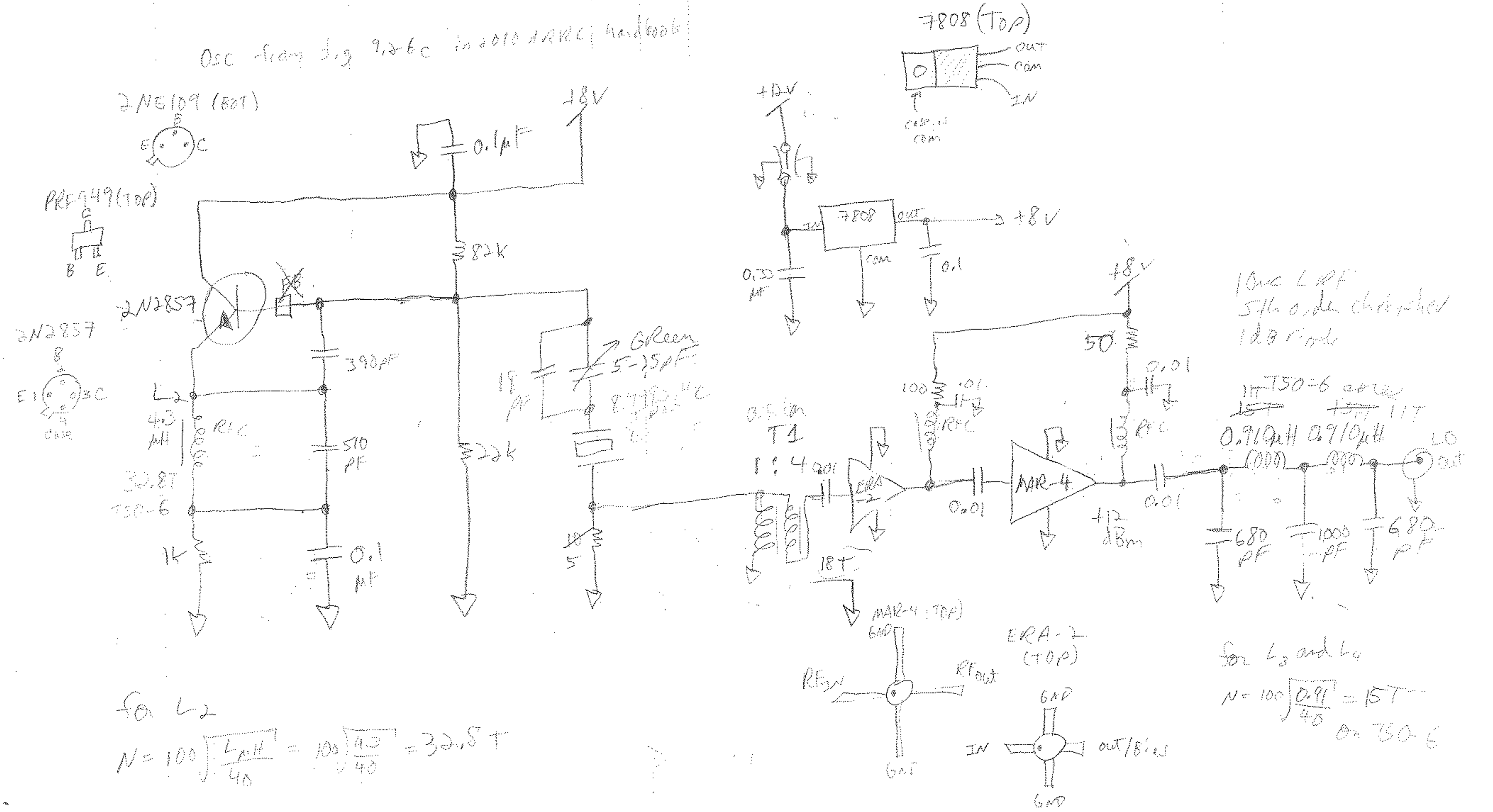


Front End
Mixer Assy

Product Detector

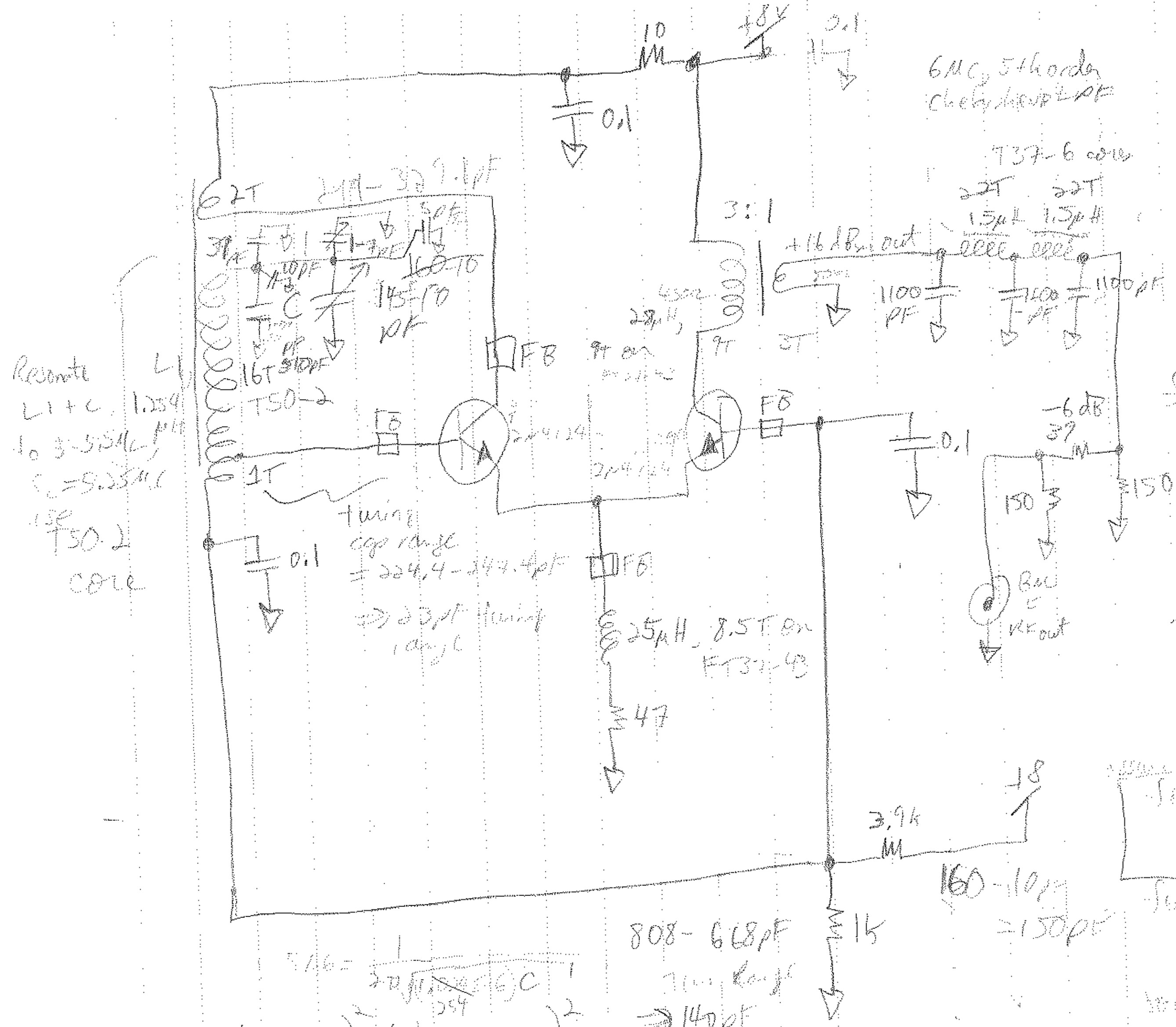


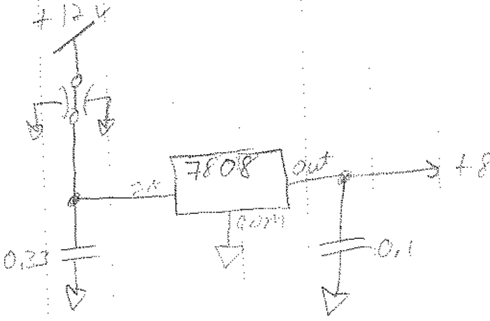
BPF: fc = 8.5Mc BW = 2Mc, 3rd order Chebyshev
(same as front-end)
all toroids T50-6



