

Audiology EKG Computer

13

COMPUTATION NOTE BOOK	
43-648	
Course	<u>Audiology Research Prod. Corp.</u>
Name	<u>W.F. McAllister</u>
9-18-59 TO	

Del Mar Engineering Laboratories

LOS ANGELES, CALIFORNIA

PROJECT COMPUTATION RECORD

SERIAL NO.

Nº

60

Please Return to:

H. Lounston, M.D.

Dept. Anesthesiology

N.C. Mem. Hosp.

Chapel Hill, N.C.

9-18-59

HIGH VOLTAGE POWER SUPPLY RESEARCH

Reason:

As a result of information appearing in "NEW EQUIP." sections of "ELECTRICAL DESIGN NEWS" & other trade publications, there have been several inquiries about data on high voltage power supplies to specifications quite different than those of our standard product.

As a result it is desirable to investigate the possibility of designing & building other types of high voltage power supplies. Several of these inquiries have been for regulated high voltage supplies with automatic overload protection. This would seem to indicate transistorized oscillator type supplies, a field in which we have no experience. Since development of supplies of this type would mean entering into an R&D program & since all inquiries to date have been in the form of a request for bid, stating price, delivery etc. it has been impossible to consider the R&D approach from the time stand point alone.

The most recent request is lacking in many necessary specifications but indicates the following voltages and currents: 20-30 KV @ 1 ma. (30 watts), 8-10KV @ 1 ma. & 3.5-6.5 KV @ 3 ma. It would appear that this is an unregulated requirement & could be met with either a transformer, rectifier & filter approach or an RF type supply. Since there are a number of manufacturers of supplies of this general nature at present it remains to be decided as to the most favorable course of action to be taken. To produce power supplies with voltage & current requirements that differ considerably from the present product means a definite development program. The question resolves itself to simply, shall we develop a number of semi standard supplies that vary quite widely from the present product or shall we limit any bids to supplies that are very close to the present product? If the decision is to vary specifications, what is the desirable limit of these variations?

11/23/59

TRANSISTORIZED HIGH VOLTAGE POWER SUPPLY DATA

- ① NAVY PREFERRED CKTS. HANDBOOK - SUPPLEMENT #1 CKT. # 202
- ② ELECTRONICS OCT. 23, 1959 P 122
- ③ ELECTRONICS SEPT. 4, 1959 P 56
- ④ ELECTRONICS DESIGN SEPT. 16, 1959 P 40 (PART 1)
- ⑤ ELECTRONICS DESIGN SEPT. 30, 1959 P 36 (PART 2)

COMPOSITE TRANSISTORS - LOG

AT ARA PLANT, KENSINGTON, M.D. NOV. 3, 1959 TO DEC. 8, 1959

EVALUATION TESTING OF ARA SAMPLES, DEC. 9, 1959 THRU REMAINDER OF DEC.

CONSTRUCTION OF FINNED VERSION OF 2N626 DURING LAST OF DEC. TESTS INDICATED AN INCREASE FROM 3.3 WATT LEVEL OF ARA 2N626 W/OUT HEAT SINK TO 5.7 WATT LEVEL FOR FINNED VERSION ALSO W/OUT HEAT SINK. THESE INPUTS RAISED THE CASE TEMPERATURES FROM $\approx 23^{\circ}\text{C.}$ TO 45°C. IN EACH CASE.

COMPOSITE TRANSISTOR PROGRAM WAS MOVED TO DEL EFFECTIVE JAN. 4, 1960. AT THIS TIME AN EFFORT WAS BEGUN TO IMPROVE BOTH OPERATION & PACKAGING. THE VARIOUS FORMS WERE AS FOLLOWS:

1. $1\frac{1}{4}'' \times 1\frac{1}{4}'' \times 3''$ "T" SECTION W/ 2-2N379's
2. SAME "T" SECTION W/ 1-2N379 & 1-2N1172
3. $1\frac{1}{4}'' \times 1\frac{1}{4}'' \times 1\frac{3}{4}''$ "T" SECTION W/ 1-2N379 & 1-2N1172

NOTE:

NO. 3 ABOVE WAS THE FIRST UNIT THAT WAS BREADBOARDED FIRST & THEN ASSEMBLED. IN BREADBOARD FORM IT WORKED OK BUT FOLLOWING ASSEMBLY ITS PERFORMANCE WAS DEGRADED.

9.23

7

Work of the heart.

Problem: to calculate and demonstrate the work of the heart in direct measurements in time for results to be included in the senior thesis (due Jan.?)

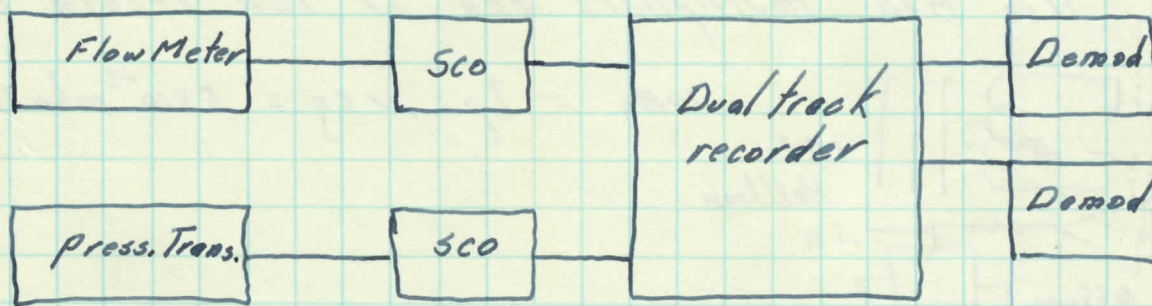
Method: 1. derivation of equation and design of computer.

2. record pressure-flow curves

3. build computer and run curves

4. write it up

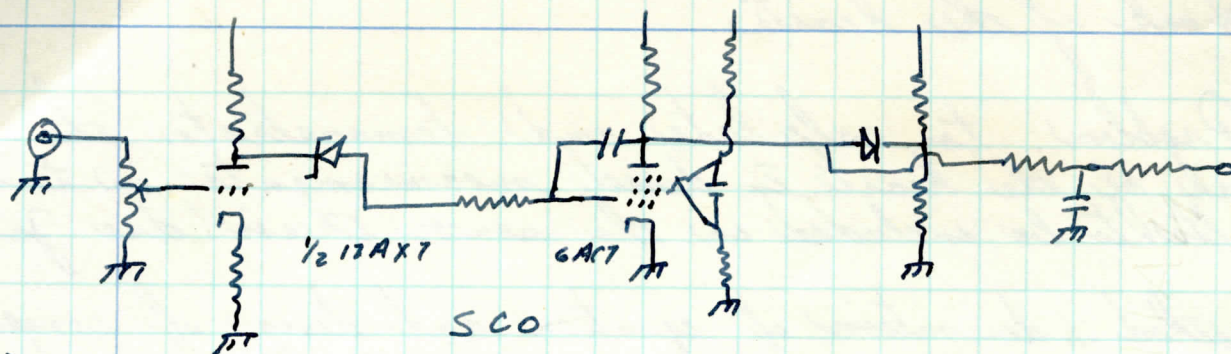
2]



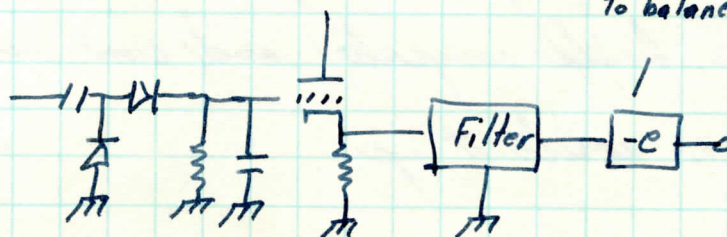
3]
$$W = \int_T P \times \Delta V + \int_T \frac{1}{2} m v^2 = k \int_T P \times \dot{V} + k' \int_T \dot{V}^3$$



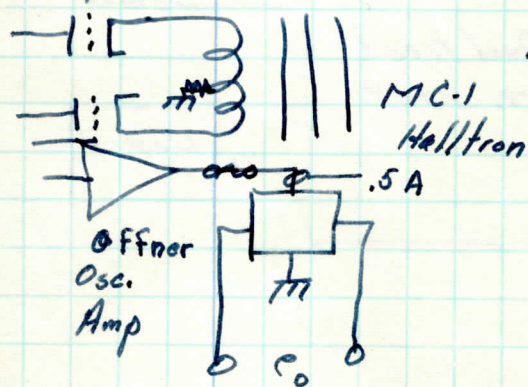
Pressure
From →
Officer



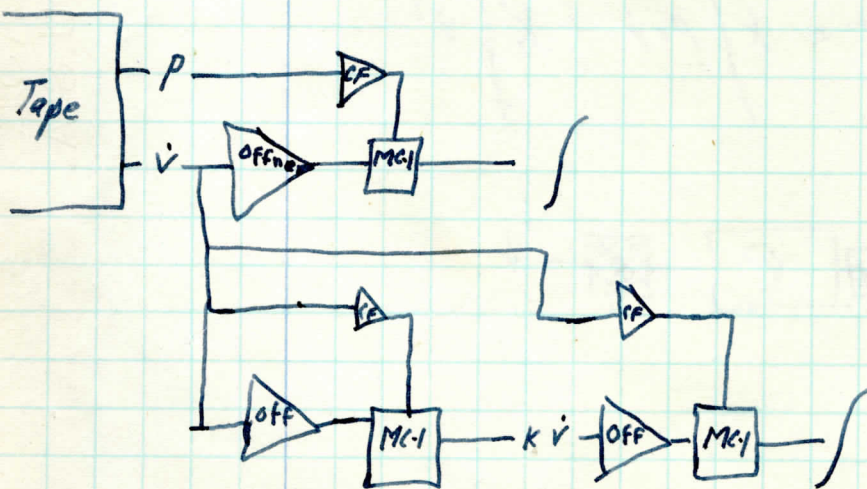
To balance out grid base of C_F



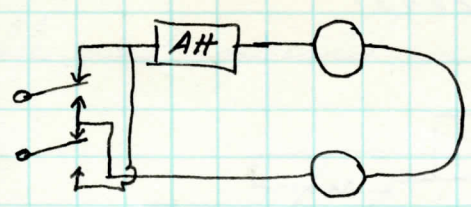
Use Hall multipliers 3ea or run record separately



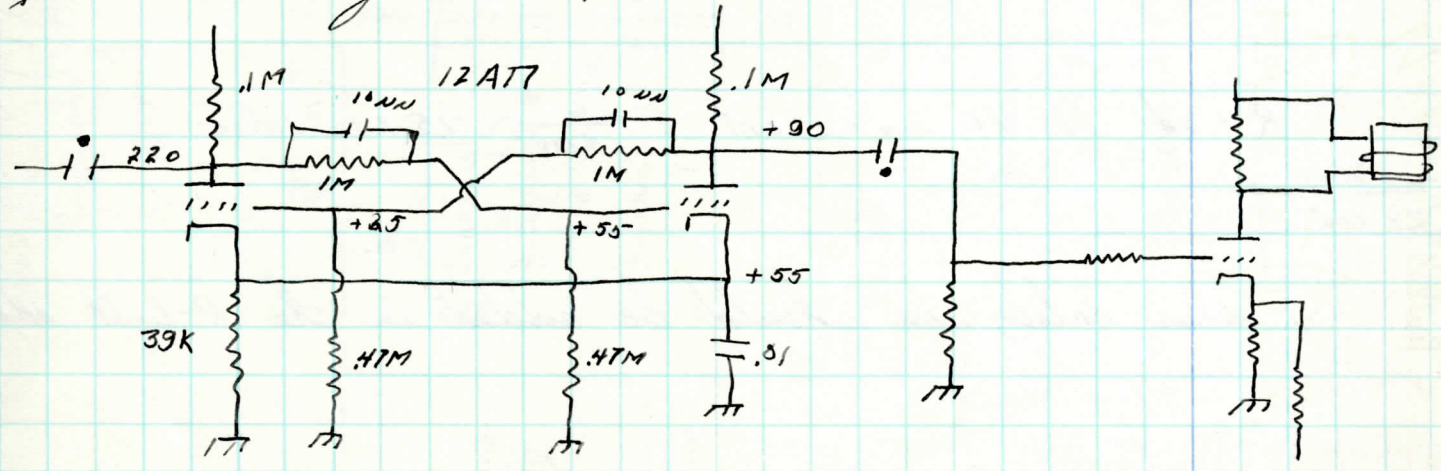
Complete



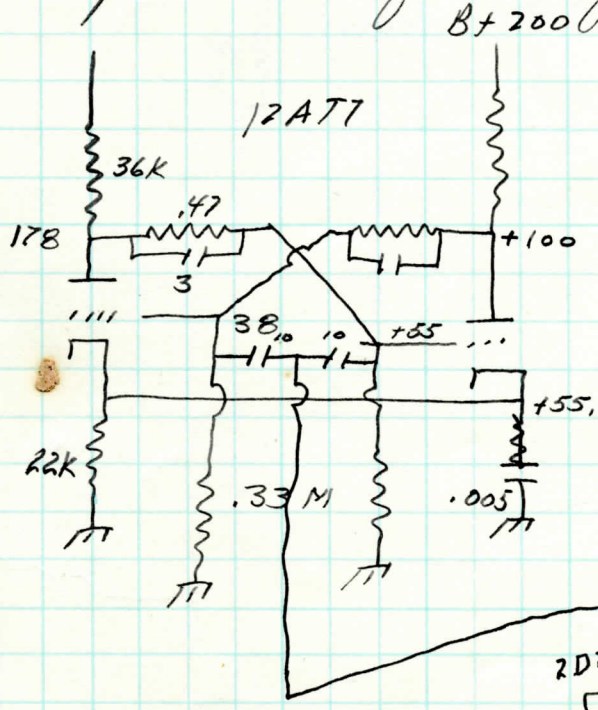
10.16.62 Binoual Balance



Use an Eccles-Jordan ckt. to insure balance -

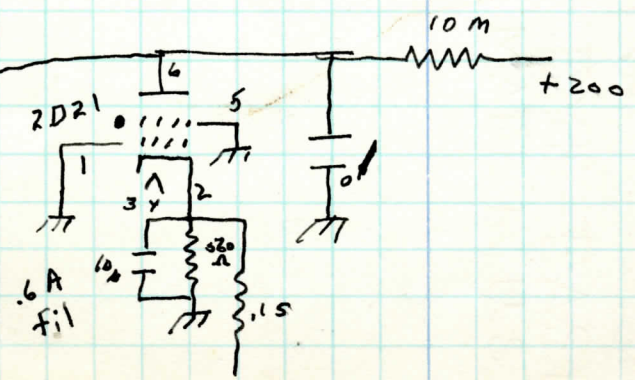


The above ckt was hard to trigger - The ckt. below (EECO) was adopted & the following driver tried.

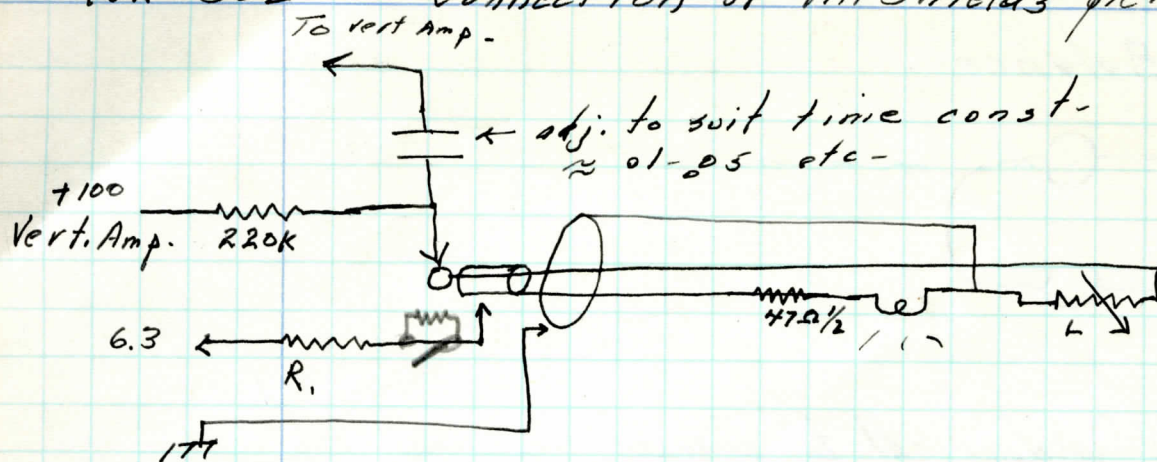


100 V square wave in ckt. operated from 160-220 V -

Ckt. works but trimming is required of Flip Flop



Tek 502 Connection of Air Shields pick up to 502 Tek -

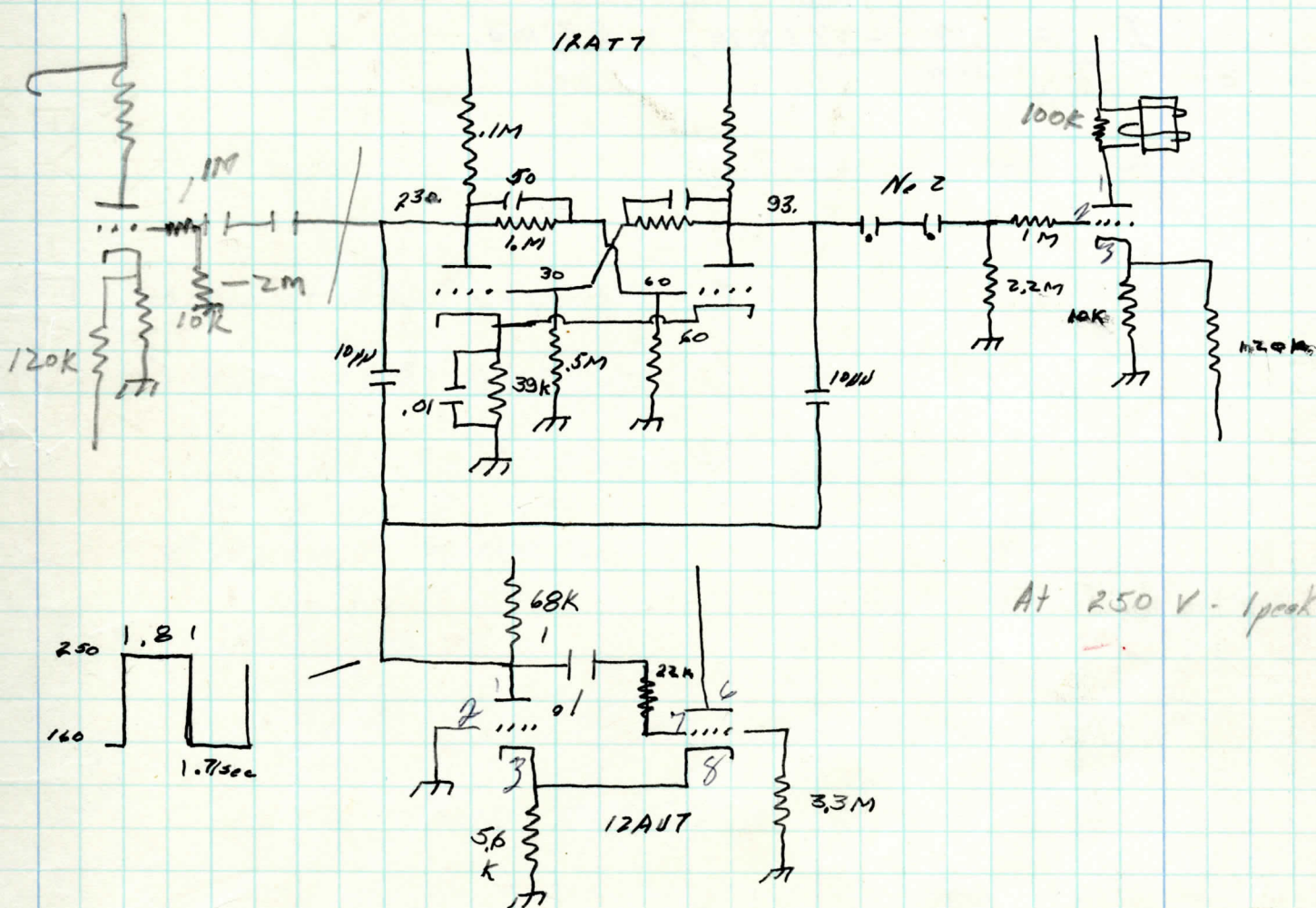


R_1 - adj. to 40 ma-start $\bar{e} \frac{6}{4 \times 10^{-2}} = 1.5 \times 10^2 \text{ min}$

$\frac{10^2}{.22 \times 10^6} = 5 \times 10^1$

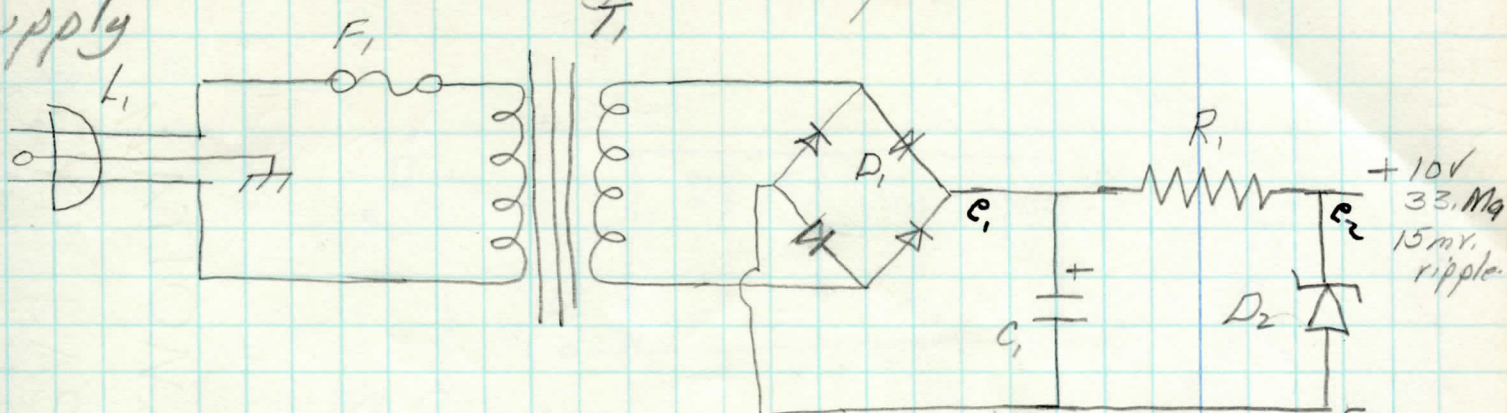
a series calib. res. should be added in the R_1 -light chain -

Preceding ckt. were touchy - The ckt. below seemed stable and operated over B+ 200 to 300 volts.



MK II 3 strain Gage Coupler

Pwr Supply



320 T_1 - Stancor P-6469 25.2 V 1 A

1ea

82 C_1 - Sprague TVA 1310 100 μ 50V

1ea

100 D_1 - Int. Rectifier 5E4 100 VRMS

4EA

L_1 - Belden # 1740B-5 8' Line cord gnd. 1ea

R_1 - 125 Ω 10 W.

D_2 - Int. Rect. 10 Z10 10V 10W Zener diode

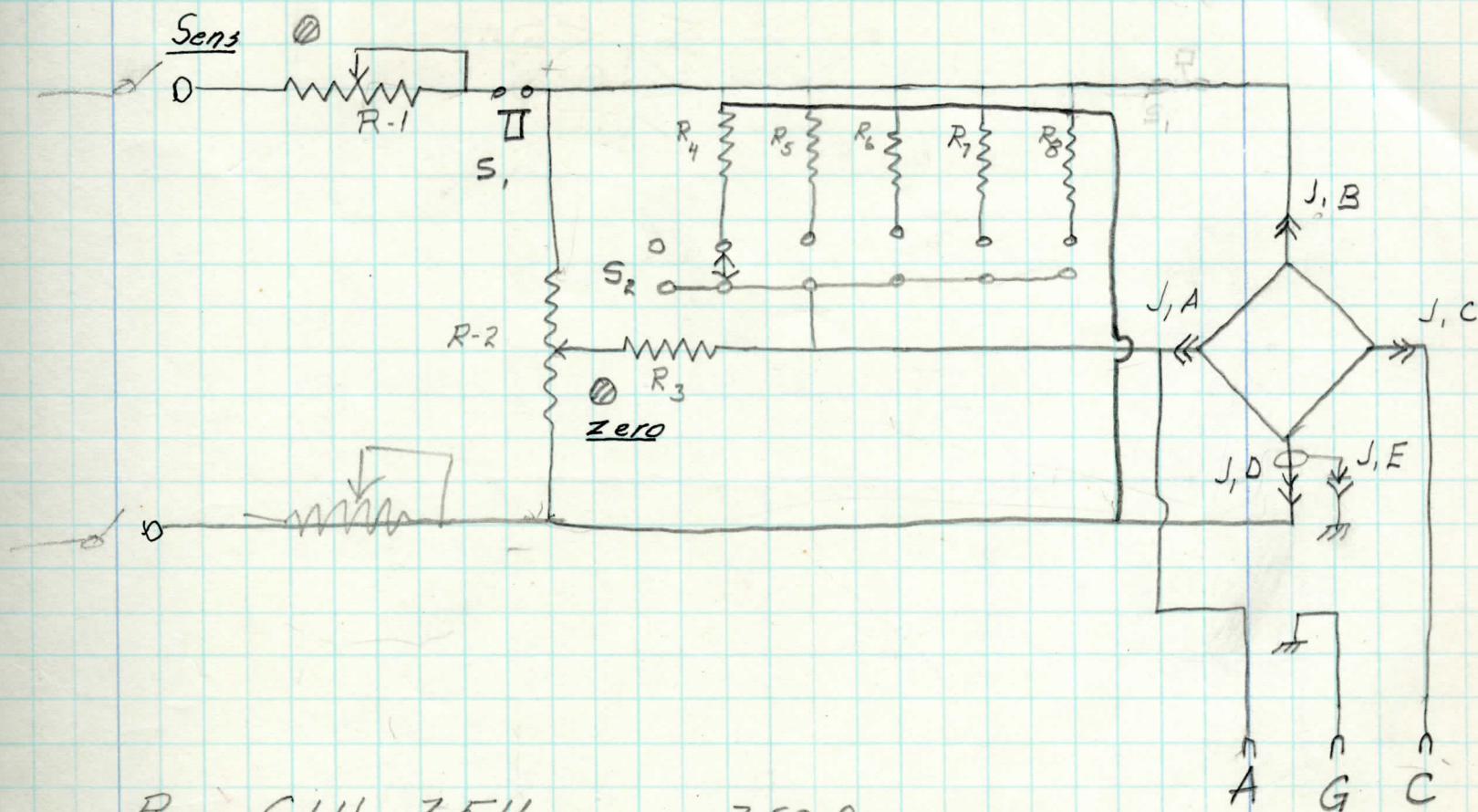
F_1 - Fuse Holder & 1/4 A S.B.

125
25
625
3125

10 250
125

625
3125

Coupler



R_1 - CLU-3511 350 Ω

R_2 - CLU-1031 AB - 10K

R_3 - 30K 1W -

$R_{4,5}$ - 500K Trimpot Bourns 272-1-504

$R_{6,7}$ - 200K Trimpot "

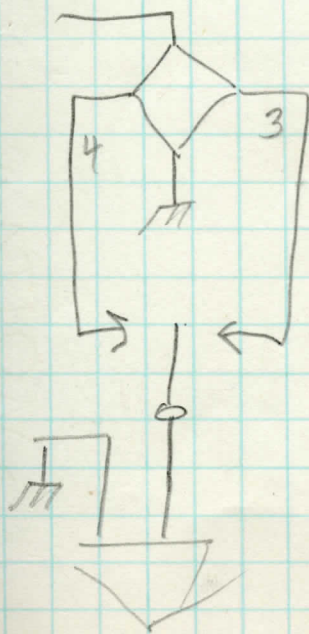
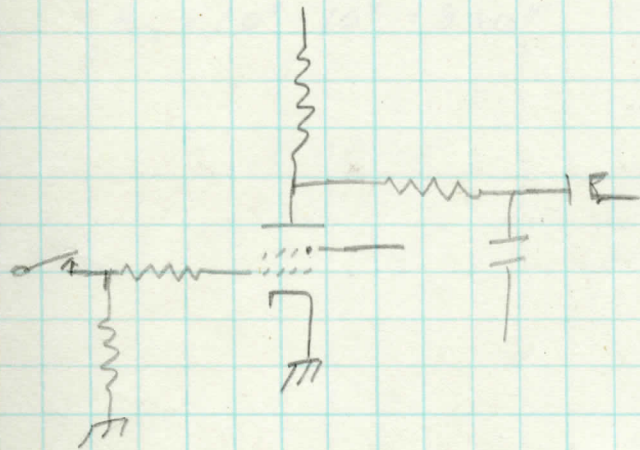
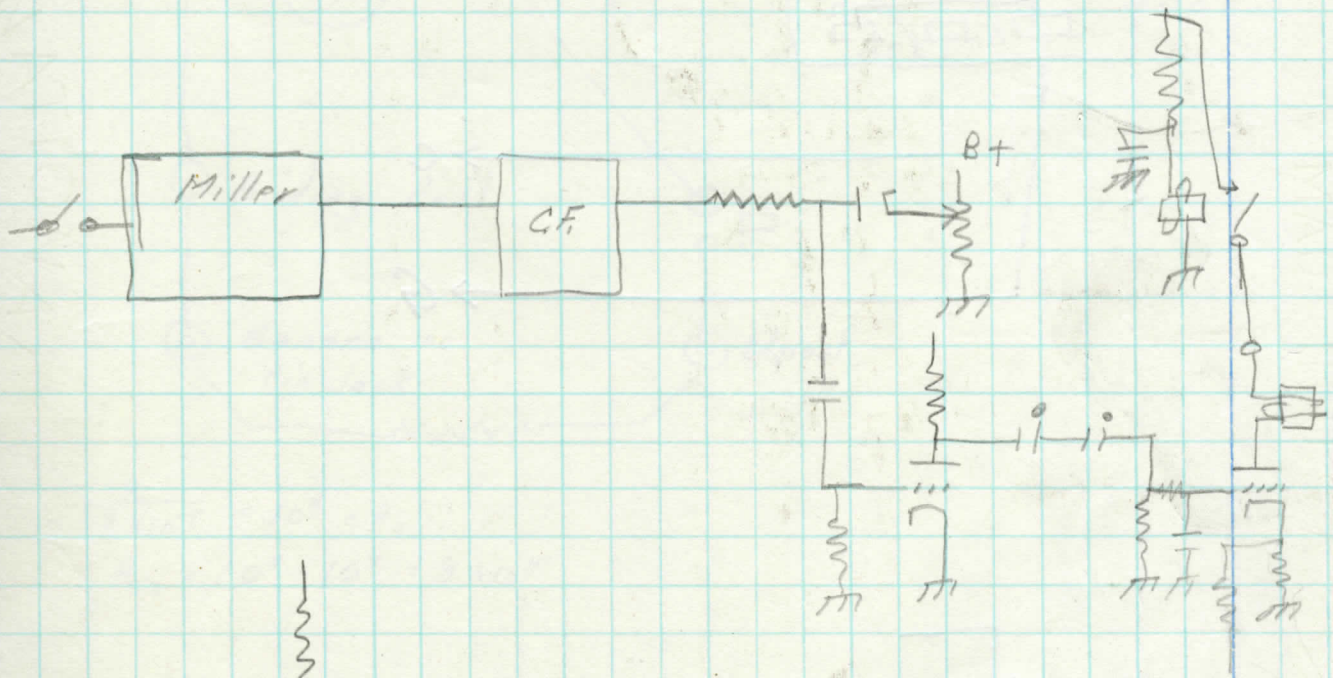
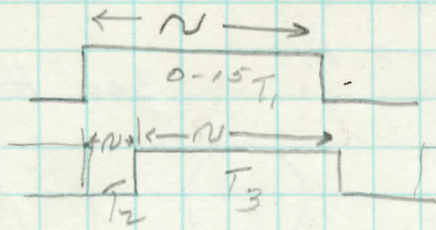
R_8 - 100K Trimpot " 272-1-104