Low Phase Noise

XTAL BFO





for T50-6, $A_L = 30$

$L = 0.?68\mu H$

$N = 100\sqrt{\frac{L}{30}} = 100\sqrt{\frac{1.5}{30}} = 22.36T$

T50-6

$N = 100\sqrt{\frac{L}{A_L}} \Rightarrow L = \left(\frac{N}{100}\right)^2 A_L$

for T50-2, $A_L = 49$ (...)

$L = 1.254\mu H$

for T50-6, $A_L = 40$ (3-40MHz range)

$L = 1.024\mu H$

for T50-7, $A_L = 43$ (1-35MHz ...)

$= 1.108\mu H$

160-10pF = 150pF

808-668pF

Tuning range

=> 140pF tuning range of capacitor

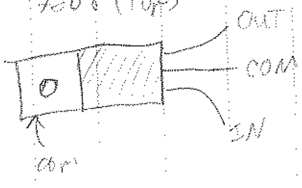
808-213 = 595pF

$5.26 = \frac{1}{2\pi\sqrt{1.254e{-6}\,C}}$

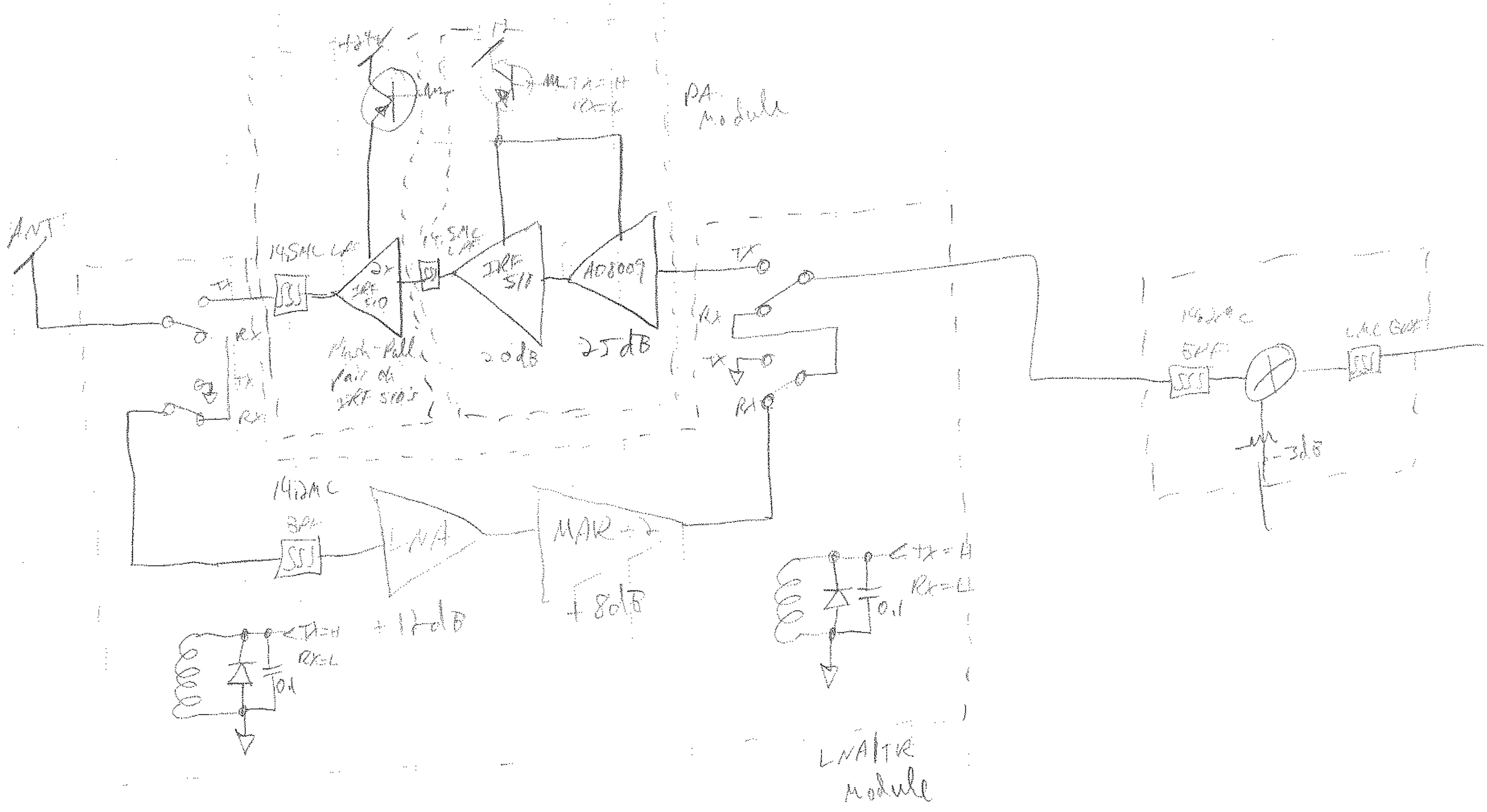
$(2\pi\, 5.26)^2 = \left(\frac{1}{\sqrt{1.254e{-6}\,C}}\right)^2$

$C = \frac{1}{1.254\,(2\pi\, 5.26)^2}$

7808 (TOP)



Low Phase Noise VFO 10-10.5MHz

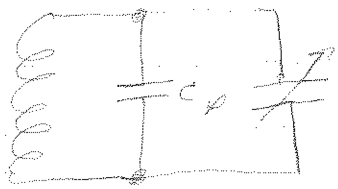


LNA/PA Subsystem

VFO Notes

$$f_c = \frac{1}{2\pi\sqrt{LC}} \quad (1a)$$

where L: $N = 16$ turns



$20pF \le C_v \le 200pF$

- solve for the parallel capacitor value C_p, where the variable capacitor $C_v = \begin{cases} 20\,pF & \text{for } f_H = 10.5E6\ Hz \\ 200\,pF & \text{for } f_{Lo} = 10E6\ Hz \end{cases}$