S_1 SPST N.C. Push-button

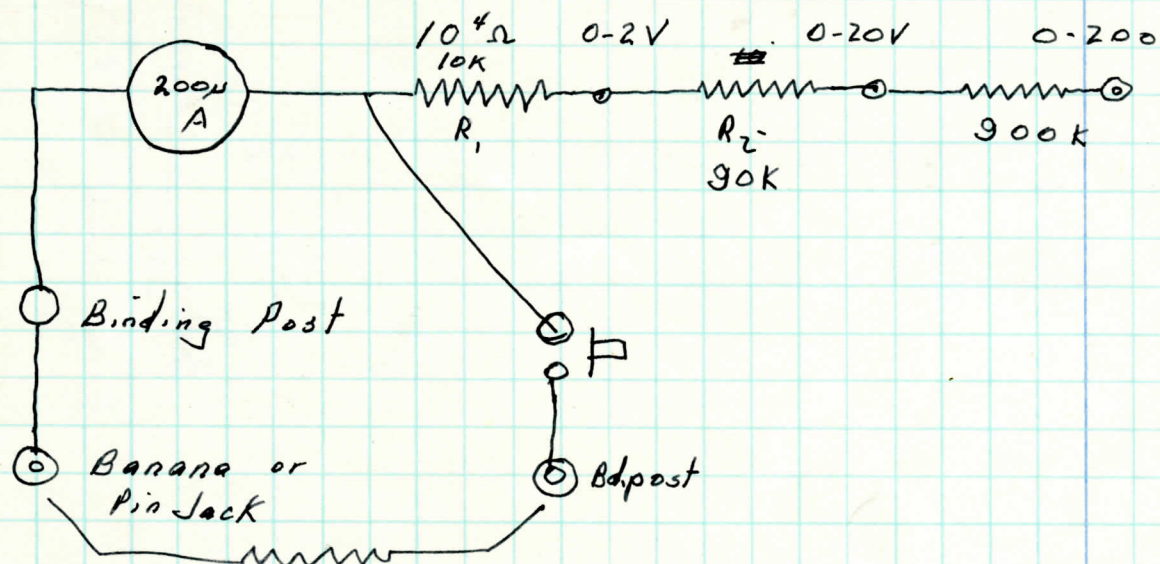
S_2 Centralab PA 1035 1 P/6 Pos 60° Phendit

J-1 AN 3102 A 145 55

Timer



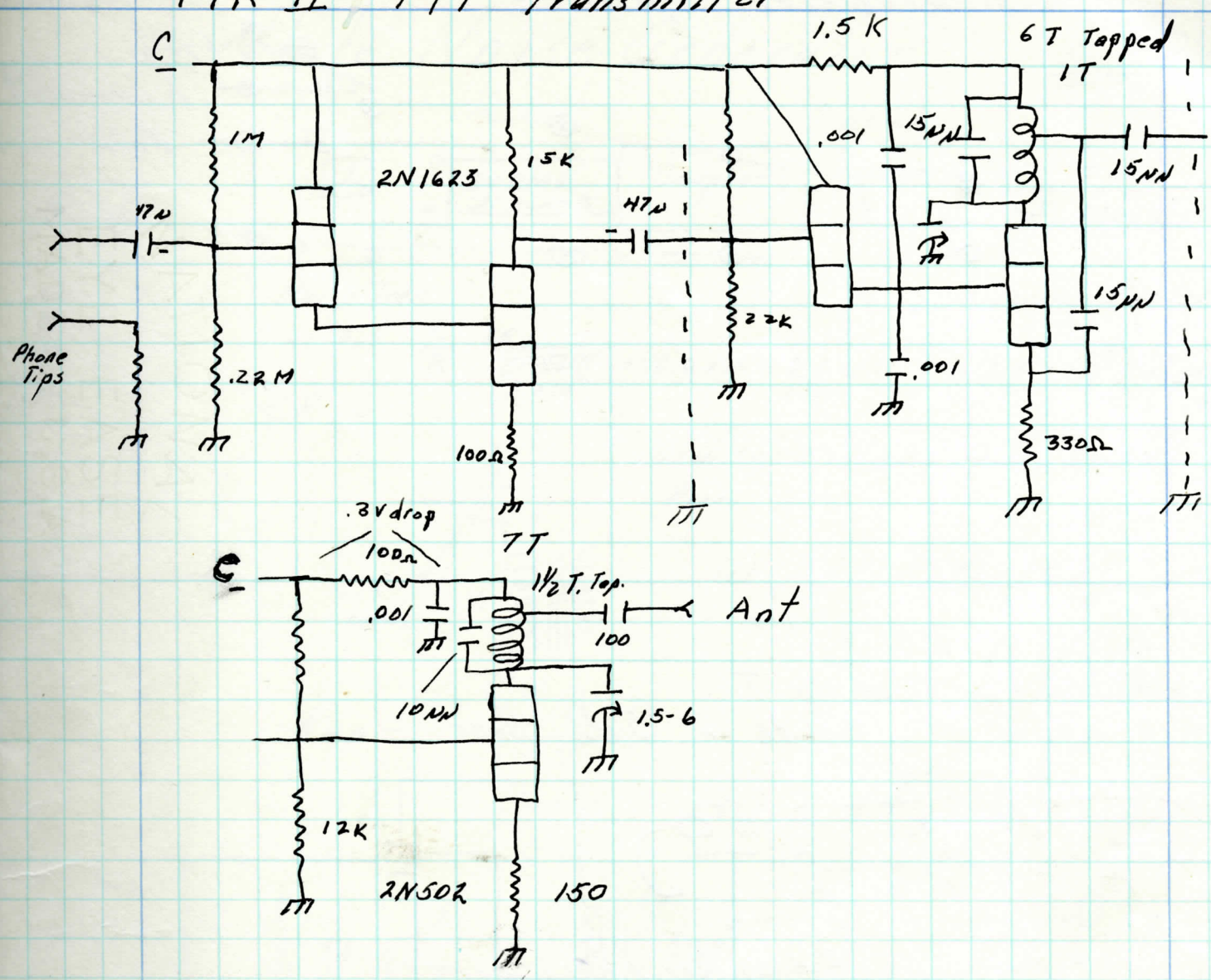
Multimeter-



$$\frac{2}{2 \times 10^{-4}} = 10^4 = R_1$$

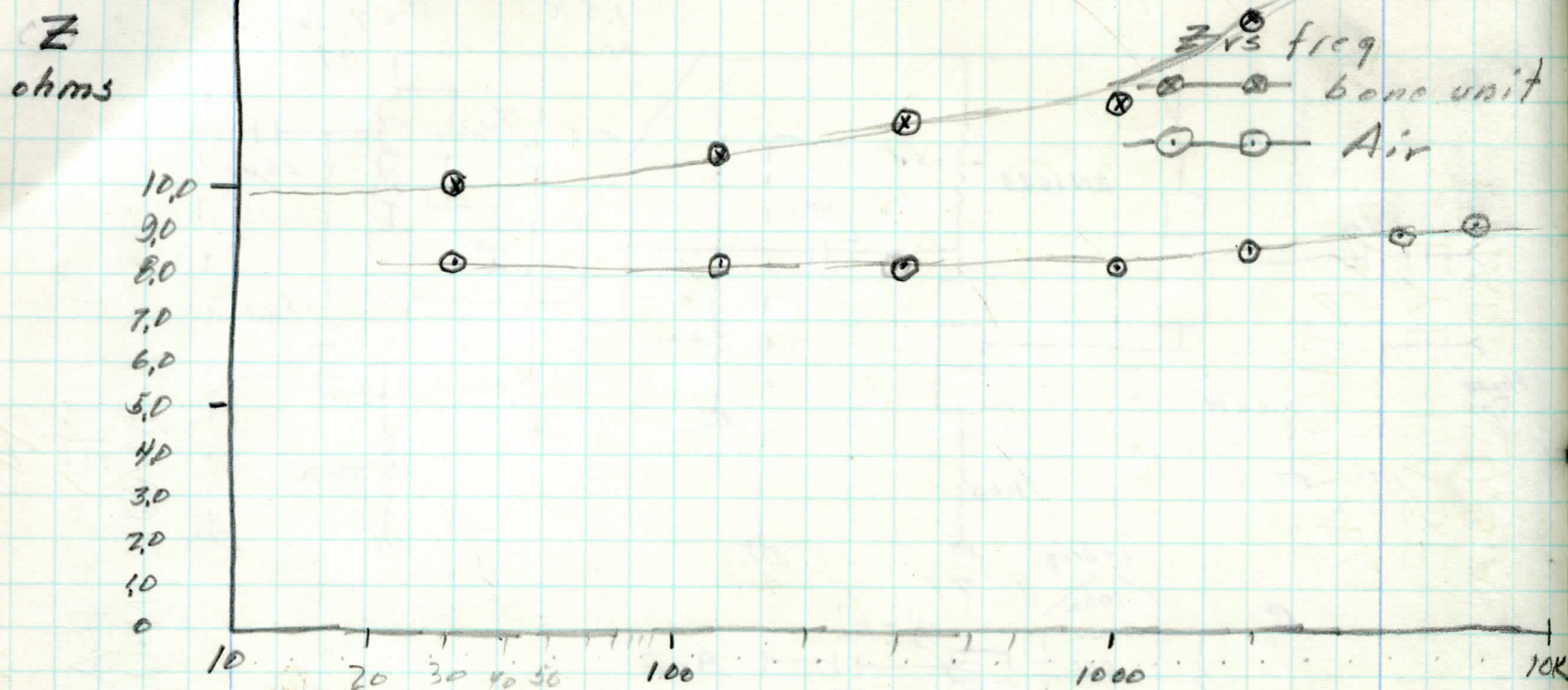
$$R_2 = 10^5 - 10^4 = 9 \times 10^4$$

MK II FM Transmitter

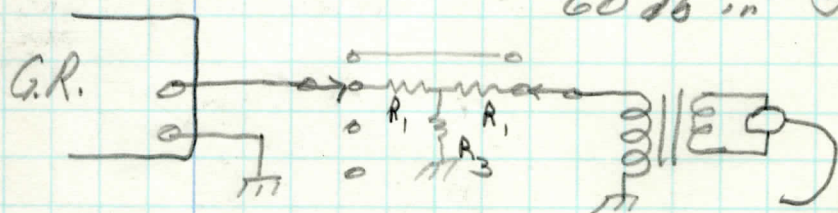


1.18.63

Audiometer Phones



Obtain or build a 'T'
60 db in 5 db steps



From FTI Monogr - P-416 Rec. + Rep. Sound-

Trial for $Z = 600 \Omega$

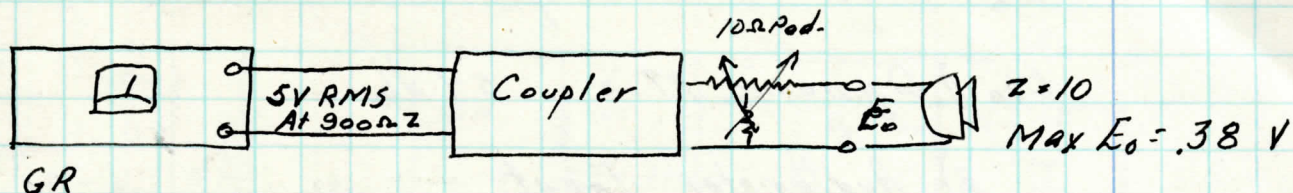
5 db - $R_1 = 170 (150) R_3 = 1K$

10 db - $320 (300) R_3 = (470)$

	R_1	R_3
Use $Z = 900$		
5	280	1625
10	480	340
15	620	185
20	730	< 150
25	830	off scale
30	880	
35	895	
40	900	
45	900	
50	900	
55	900	
60	900	

11.30.62

White Noise Generator

see P-28

GR

Noise Gen

$$P_{wr \text{ out}} = \frac{E^2}{R} = \frac{.25}{9 \times 10^2} = 2.6 \times 10^{-2} = \underline{26 \text{ mW}}$$

C.F. -

$$\text{Driving Power} = \frac{E^2}{R}$$

$$P_{reg} = \frac{(3.8 \times 10^{-1})^2}{10} = \frac{14.44 \times 10^{-2}}{10} = \underline{14.4 \text{ mW}}$$

Unsuitable - High D.C. current through Pri.

Use Xfmr-coupling

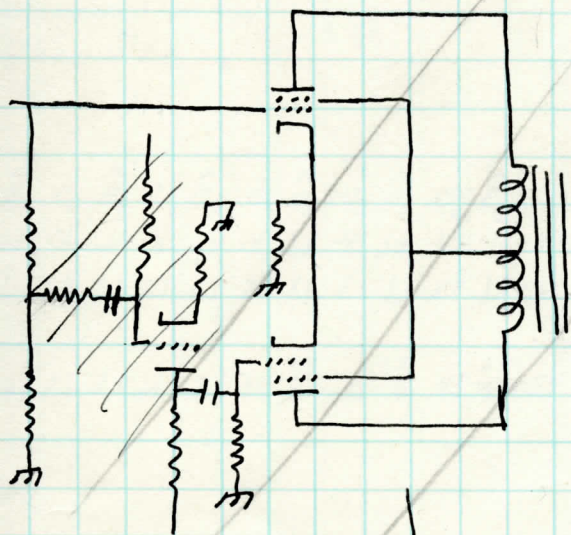
900Ω to 10Ω

Try UTC CYL-1 (300) 500 to 2 to 75 Ω

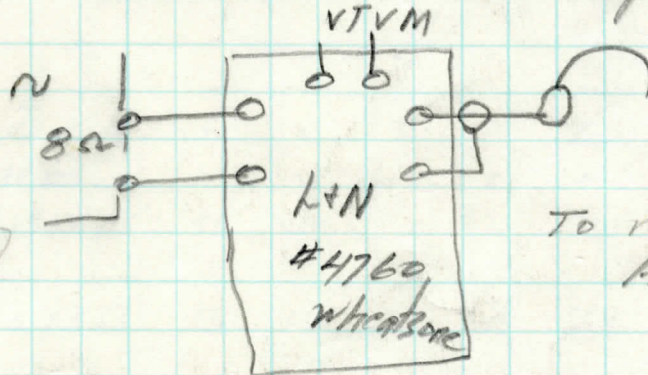
$$\frac{9}{30}$$

$$\frac{3\frac{1}{4}}{129\frac{1}{10}}$$

Amp -



Meas. of Phone Imp



To much AC

in Air

8.4 30Ω - 10Ω
make eq - ex Bone Whit

8.4 120 Ω - 10.8 Ω

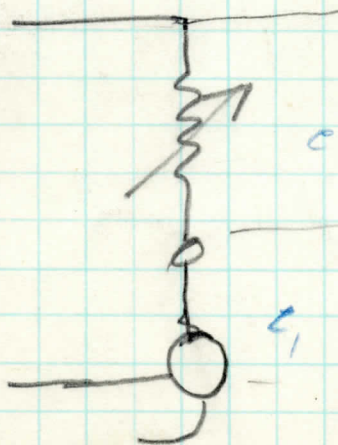
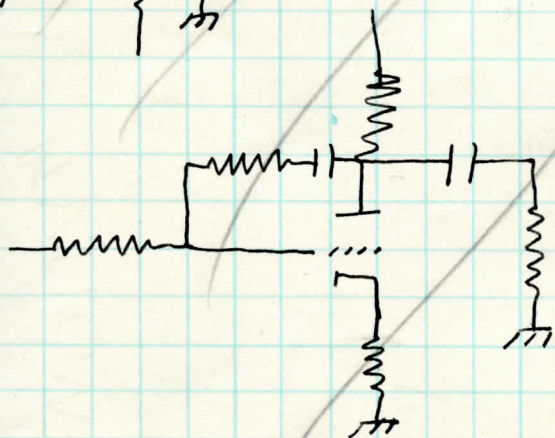
8.4 300 Ω - 11.5 Ω

8.4 1KΩ - 12 Ω

8.8 2KΩ - 14 Ω

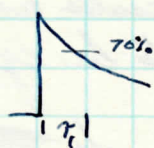
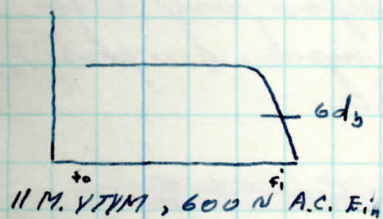
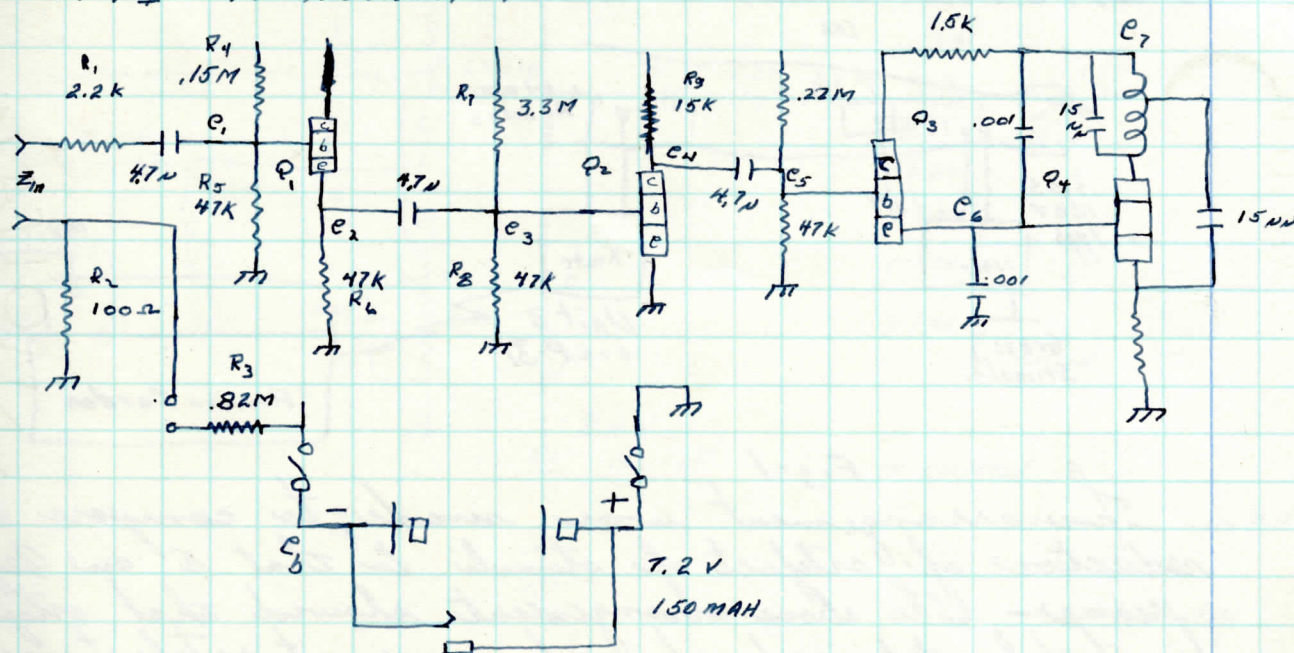
9 4KΩ 18

9.3 8 25



12.26.62 EMG -

MK I - Transmitter



Unit #	meas at e_7																Eq. R.A. noise input					
	e_1	$\hat{e}_1$	e_2	$\hat{e}_2$	e_3	$\hat{e}_3$	e_4	$\hat{e}_4$	e_5	$\hat{e}_5$	e_6	$\hat{e}_6$	e_7	$\hat{e}_7$	A_7	e_8	F_1	τ_0	T_1	Z_{in}	Z_{sig}	Z_{sig}
	-Y.	mV	-Y.	mV	-V.	mV	-V.	1V	-V.	1V	-V.	1V	-V.	1V	M. $\frac{1}{\mu A}$	$\frac{1}{\mu A}$	kC	n	mS.	K	∞	2k
1	1.9	2.4	1.8	2.2	.07	2.2	2.5	1.7	1.	1.7	.57	1.7	4.65	4.8	1.5	7.25	40	<20			33 μV	10 μV
2																						
3	1.75	2.4	1.7	2.1	.1	2.1	3.9	1.5	.9	1.5	.45	1.5	.54	.5	1.5	7.3	33	<20	30	50	25 μV	2.5 μV

1.1.63

Recording of evoked potentials from surface electrodes
 & EMG transmitters & Allen Downie.

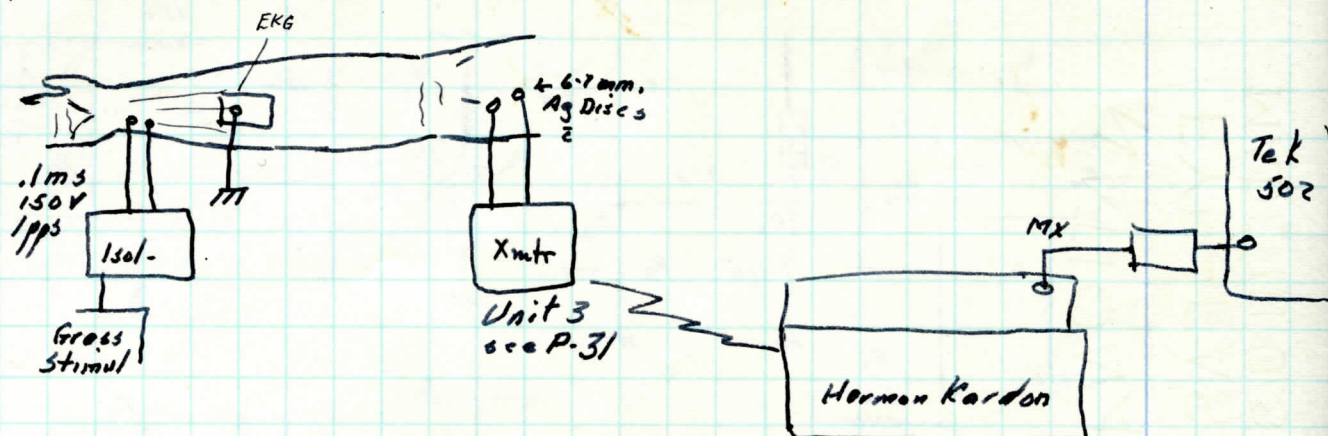
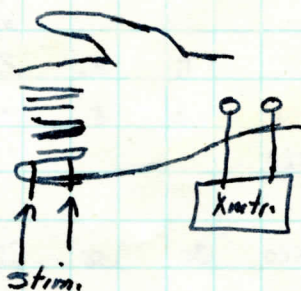


Fig-1

This arrangement was made to compare ~~the~~ reduction of artefact of stimuli to that & on Regonant[®] preamp - The above arrangement showed that artefacts were definitely reduced and movement artefact was also much less. No photos of amp. results were made. See photo 18, 5. Noise performance was adjudged to be equal.

The arrangement below was made ~~at the same time~~.



The amplifier did not record the potential at all while moderate results were obtained from the X-mtr.

This arrangement was next shifted to the 2^o finger and median ~~nerve~~ & Photos 4567.

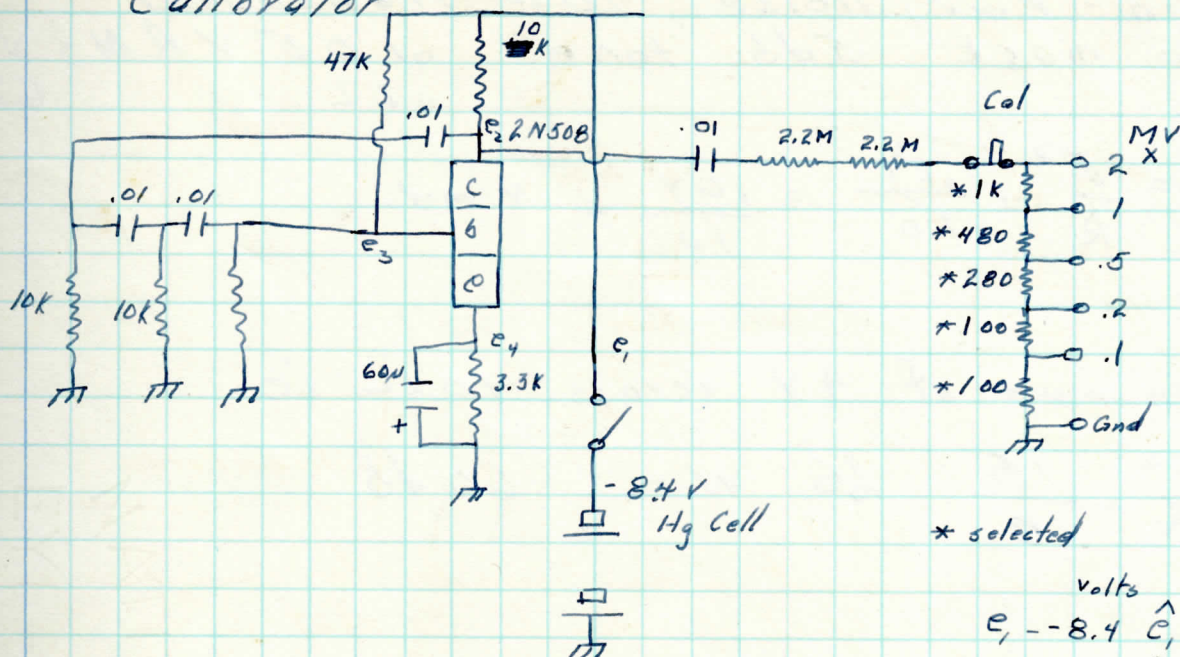
Needle electrodes were then inserted over this nerve at the point and Photo 8, 9, 10, 11 made.

There seems little doubt that telemetry even in the form of the EMG trans. can improve the stimulus reduction considerably and also have comparable S/N ratios. There is a marked S:N reduction possible and artefact can probably be reduced further & smaller units.

Photos under Neurology in top drawer of small file.

12-26-62 EMG

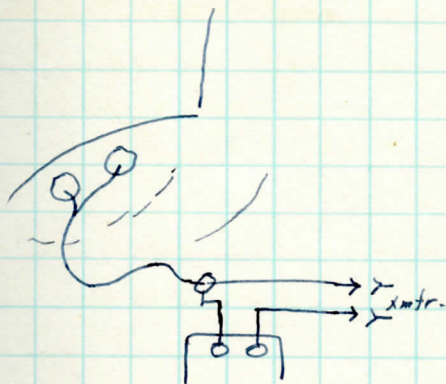
Calibrator



* selected

volts	volts P.P
$e_1 - -8.4$	$\hat{e}_1 -$
$e_2 - -4.0$	$\hat{e}_2 - 4.8$
$e_3 - -1.7$	$\hat{e}_3 - 50 \times 10^{-3}$
$e_4 - -1.6$	

$$f_6 = \frac{1}{\gamma} = \frac{1}{\frac{50 \times 10^{-3}}{2.2}} = \frac{10^3}{2.26} \approx 410 \text{ n}$$



1.18

Min - Pwr, noise, 10Ω transducer
to mask 5db tone 0.103 V RMS WT
0.22 GT

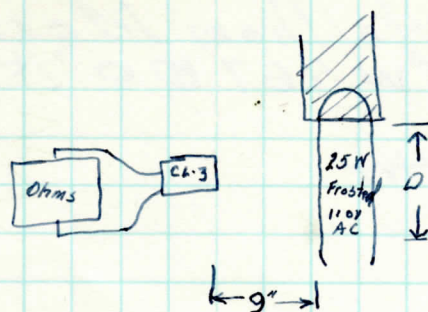
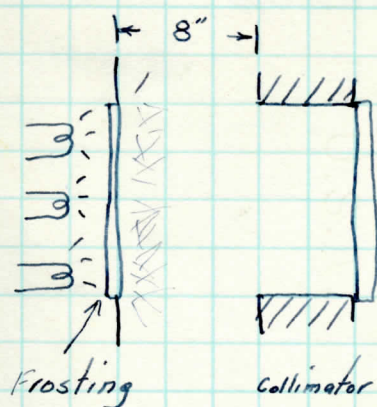
$$W = \frac{E^2}{R} = \frac{(0.2)^2}{10} = \frac{0.04}{10} = 4 \text{ mW}$$

Minimum of 4V across 10Ω ie

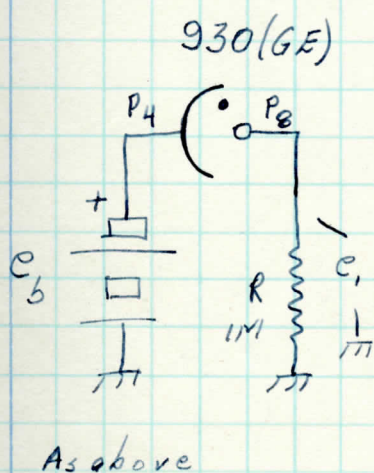
$$W = \frac{E^2}{R} = \frac{16}{10} = 1.6 \text{ W} = 60 \text{ db}$$

$$\begin{array}{r} 25 \\ 24 \overline{) 60} \\ \underline{48} \\ 120 \end{array}$$

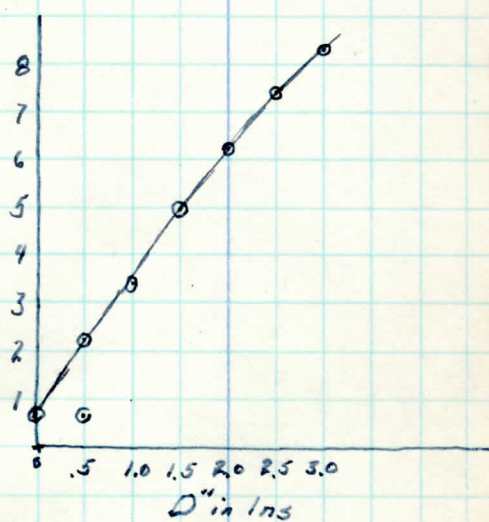
12.26.62 Displacement Transducer (Downie for Knee Jerk)