- this results in 2 eq's and 2 unknowns:

$$10.5E6 = \frac{1}{2\pi\sqrt{L(20E-12 + C_p)}} \quad (1)$$

$$10E6 = \frac{1}{2\pi\sqrt{L(200E-12 + C_p)}} \quad (2)$$

- looking at (1), solve for L:

$$10.5E6 = \frac{1}{2\pi\sqrt{L(20E-12 + C_p)}}$$

$$\left(\sqrt{L(20E-12 + C_p)}\right)^2 = \left(\frac{1}{2\pi 10.5E6}\right)^2$$

$$L(20E-12 + C_p) = \frac{1}{(2\pi 10.5E6)^2} \cdot \frac{1}{(20E-12 + C_p)}$$
$$(20E-12 + C_p)$$

$$\boxed{L = \frac{1}{(2\pi 10.5E6)^2 (20E-12 + C_p)}} \quad (3)$$

- looking at (2), solve for C_p:

$$10E6 = \frac{1}{2\pi\sqrt{L(200E-12 + C_p)}}$$

$$\left(\sqrt{L(200E-12 + C_p)}\right)^2 = \left(\frac{1}{2\pi 10E6}\right)^2$$

$$\frac{L}{L}(200E{-}12 + C_p) = \frac{1}{(2\pi 10E6)^2} \cdot \frac{1}{L}$$

$$200E{-}12 + C_p = \frac{1}{L(2\pi 10E6)^2}$$

$$C_p = \frac{1}{L(2\pi 10E6)^2} - 200E{-}12 \quad (4)$$

– substitute (3) into (4)

$$C_p = \frac{1}{\left[\frac{1}{(2\pi 10.5E6)^2(20E{-}12 + C_p)}\right](2\pi 10E6)^2} - 200E{-}12$$

$$C_p = \frac{1}{\left(\frac{(2\pi 10E6)^2}{(2\pi 10.5E6)^2(20E{-}12 + C_p)}\right)} - 200E{-}12$$

$$C_p = \frac{1}{\left(\frac{10E6}{10.5E6}\right)^2\left(\frac{1}{20E{-}12 + C_p}\right)} - 200E{-}12$$

$$C_p = \left(\frac{10.5E6}{10E6}\right)^2(20E{-}12 + C_p) - 200E{-}12$$

$$C_p + 200E{-}12 = \left(\frac{10.5}{10}\right)^2(20E{-}12 + C_p)$$

$$C_p + 200E{-}12 = \left(\frac{10.5}{10}\right)^2(20E{-}12) + \left(\frac{10.5}{10}\right)^2 C_p$$

$$\left[1 - \left(\frac{10.5}{10}\right)^2\right]C_p + 200E{-}12 - \left(\frac{10.5}{10}\right)^2(20E{-}12) = 0$$

$$-102.5E{-}3\,C_p + 177.95E{-}12 = 0$$

2

$$177.95E{-}12 = 102.5E{-}3\, C_p$$

$$\Rightarrow C_p = \frac{177.95E{-}12}{102.5E{-}3} = 1.736E{-}9 \text{ F}$$

↳ Find L and double-check result

- Subst C_p into (1a) and solve for L @ $f_c = 10E6$ and $C_v = 200E{-}12$ F

$$10E6 = \frac{1}{2\pi\sqrt{L(1.736E{-}9 + 200E{-}12)}} \Rightarrow L = 0.13\,\mu H \;\; (130.837E{-}9\,F)$$

- double-check by subst. C_p into (1a) and solve for L @ $f_c = 10.5E6$ and $C_v = 20E{-}12$ pF

$$10.5E6 = \frac{1}{2\pi\sqrt{L(1.736E{-}9 + 20E{-}12)}} \Rightarrow L = 0.13\,\mu H \;\; (130.839E{-}9\,F)$$ ✓

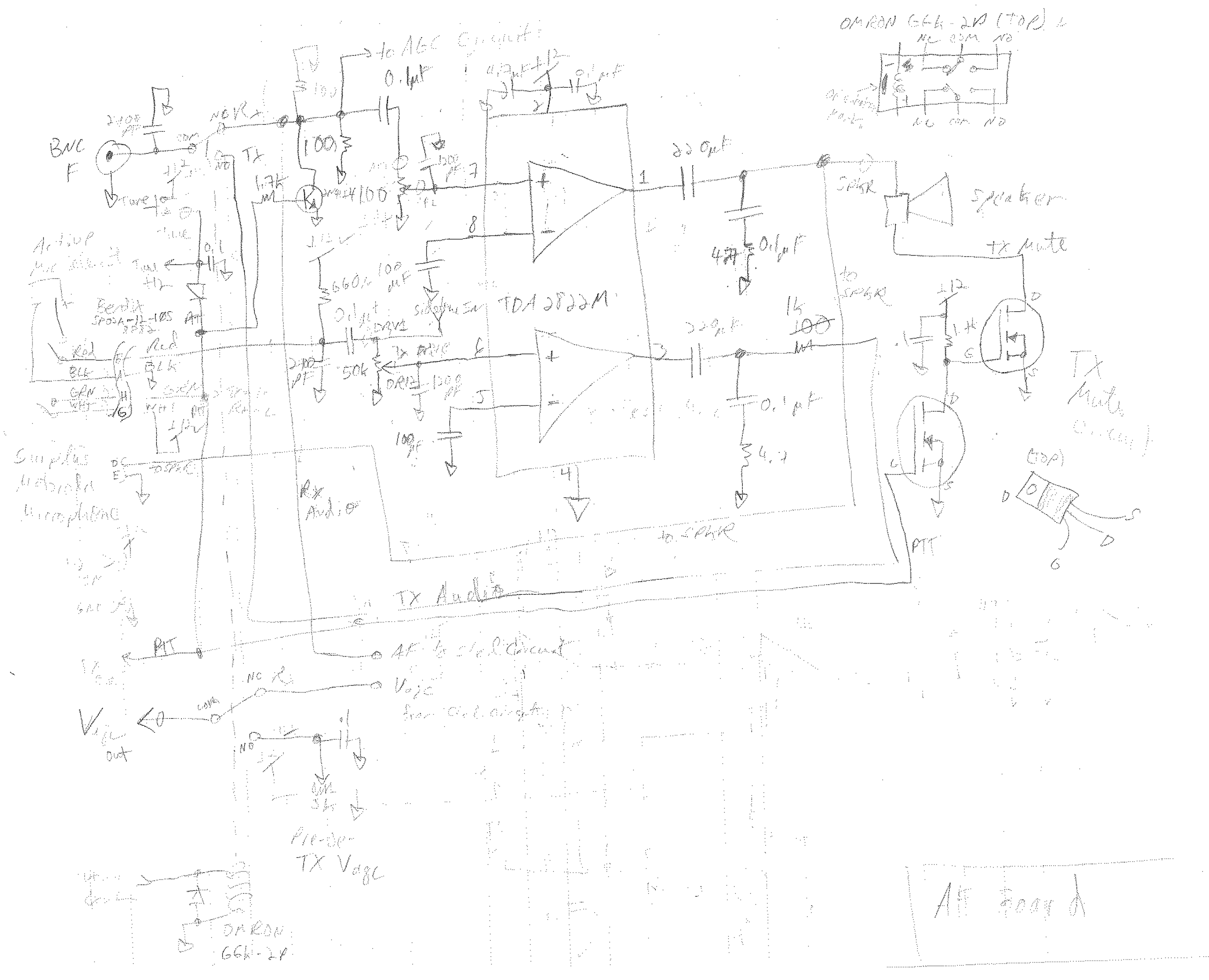
↳ Next, we need to calculate the dimensions of a 16 turn air-core inductor of reasonable size with a value of $L = 0.13\,\mu H$

- from 2010 ARRL handbook:

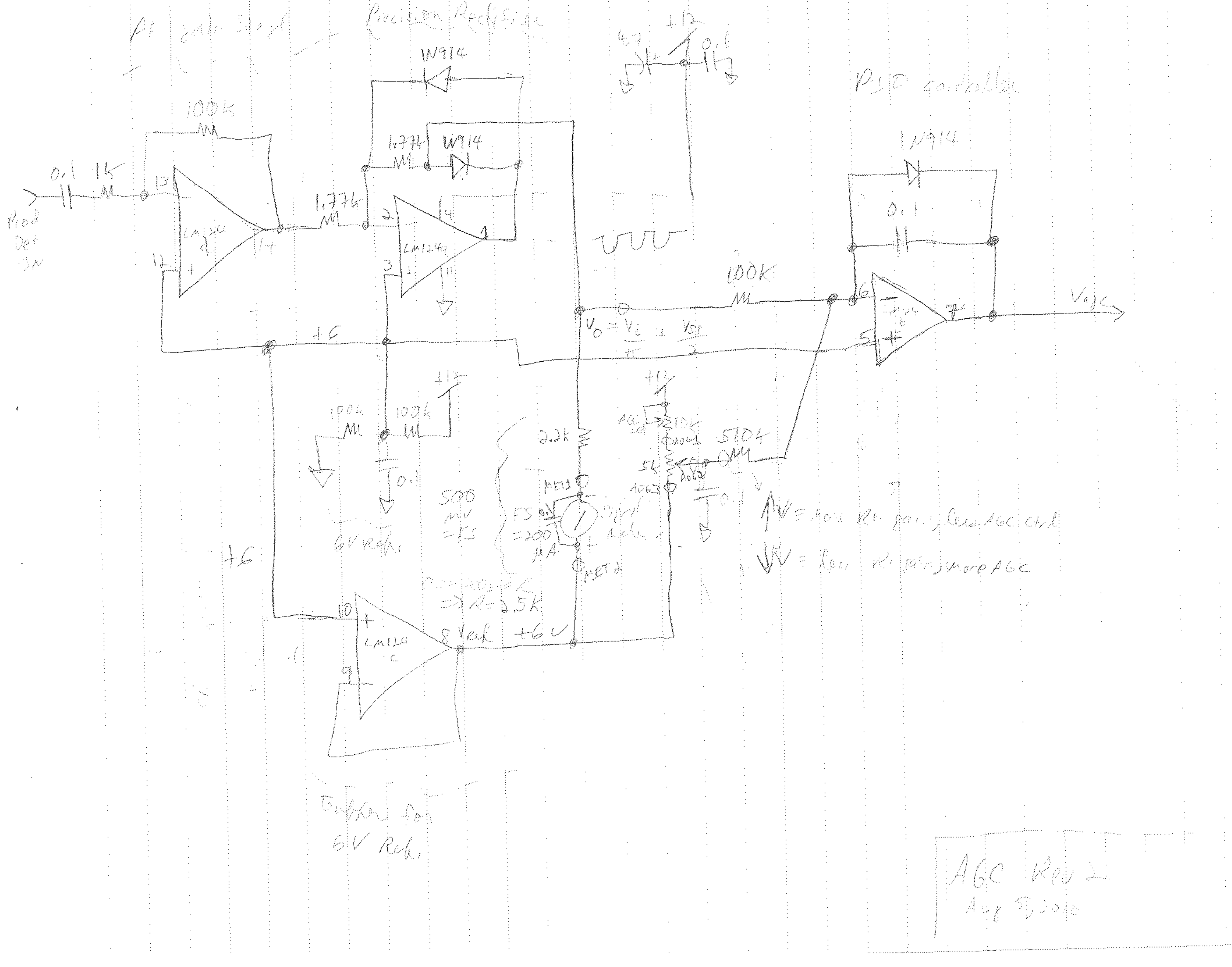
$$L(\mu H) = \frac{d^2 n^2}{18d + 40l}$$, where all dimensions are in inches

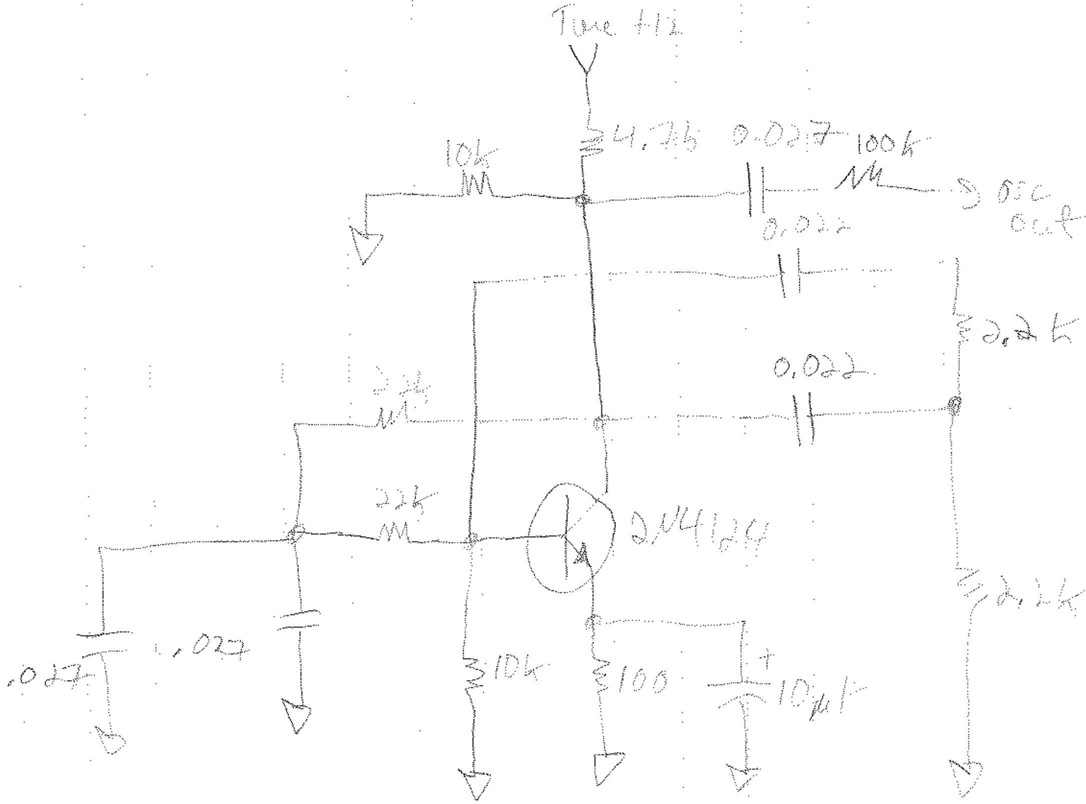
$$d = 0.187 + 0.025 = 0.212$$

$$\therefore \quad 0.13 = \frac{(0.212)^2\, 16^2}{18(0.212) + 40l} \Rightarrow l = 2.12''$$