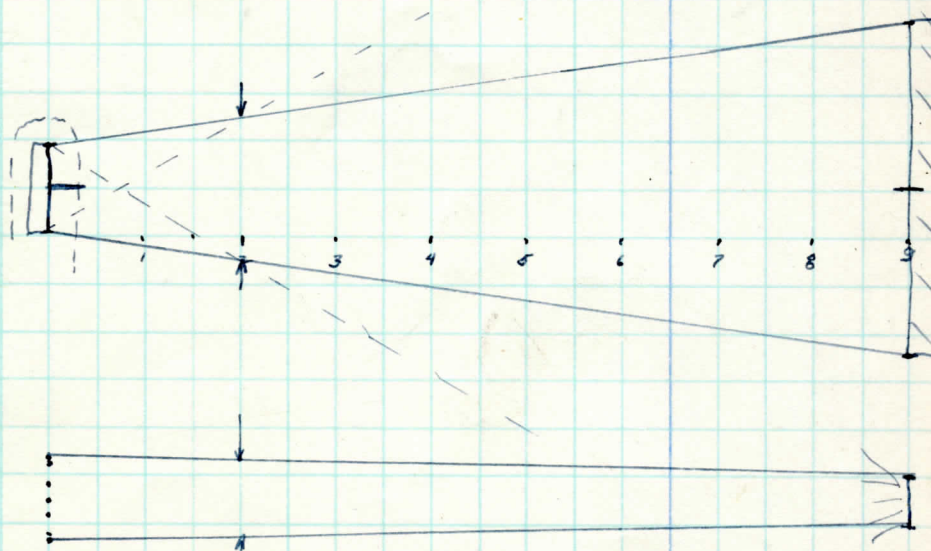
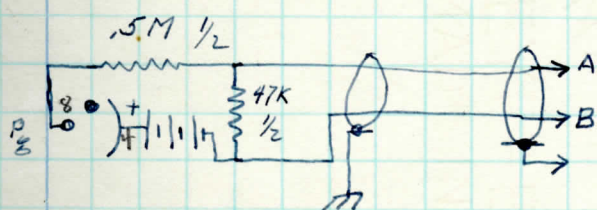
Ohms $\times 10^3$	D ins.
11.8	4
12.3	3.5
14.0	3.0
17.0	2.5
22.0	2.0
35.0	1.5
110.0	1.0



$e_b:45$	$e_b:0$		(centered)
C_1	C_1	D	e_1
Volts	Vx1	Ins.	Volts
8.7		4.	8.3
7.3	6.2	3.5	7.40
6.75	5.4	3.	6.20
5.50	4.7	2.5	5.00
4.1	3.5	2.0	3.30
2.6	1.7	1.5	2.15
1.0	0	1.0	.7

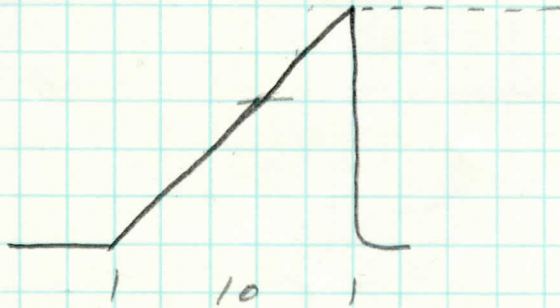


$$D'' = D - 1$$



12.31.62

Timer 0-10 sec. duration 5% accuracy (1/10 sec)

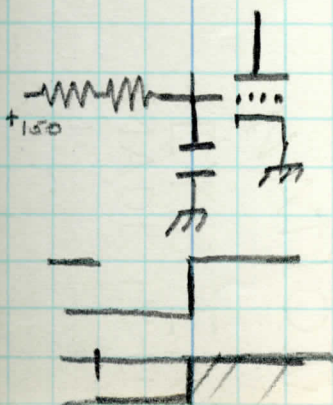
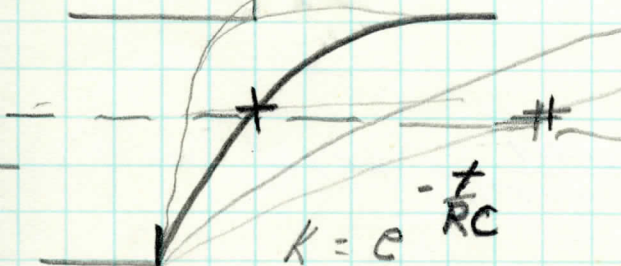
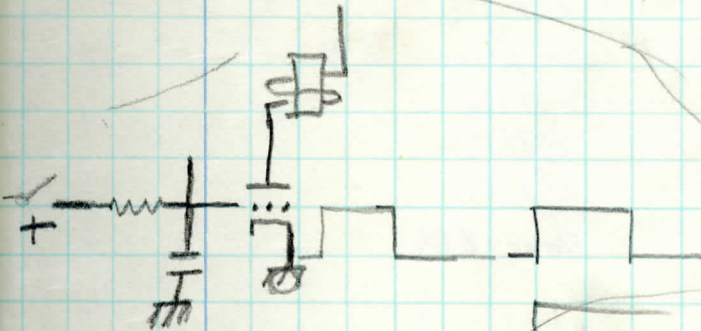
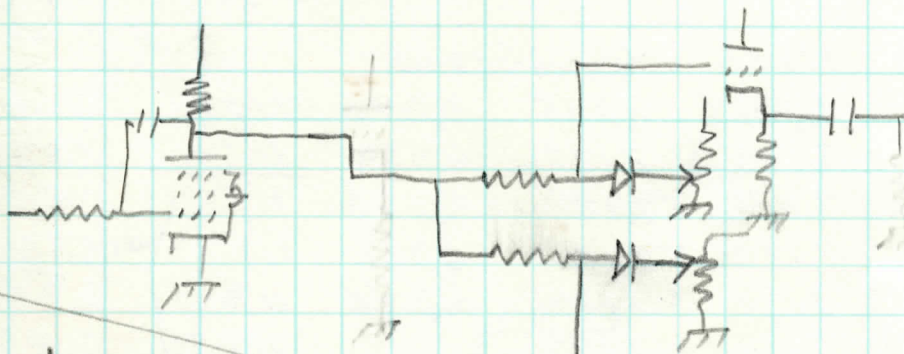
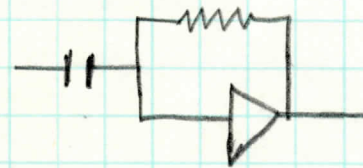
 $B+ = 250$ 

150V max

or

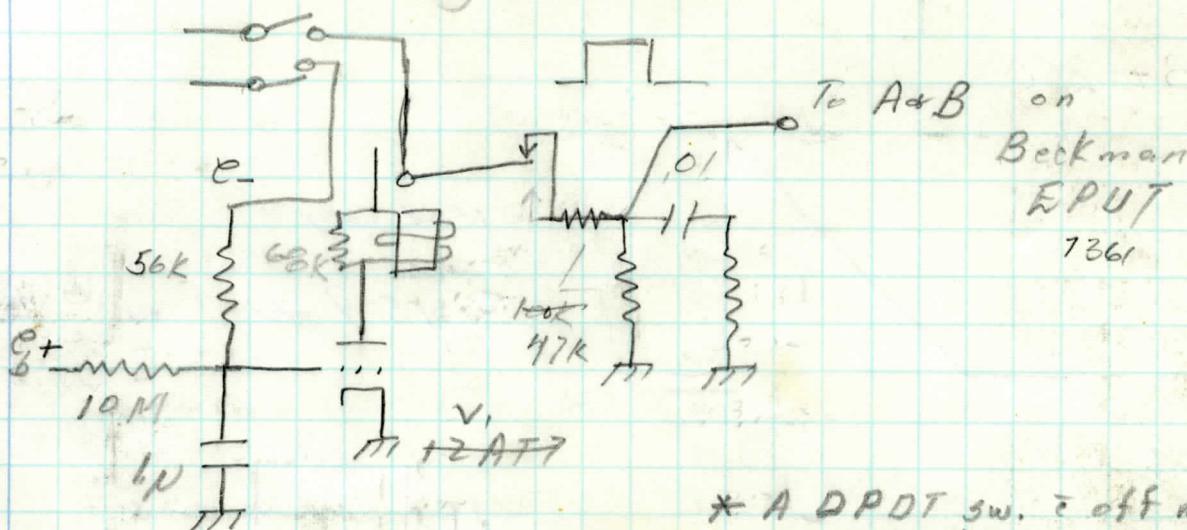
15 V sec

or

 ± 1.5 max

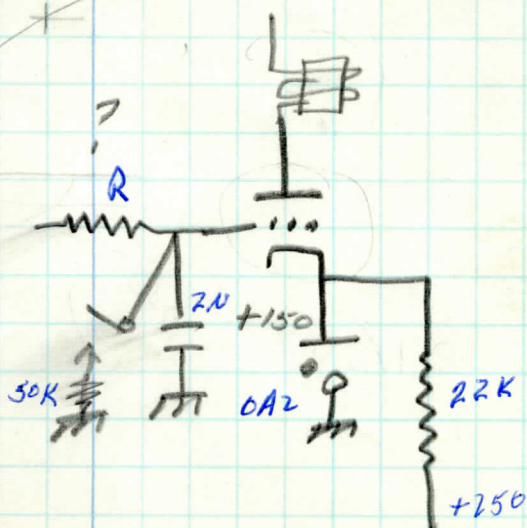
12.31.62

Tests of timing ckt's -

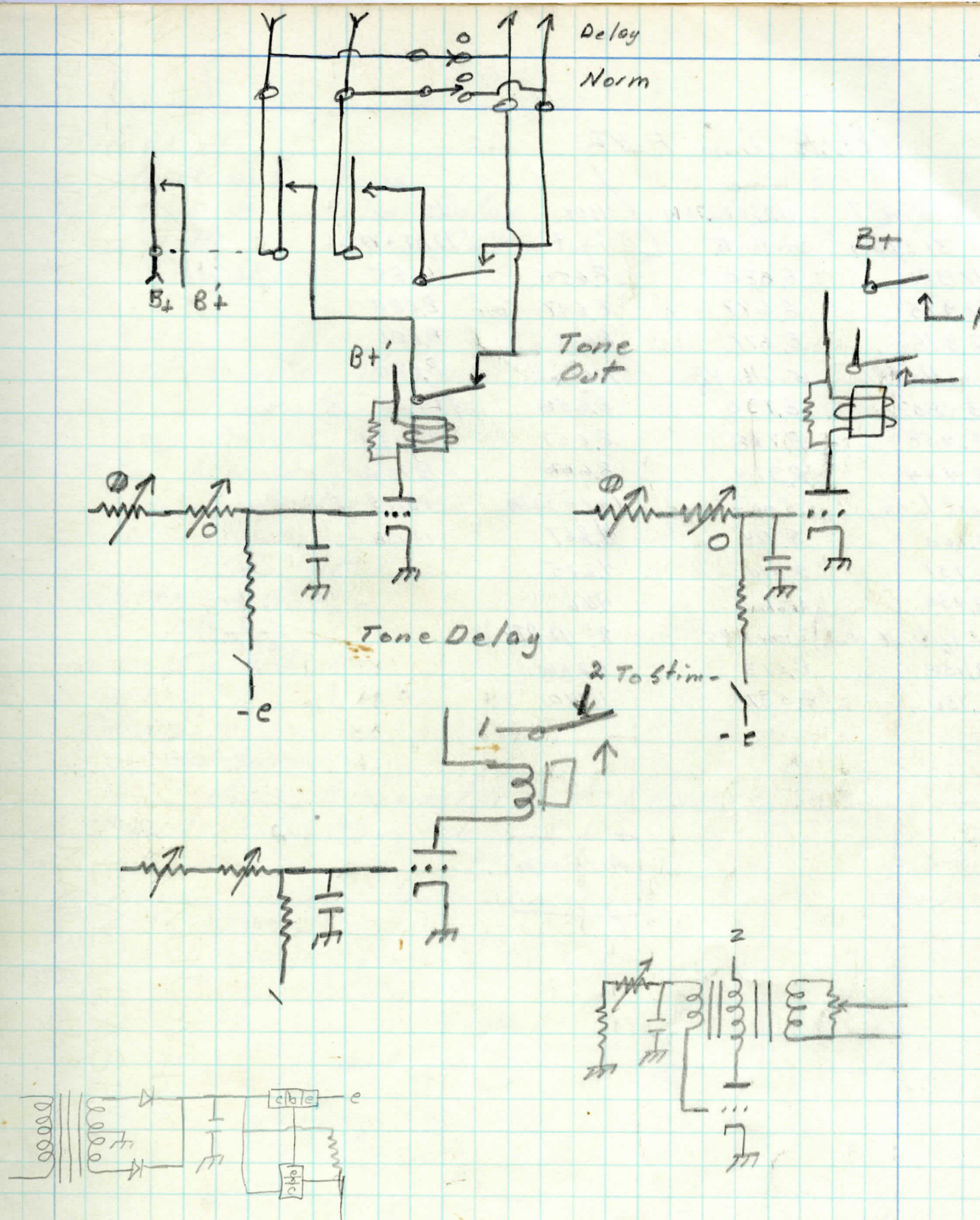


* A DPDT sw. 2 off median was used - This caused speed

$E_b = +150$	$E_c = -135$	12AX7	12AT7	12AX7	12AT7	$R = 4 \times 2.26M (WE)$	$C = 2 \mu 200V$	12AX7	Theor.
T - sec	T (2 12AT7)								
6.925	6.920	7.092	7.135	6.944	11.781	2.26M x 2			5.91
6.982	6.931	7.109	7.137	6.939	11.780	5.837			
6.954	6.915	7.078	7.138	6.933	11.821	5.842			
6.965	6.941	7.106	7.135	6.939	11.823	5.835			
6.937	6.933	7.108	7.136	6.946	11.825	2.855			2.95
6.985		7.158	7.137		11.839	2.854			
6.982		7.146	7.137		R = 3 x 2.26	2.846			
6.927		7.137	7.135		8.846				
		7.114	*		8.842				
		7.119			8.830				
		7.134			Theor - 8.89				
		7.136							



$$\frac{100V}{5 \times 10^{-3}A} = 20 \times 10^3 \quad W = 10^2 \times 5 \times 10^{-3} = .5 W$$



Timer -

0-10 sec Tone
0-10 " Stim. Delay
0-10 " " Det -
Stimulus;

Put on Sep. Rack

GSR

Preamplifier & Supply in Panel
Calibrate

Bin Loud Bel -
Indicator for Att.
switch -

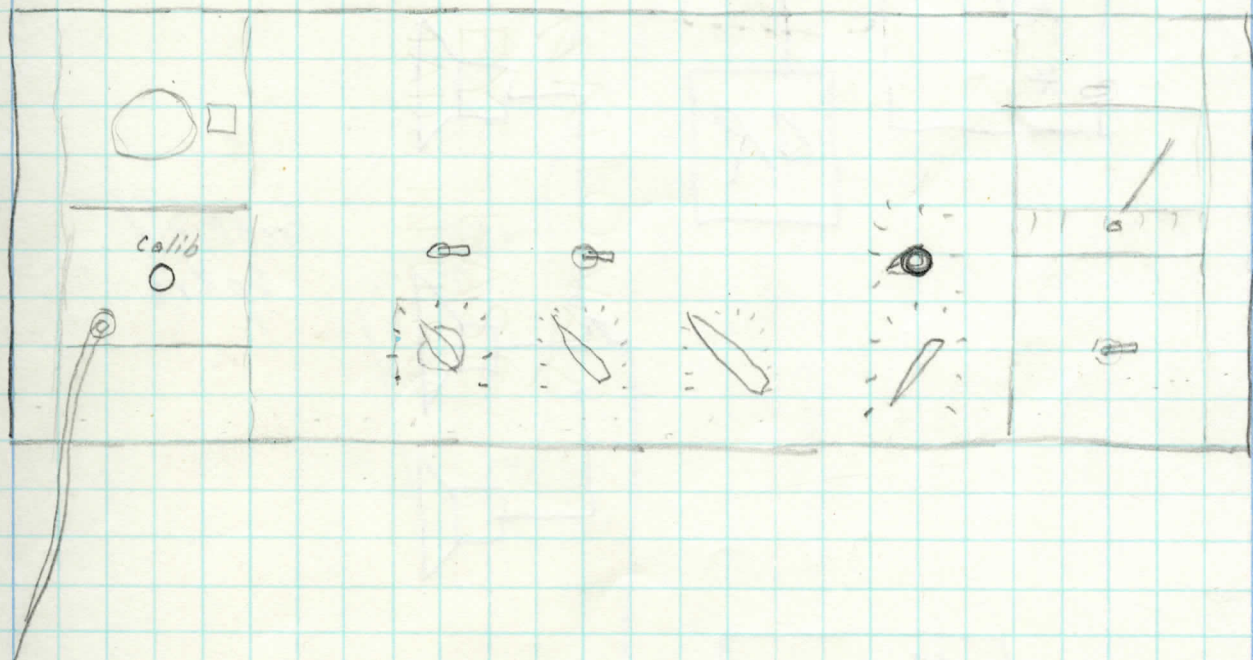
Sep. Att -
White noise -
Att -
Switch ?

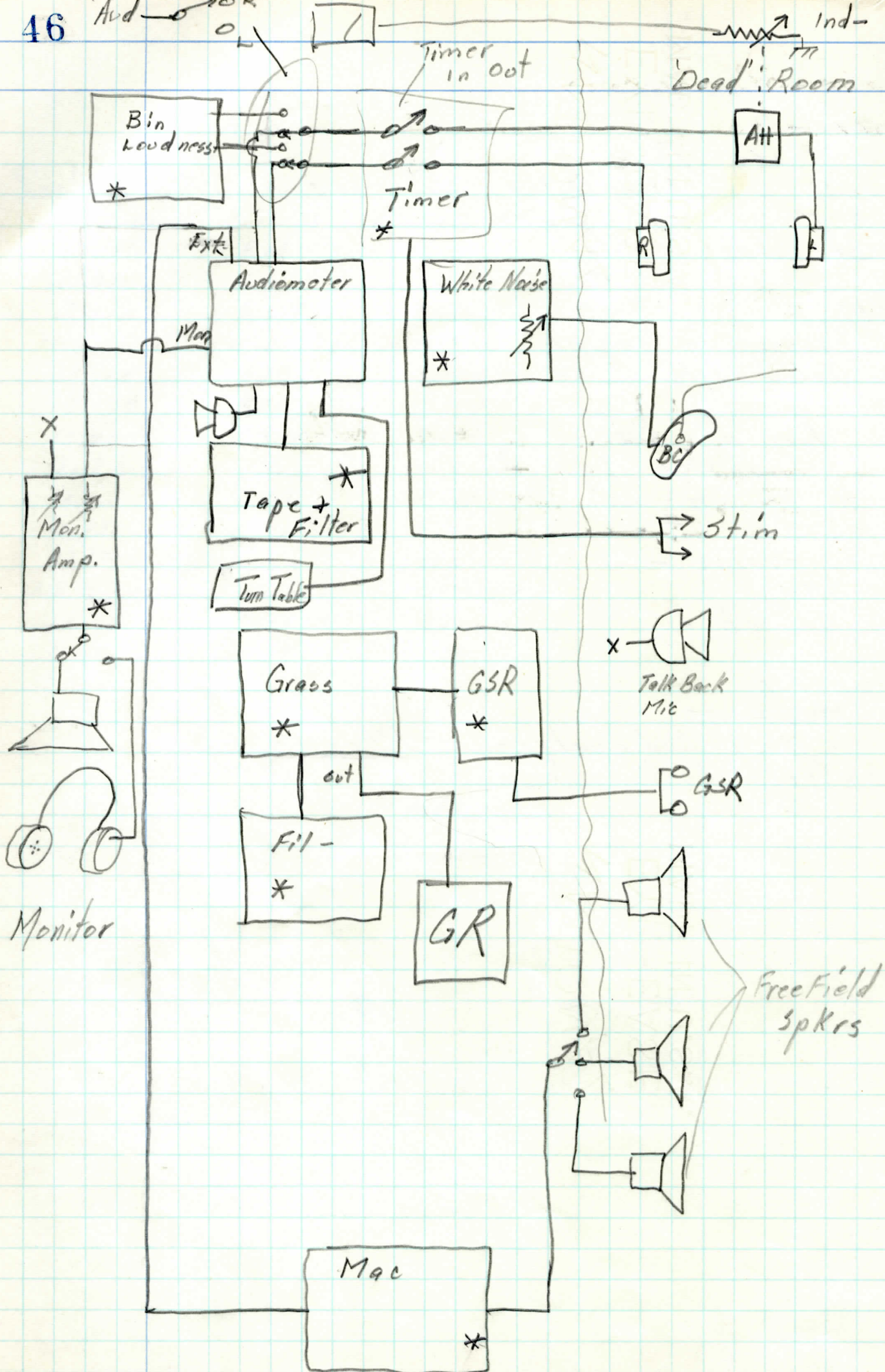
60 db -
5 db -

Monitor

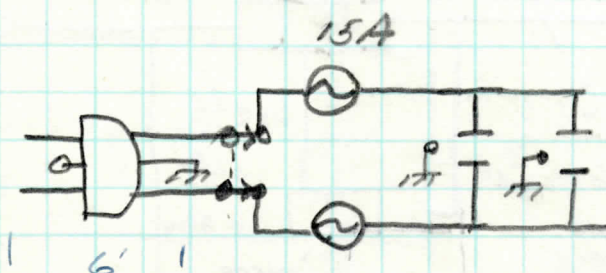
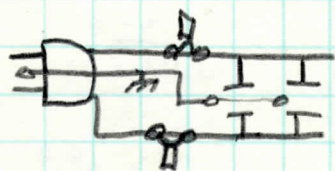
~~Master~~

Mic - Audiometer - Phones
Master A.C. Switch -

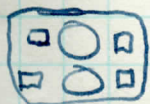




Primary AC wiring -
 2 outlets & 15 A Breaker



2 receptable

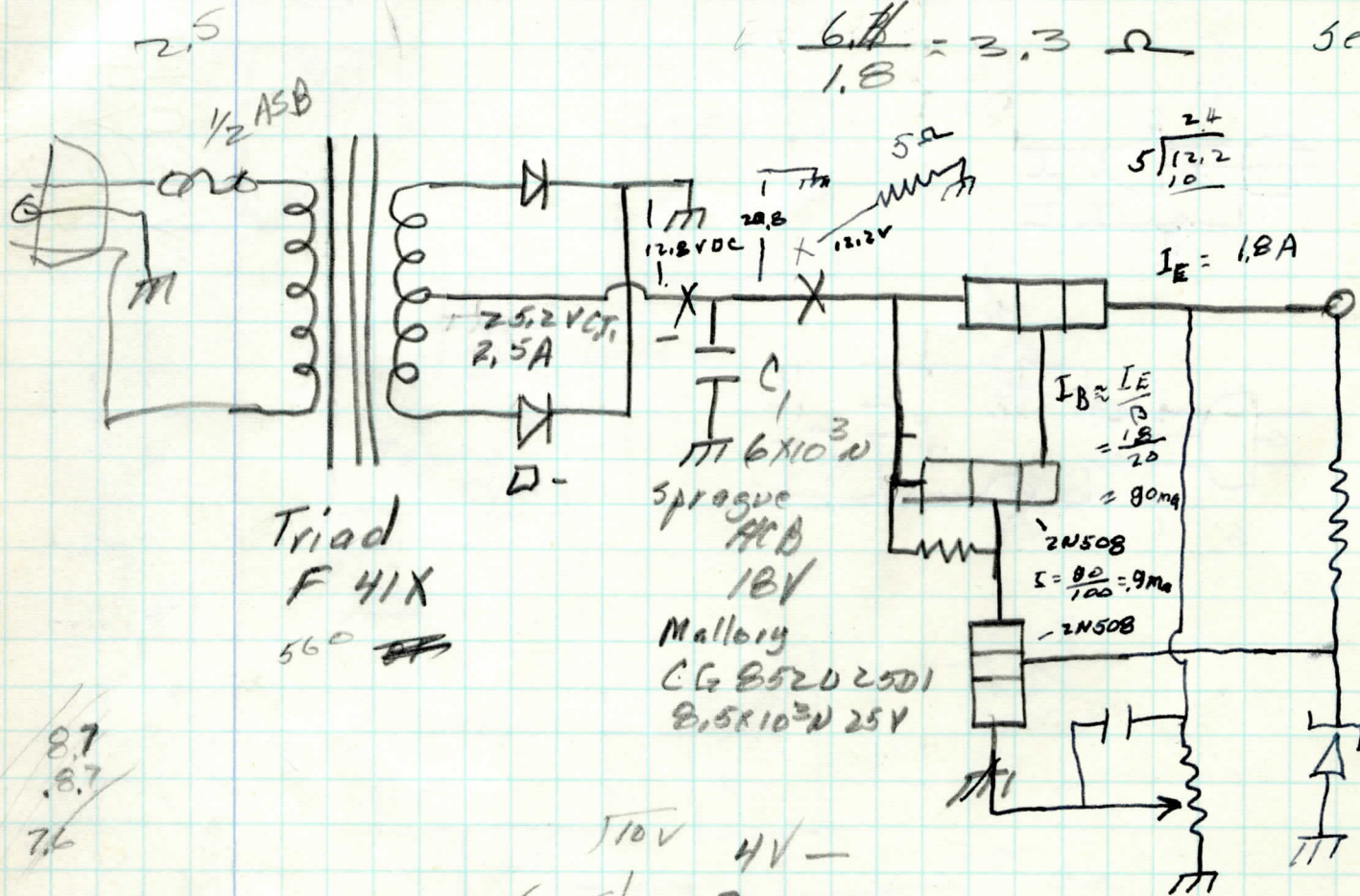


1.2.63 Fil Supply for Grass Amp (6-65H7)

$$6 \times .3 A = 1.8 A \text{ or } 12 V \text{ at } .9 A$$

$$\frac{6.6}{1.8} = 3.3 \Omega$$

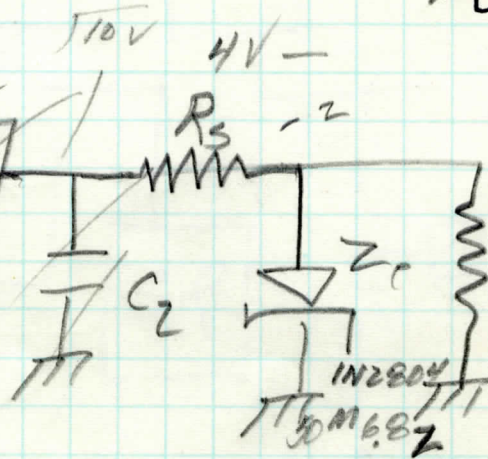
see P-48



$$R_{sw} = 2.5A \times 4V = 10W$$

$$R_L \quad R_3 = \frac{4}{2.5} = 1.6 \, \Omega$$

if $R_{2-} = 1.2 \, \Omega$

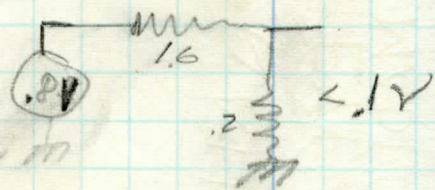


$$+R_L = \frac{10V}{2.5A} = 4\Omega$$

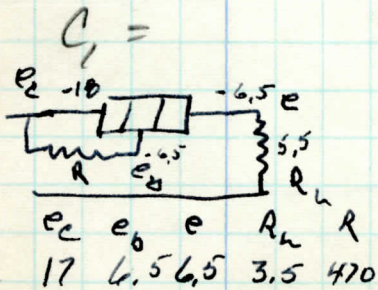
$$\omega R_L C = 2\pi f \cdot 5 \times 10^3 \times 4$$

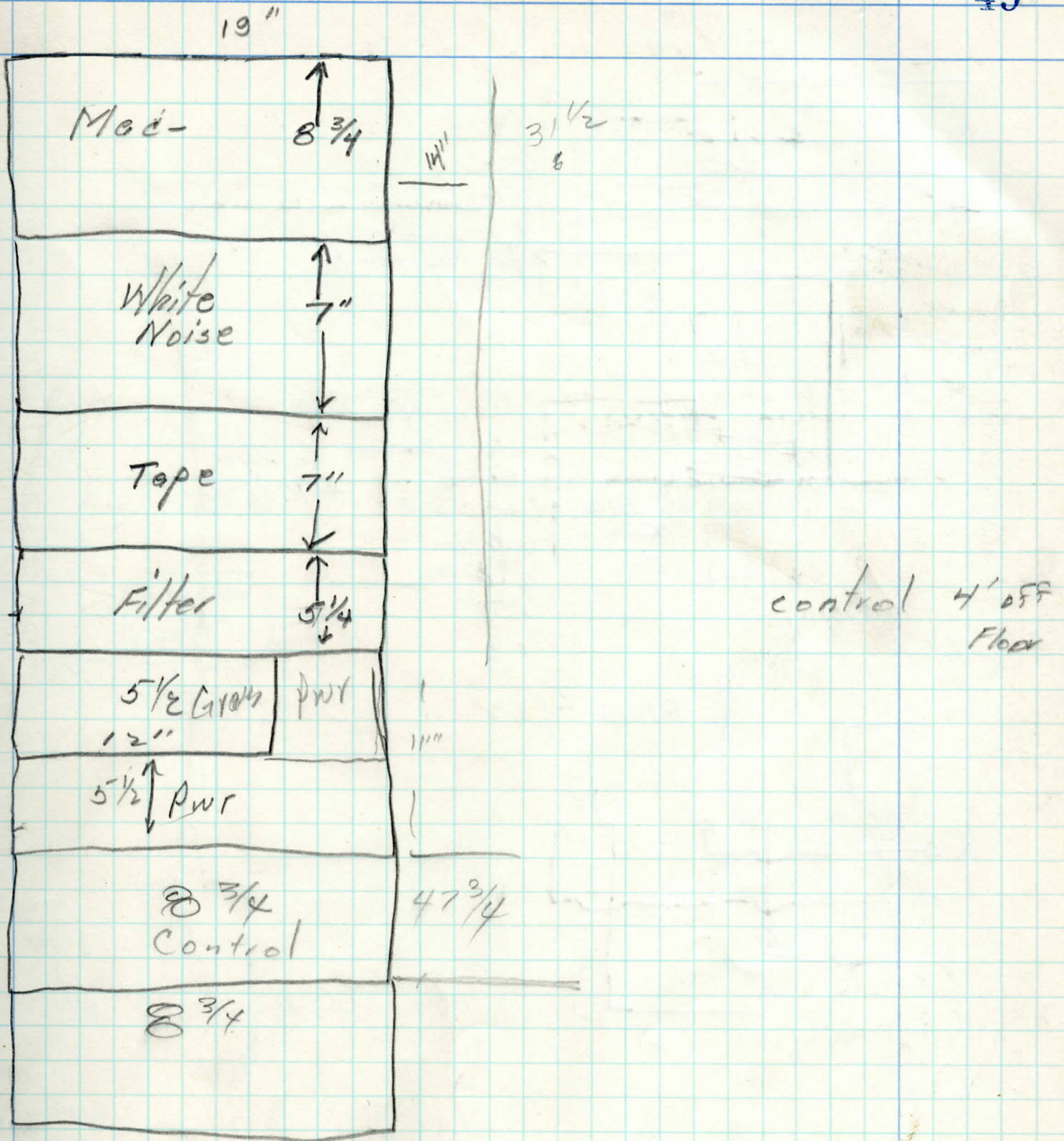
$$= 4.0 \times 10 \times 6 \times 3.14$$