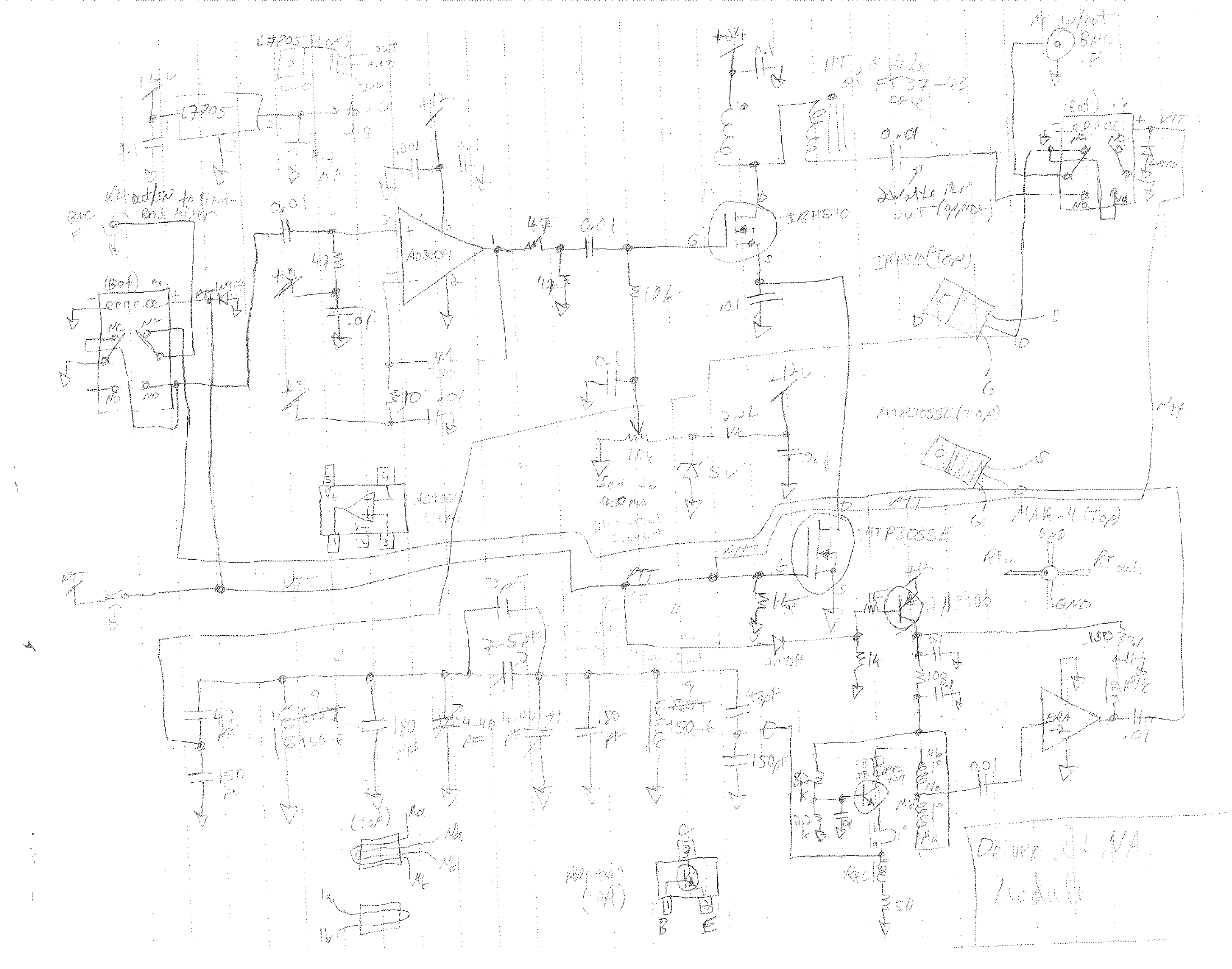
AF Board
BNC F
to AGC Circuit
0.1µF
100
4100
TX
NO Rx
TDA2822M
220µF
0.1µF
4.7
Speaker
SPKR
TX Mute
TX Mute Circuit
OMRON G6K-2P (TOP)
NC COM NO
(TOP)
D
S
G
PTT
Rx Audio
TX Audio
Vagc out
Pre-Set TX Vagc
OMRON G6K-2P
50k
Red
BLK
GRN
WHT
Simplified Motorola Microphone
Active Mic Circuit

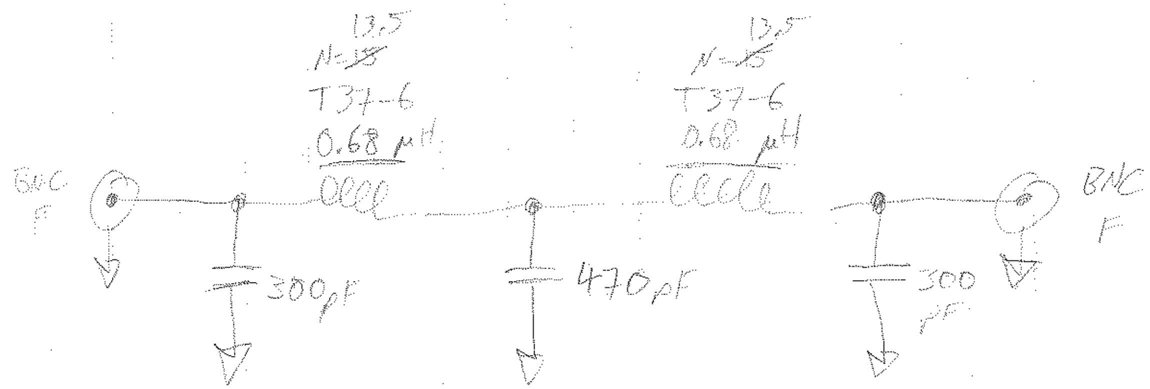

Precision Rectifier
1N914
100k
1.77k
1N914
0.1
1k
Diod Det In
LM124
1.77k
LM124
+6
+12
0.1
PID controller
1N914
0.1
100K
Vagc
100k
100k
0.1
500 mV
2.2k
MET1
MET2
200 µA
10k
5k
5.1k
+12
0.1
+6
6V Ref
Vref
+6V
LM124
R=2.5k
Buffer for 6V Ref
AGC Rev 1



"Twin T" 600 Hz
Sidetone Osc.
from kd1jv; ...
MAS/MAS.htm

Side-Tone Oscillator


L7805
AD8009
IRF510
IRF510 (Top)
MTP2955E
MTP2955E (Top)
MAR-4 (Top)
RF in
RF out
GND
ERA-2
2 Watts RF out (approx)
RF w/out BNC F
FT37-43 core
Set to
Driver / LNA
Module



For a T37-6 core:

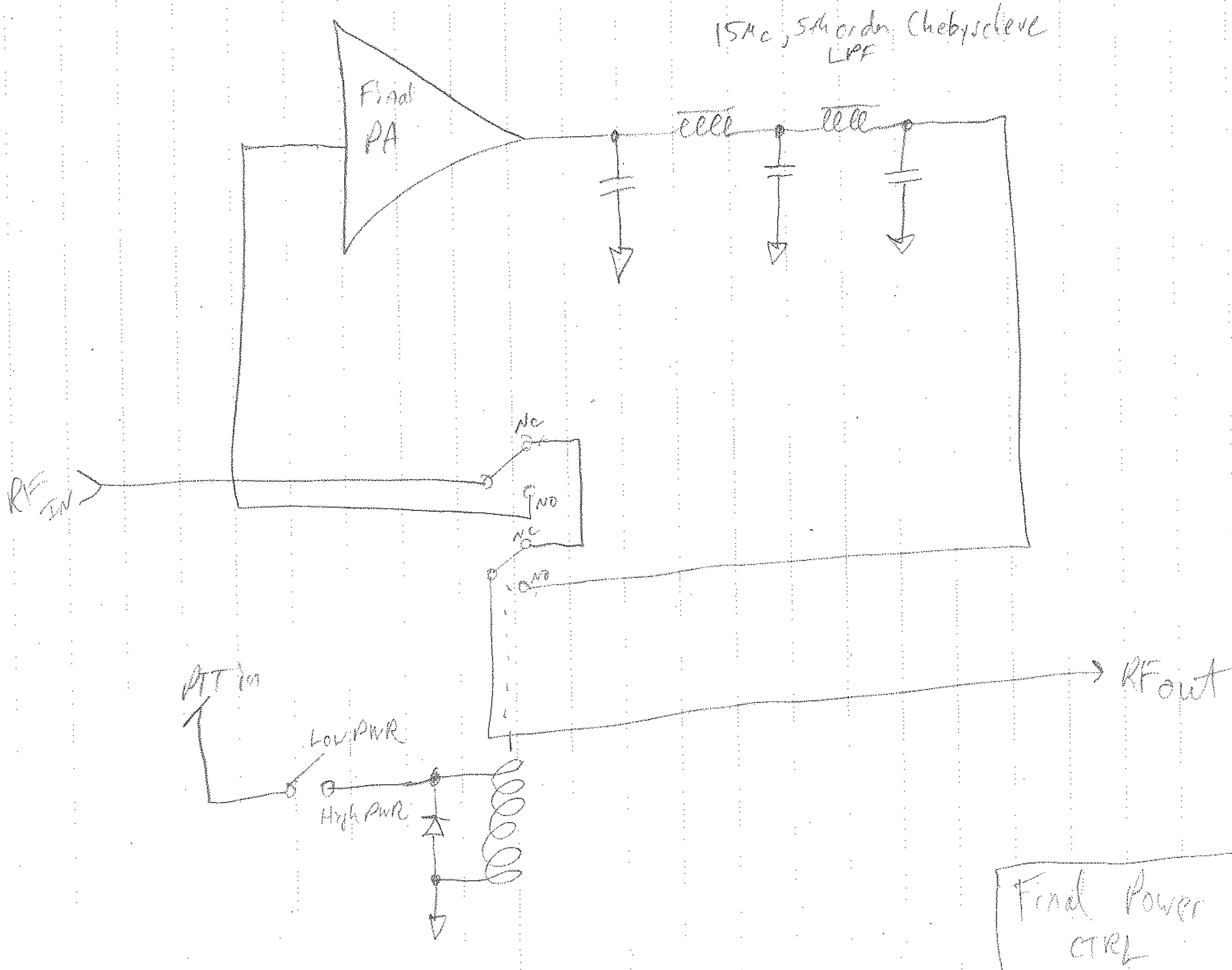
$A_L = 3$

$L_{\mu H} = \frac{A_L N^2}{1000}$

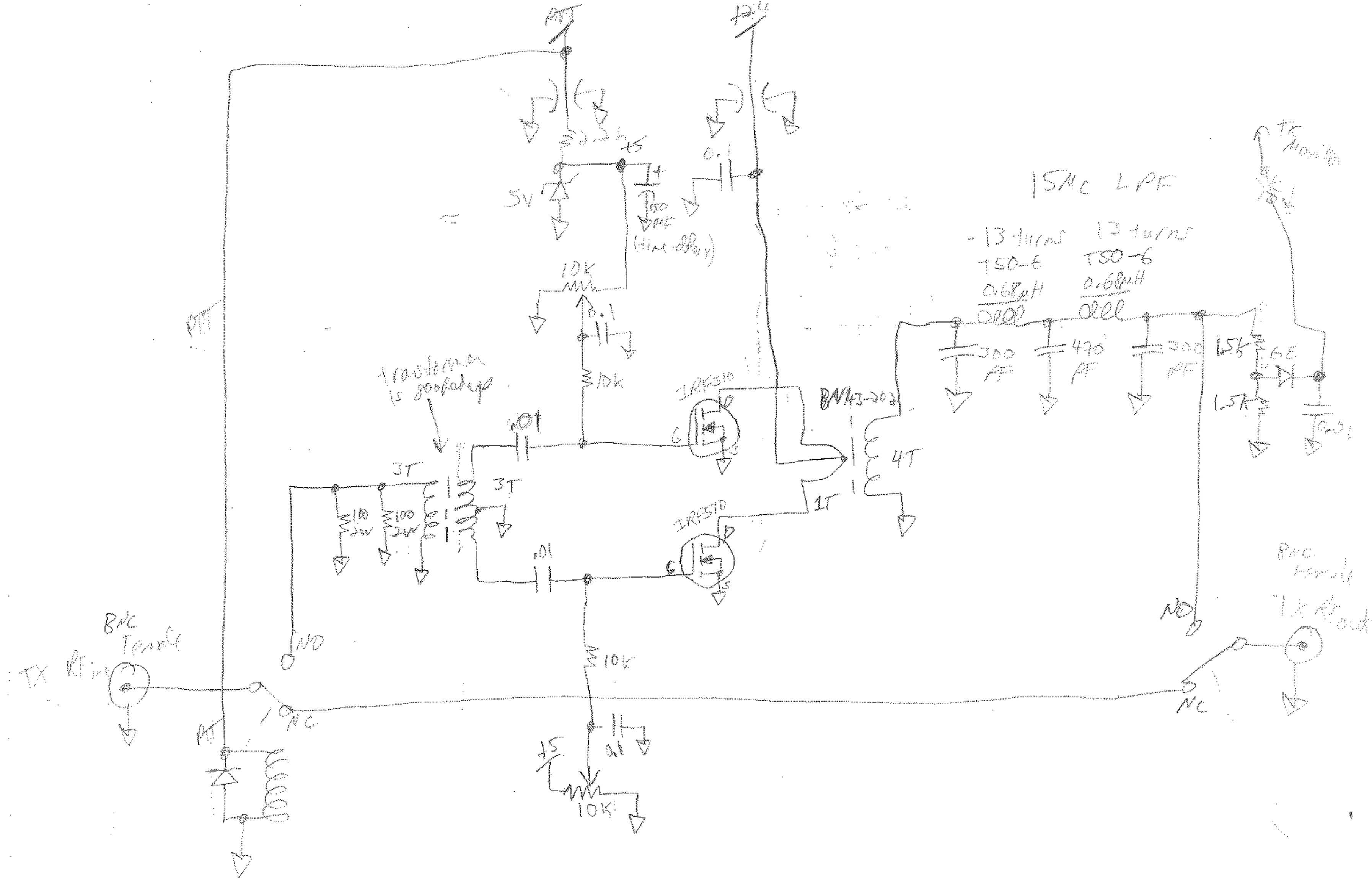
$0.68 = \frac{3 N^2}{1000} \Rightarrow N = 15$ turns