$$= 24 \times 314 \times 10^5 = 7.54 \times 10^8 \times 10^{-6}$$



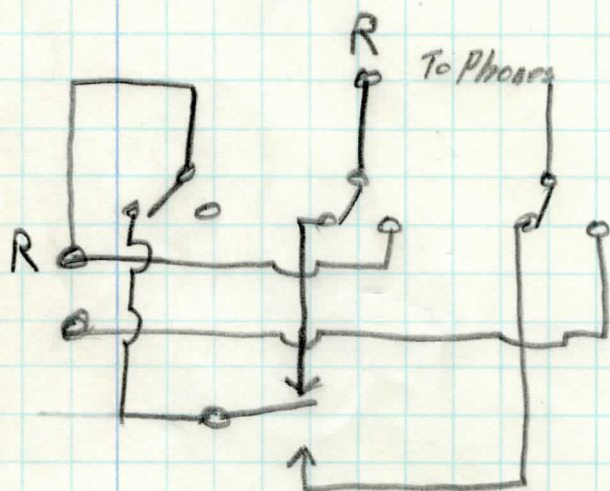
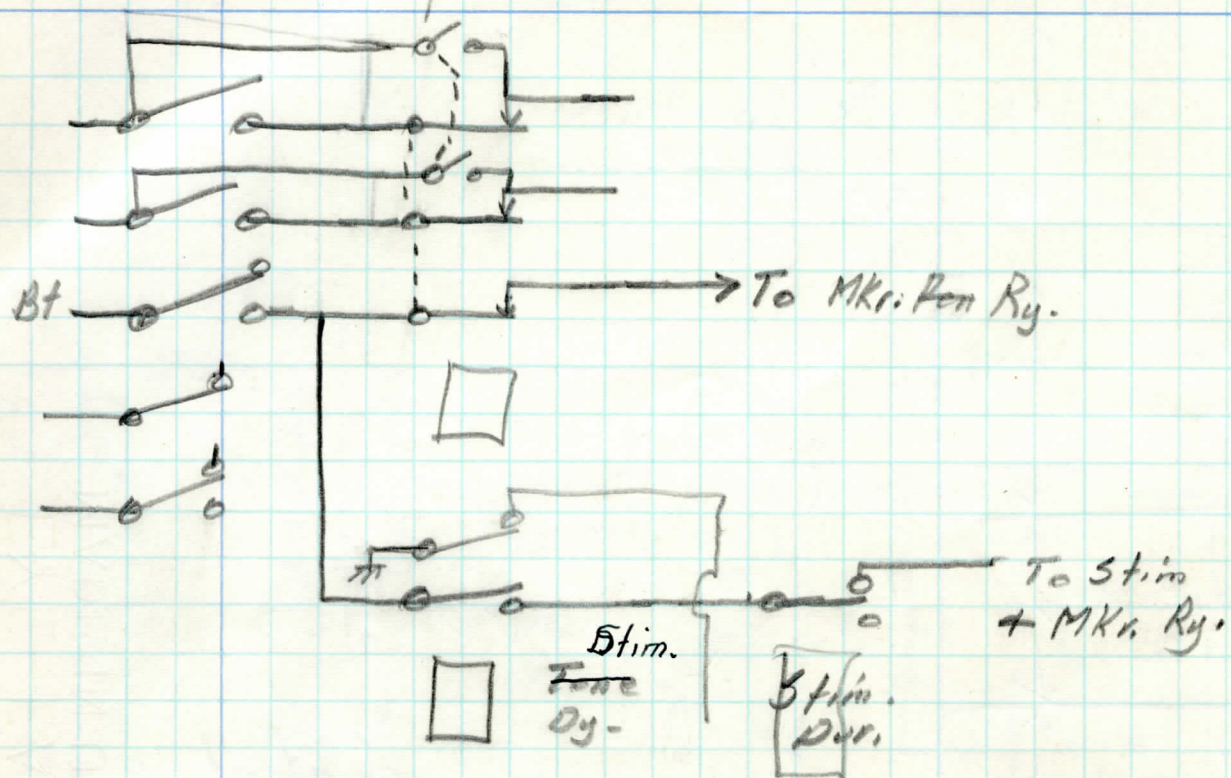
Ripple = 8%

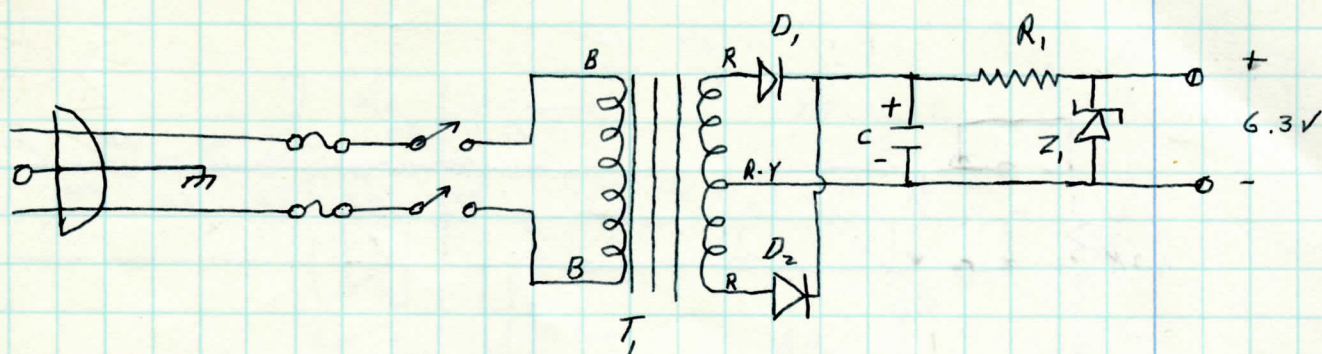




66
45
18

Norm. Delay



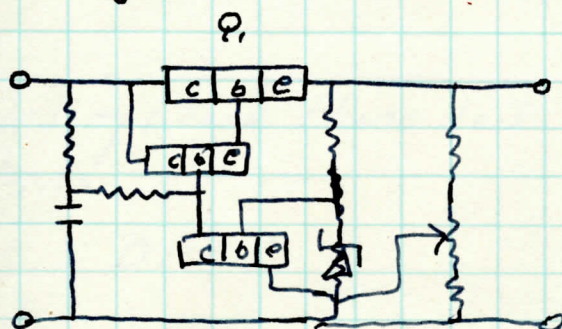


Build on a 2"x4"x6" Chassis -

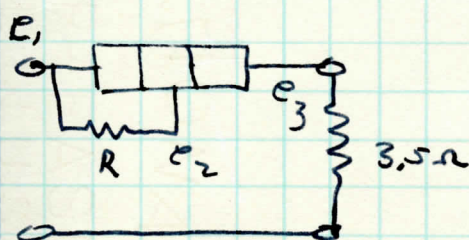
Reg. for 6.3V - 1.8A

$Q_1 = 2N1162$ $\beta = 15 \text{ to } 65$

E_{in} -
5VPP
10 to 6V

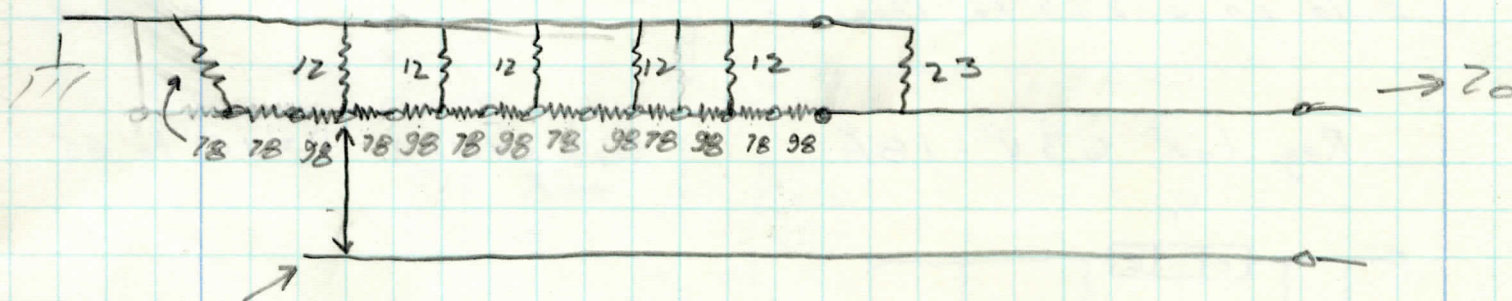
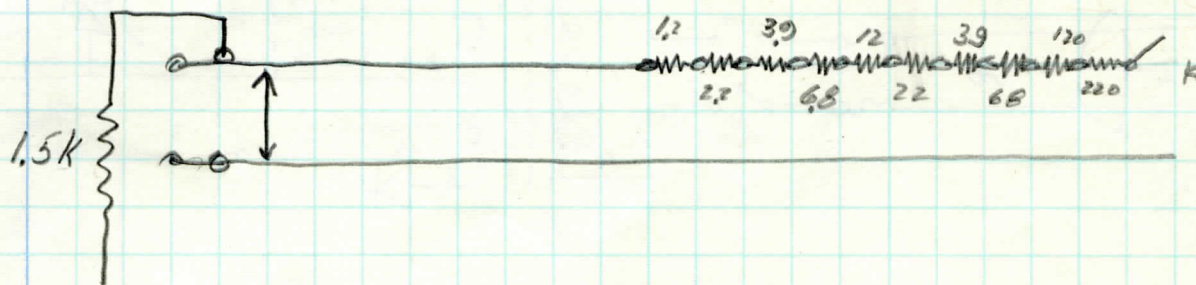


Meas β

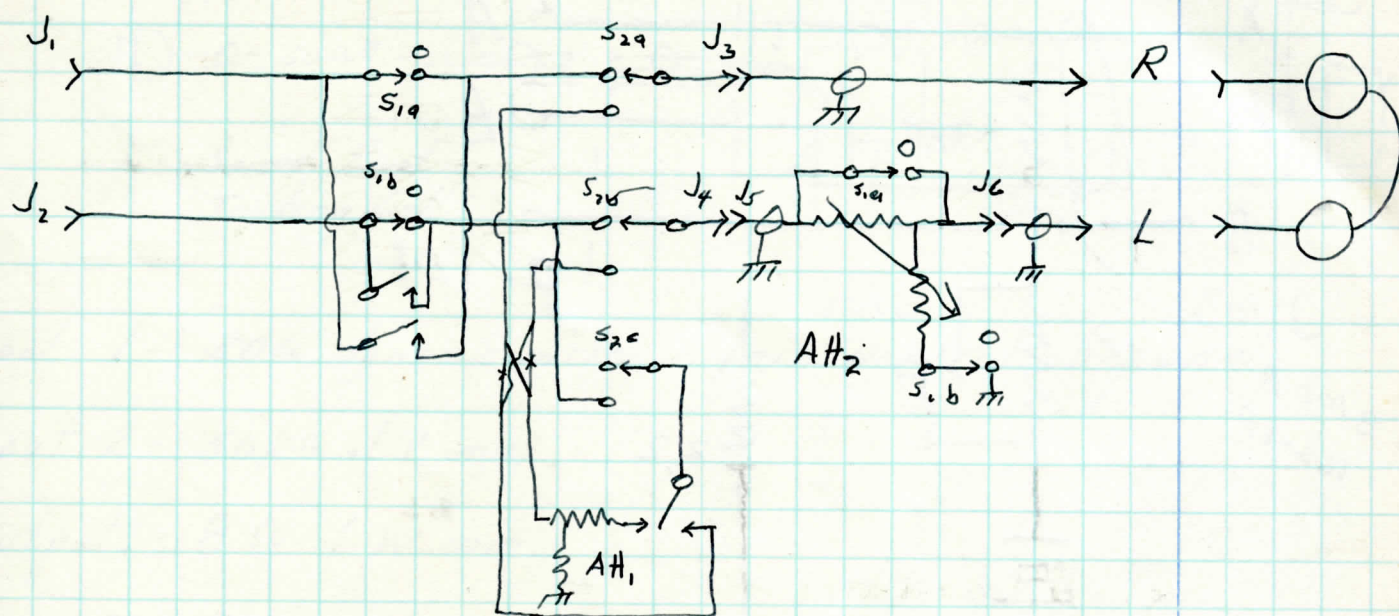


$$680 \overline{) 650.0} \quad \begin{array}{c} .009 \\ E_1 \\ 17V \end{array} \quad \begin{array}{c} E_2 \\ 6.5 \end{array} \quad \begin{array}{c} E_3 \\ 680\Omega \end{array} \quad \beta = \frac{1.8A(I_C)}{10^{-2}} = 1.8 \times 10^2$$

Beltone Hearing Loss / Att.



Audiometry - Wiring of Phones



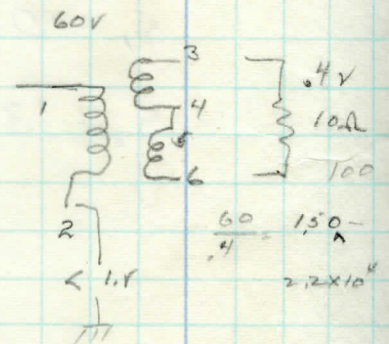
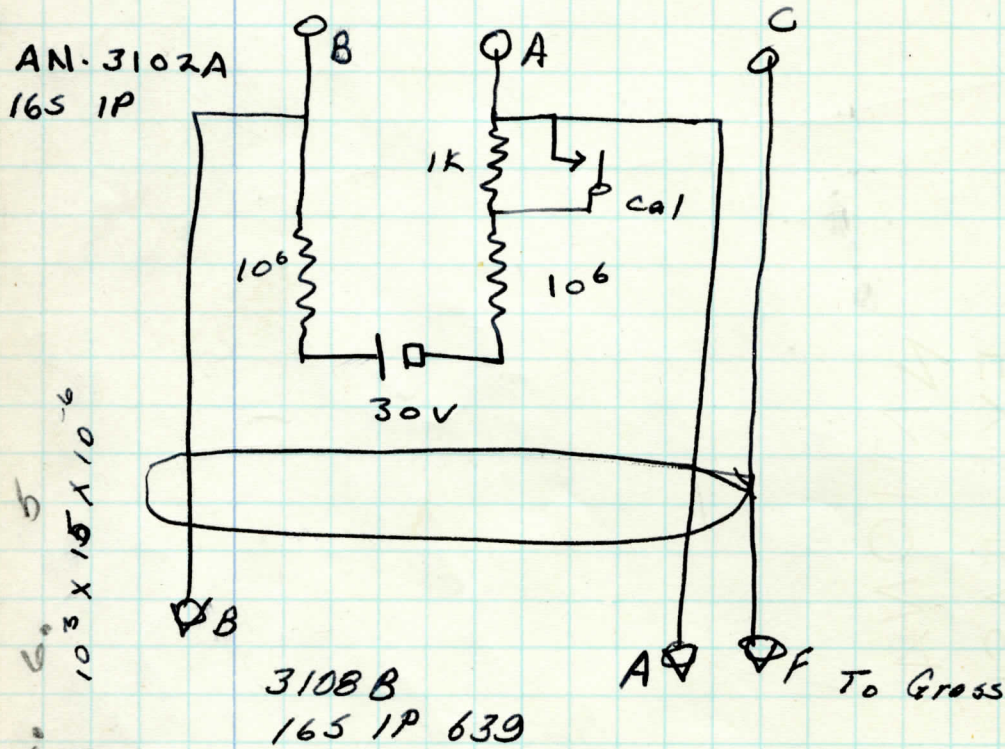
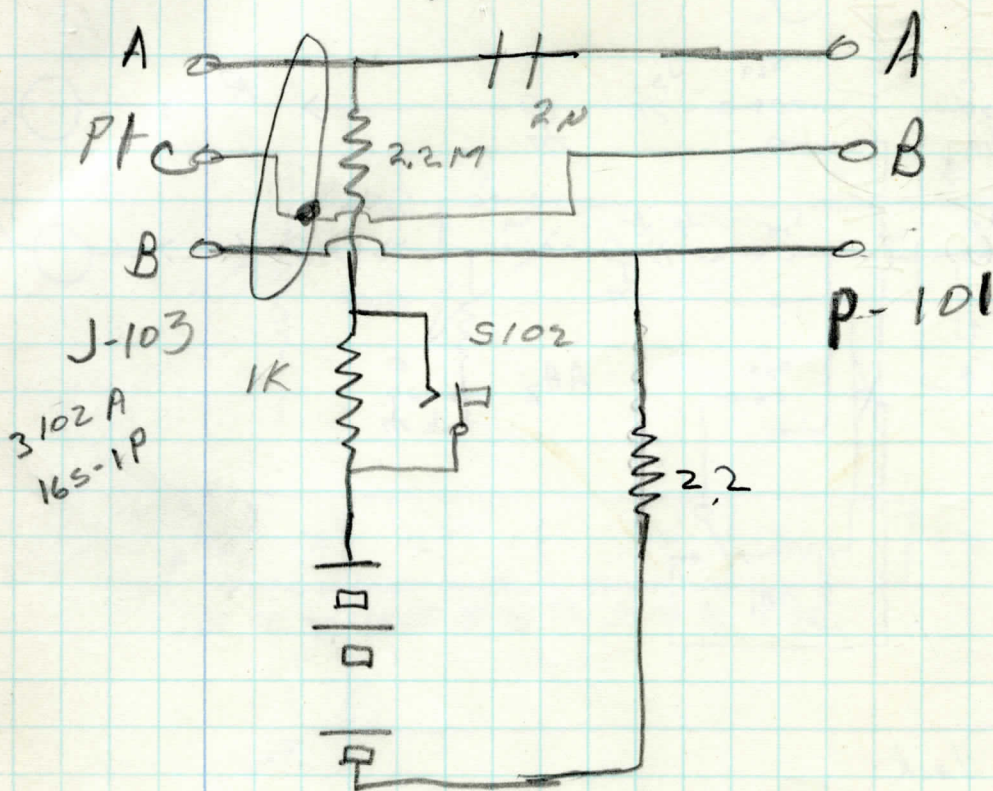
$J_1, J_2 \rightarrow 1$ cond Phone Jack
 $J_{3,4,5,6}$