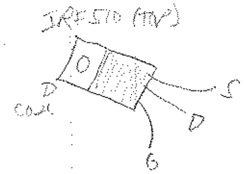
5th order Chebyshev

LPF



Final Power Amplifier
CTRL

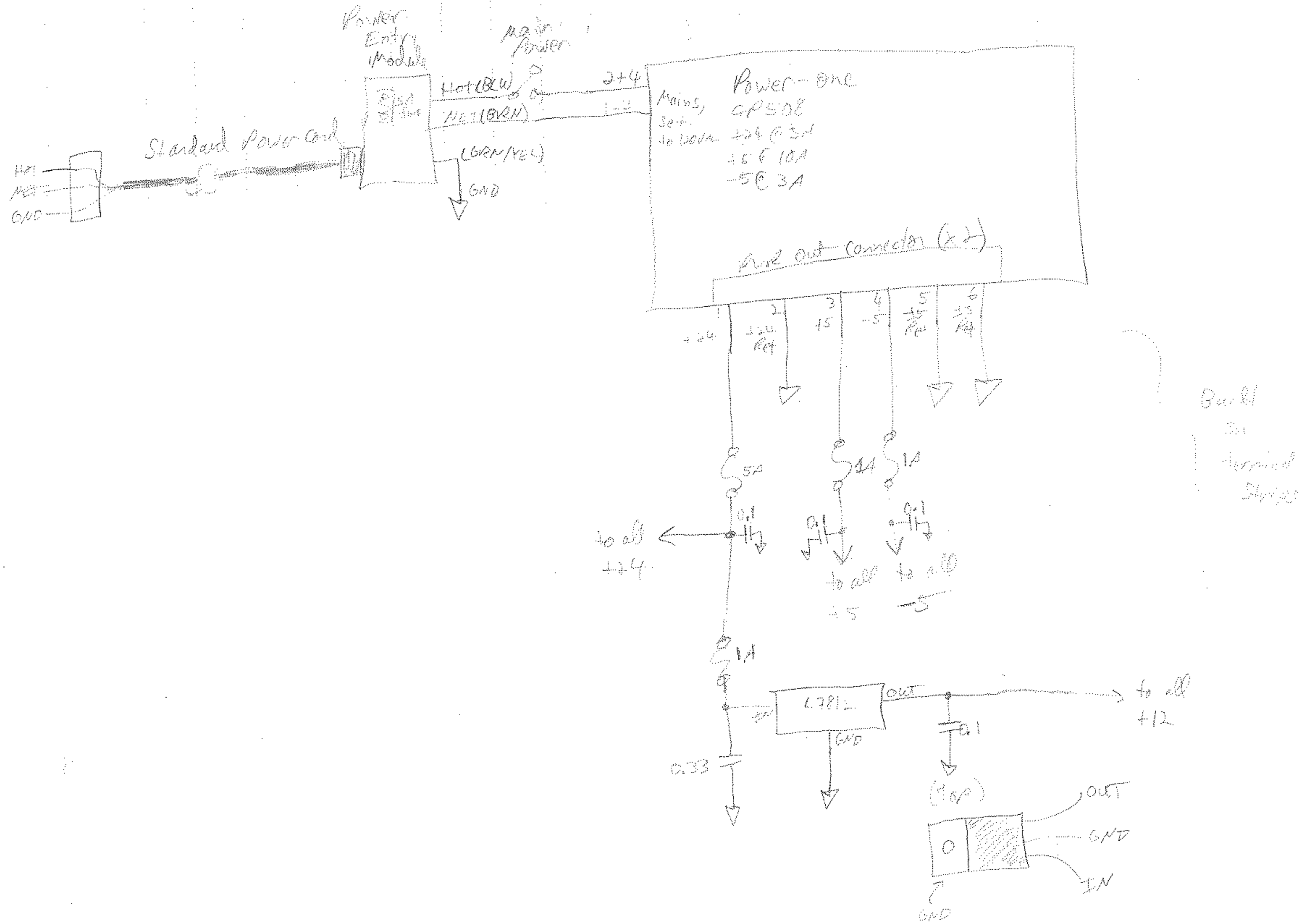




$$L_{\mu H} = \frac{A_L N^2}{1000}, \quad A_L = 4$$

$$0.68 = \frac{4N^2}{1000} \Rightarrow N = 13 \text{ turns}$$

20W Power amplifier



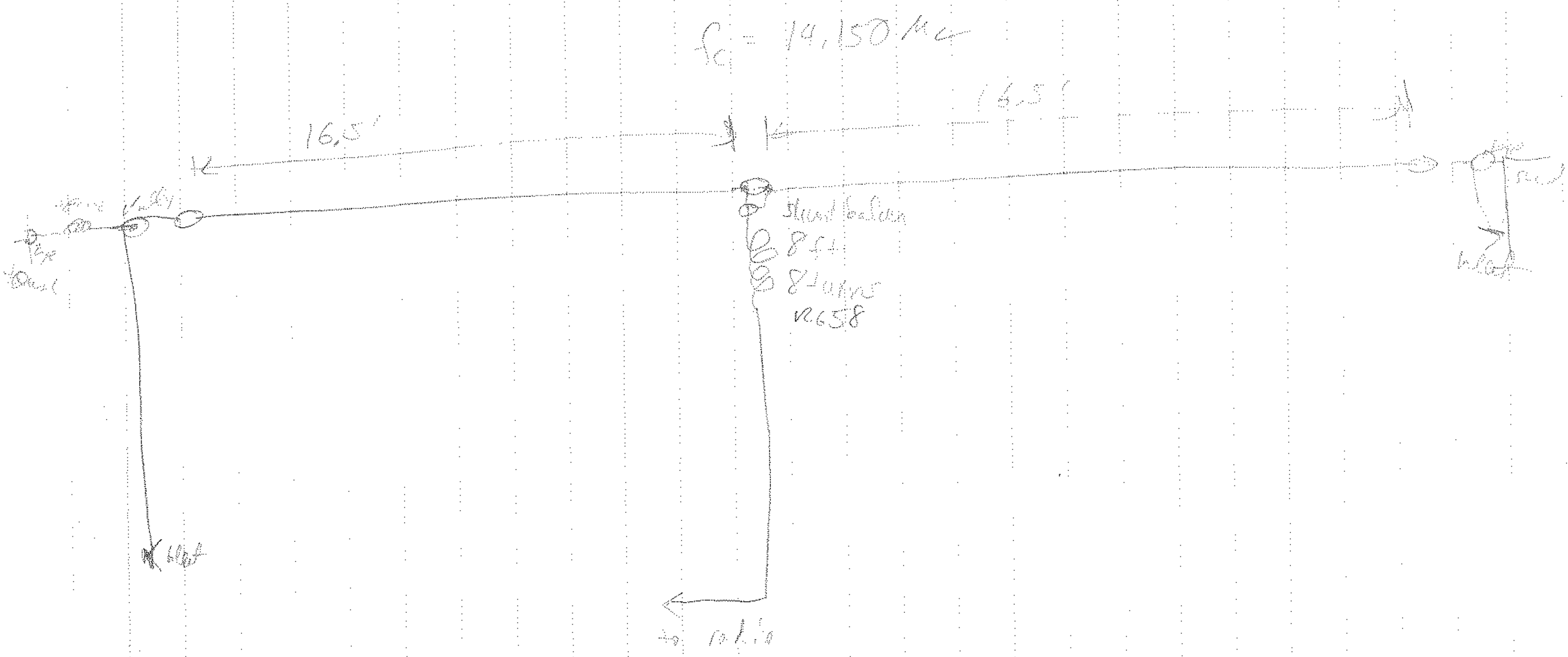
Power Distribution

BRN = Hot

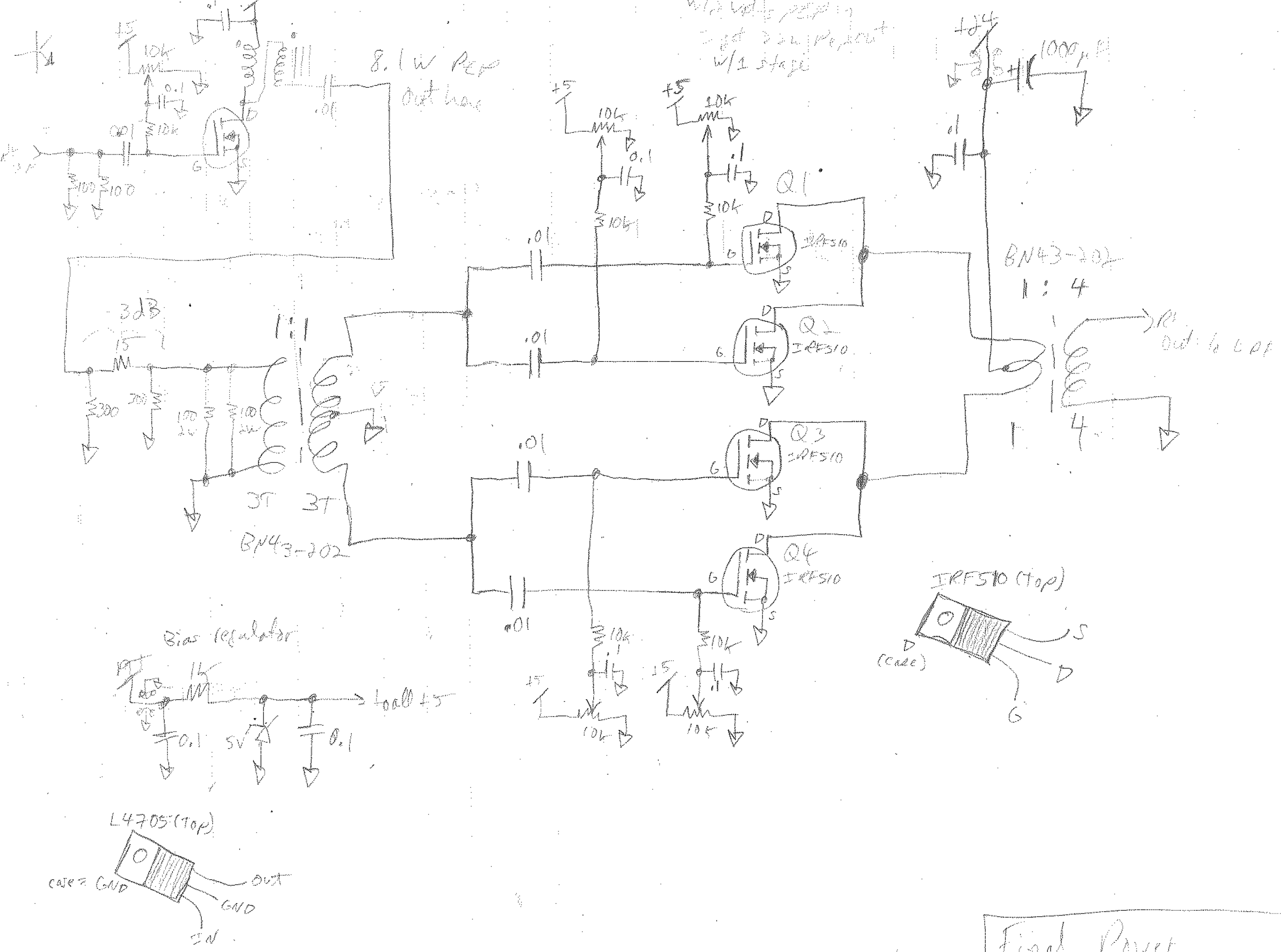
GRN = GND

BLU = NET

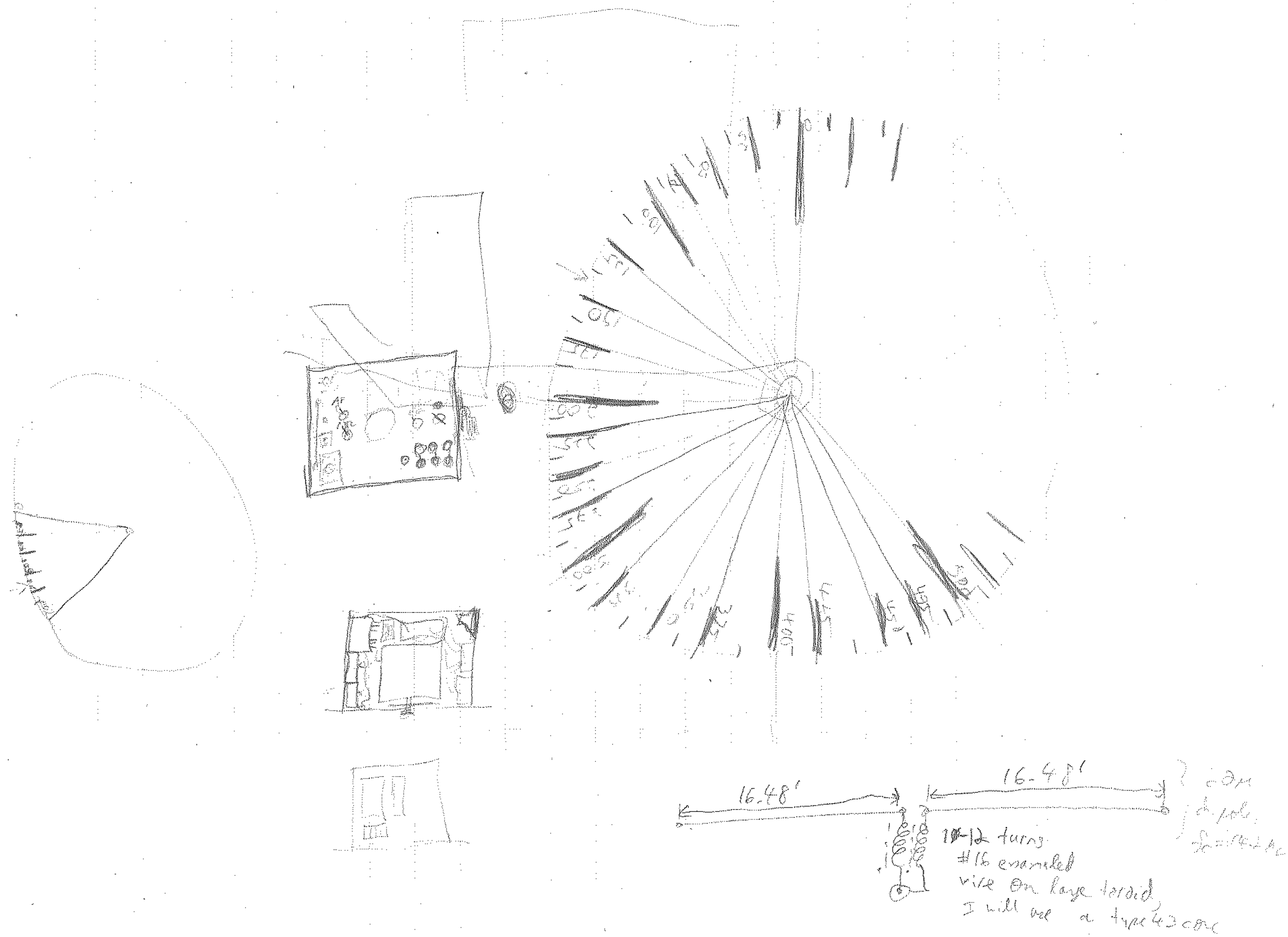
Power Supply Power Cord

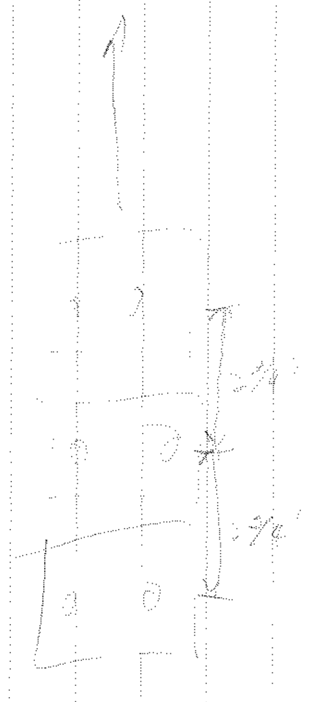


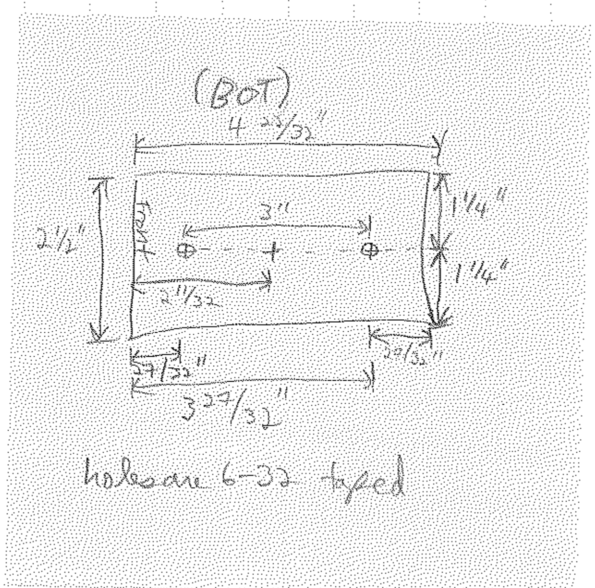
20 M Dipole Antenna



Final Power Amplifier


16.48'
16.48'
turns
#16 enameled
wire on large toroid,
I will use a type 43 core
20m
dipole




(BOT)
3"
1 1/4"
1 1/4"
2 1/2"
Front
2 11/32
3 27/32"
27/32"
holes are 6-32 tapped