$\cup_{3,4,5,6}$

5, - DPST

$S_2 - 3PDT$

GSR



$$\frac{64}{13} = 5$$

$$\frac{64}{164} = 25.0$$

$$25$$

$$r_k = \frac{9}{35 \times 10^{-3}}$$

$$= 257$$

$$R_s = \frac{7.4}{35} \times 10^3$$

$$= 2 \times 10^3$$

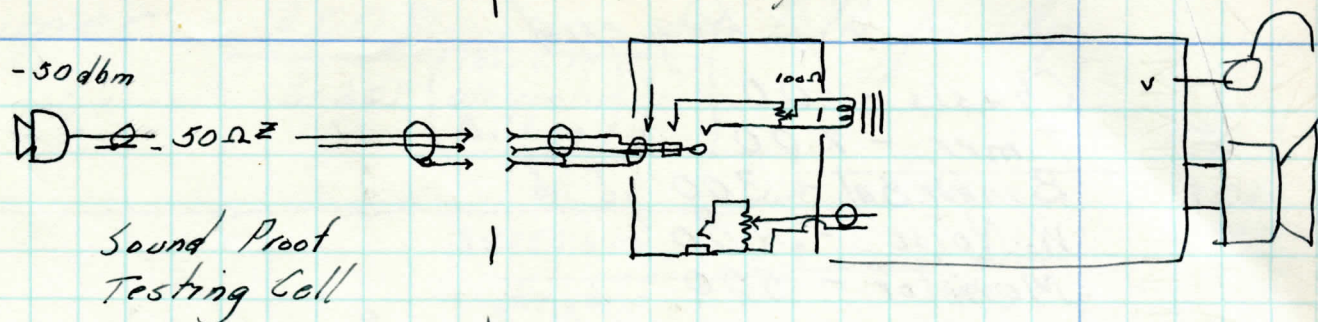
$$W = 35 \times 10^{-3} \times 70$$

$$= 2450$$

31.5
15 x 10^-6 A
12
600m
600
30
2 x 10^6

1-14 Audiometry - 'Talk Back' Amp

55



Input 1 - 50 Ω dynamic mike & gain control on panel

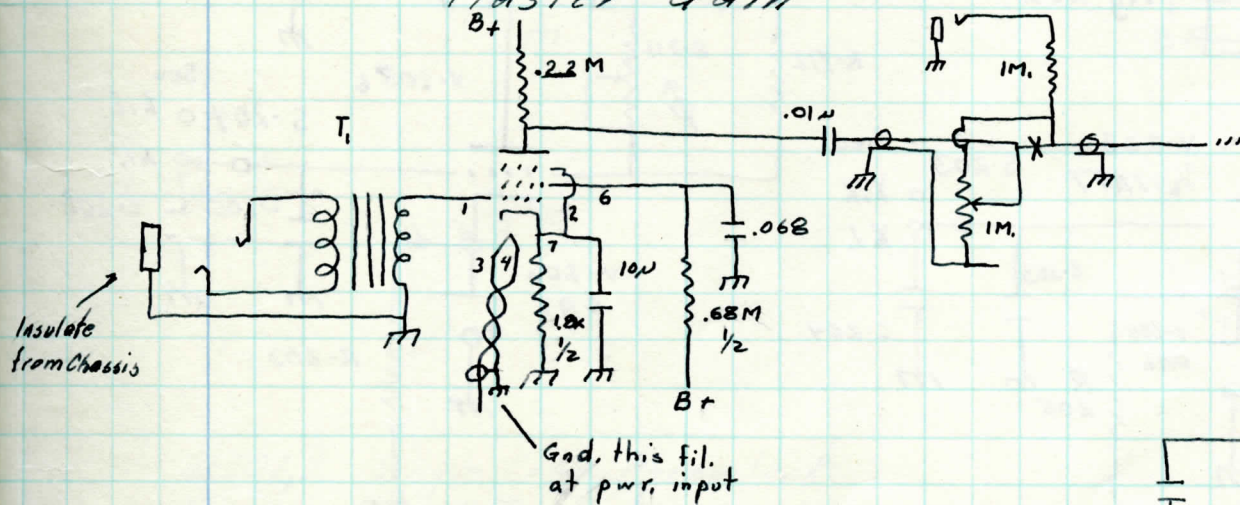
Input 2 - 50K Ω 1 V max

Output 1 - 8 Ω 1 W min.

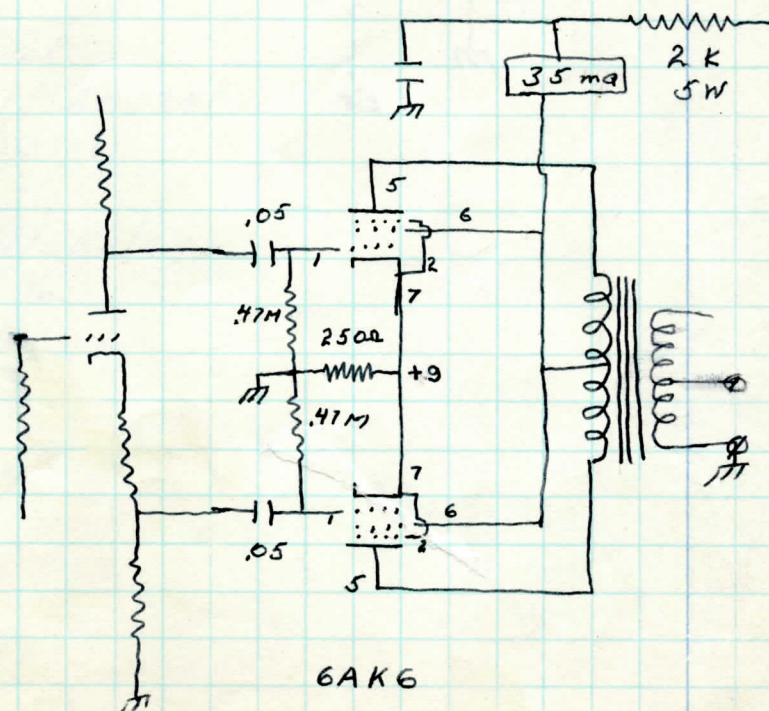
2 - Phone

Controls: Gain for Input 1 Spkr off

Master Gain



Use single ended -
See P-54



Legend

Chassis - 100

Timer - 200

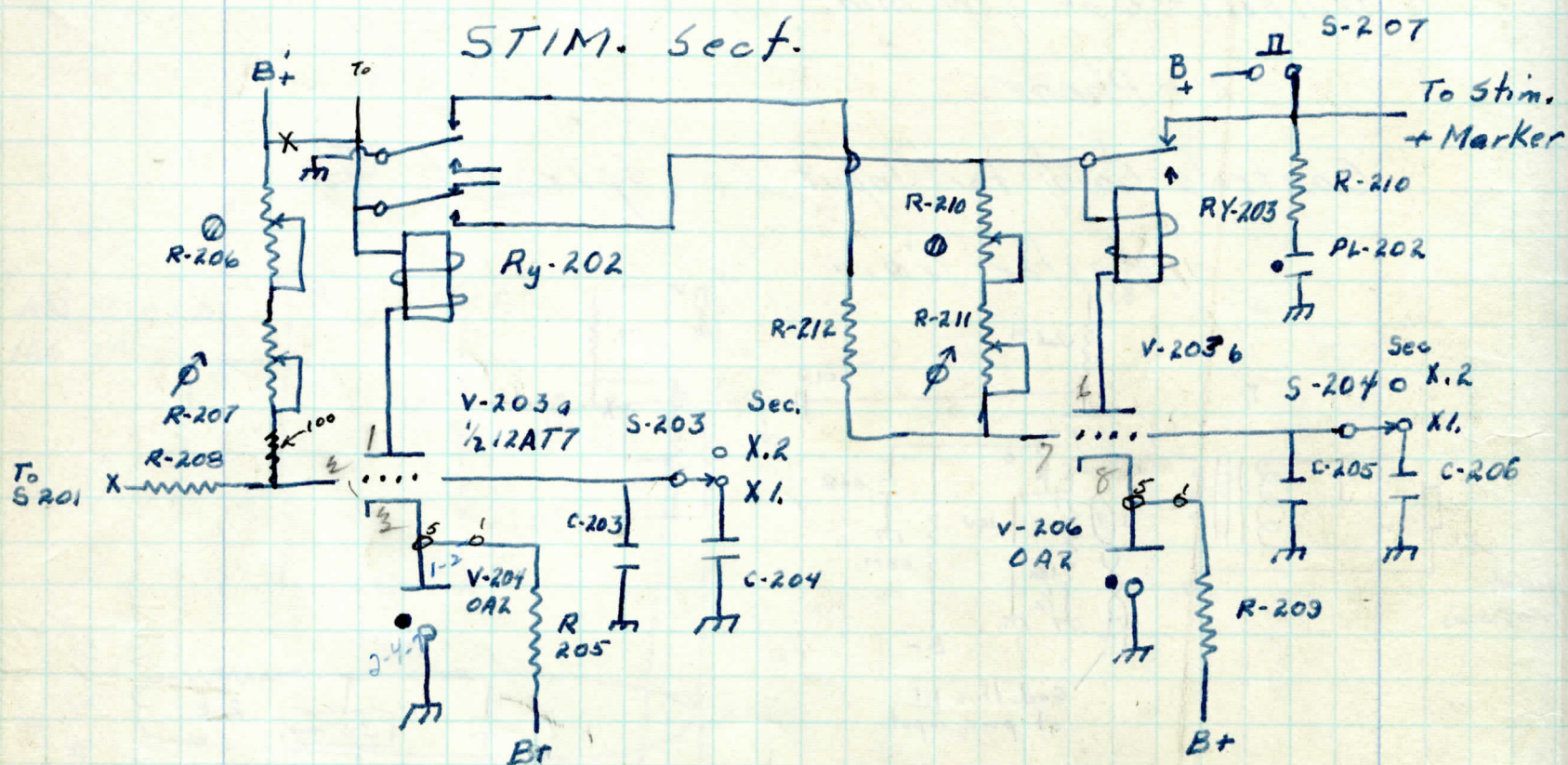
Binaur. Bal. - 300

W. Noise - 400

Monitor - 500

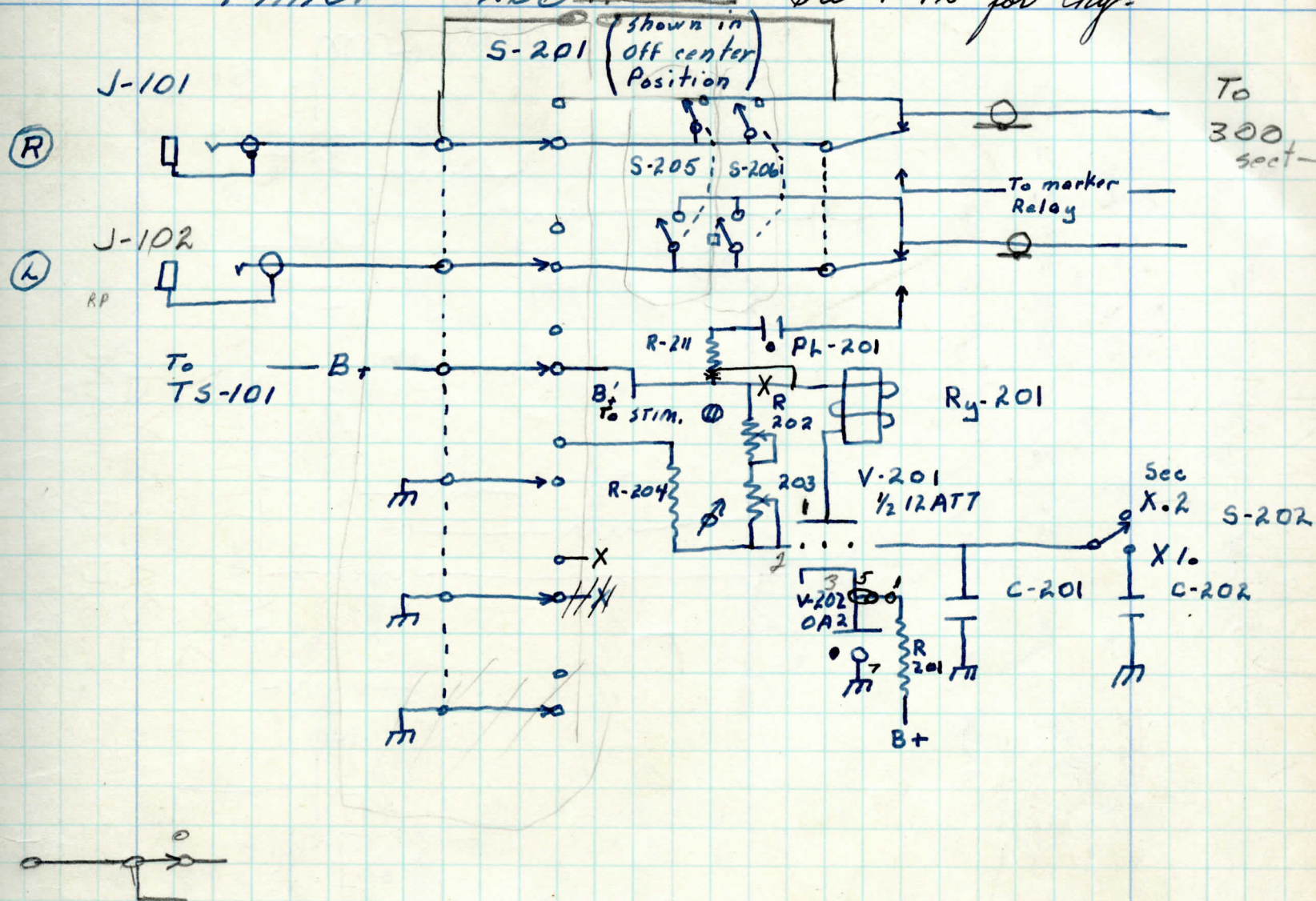
Timer - 200

5T1M. Sect.

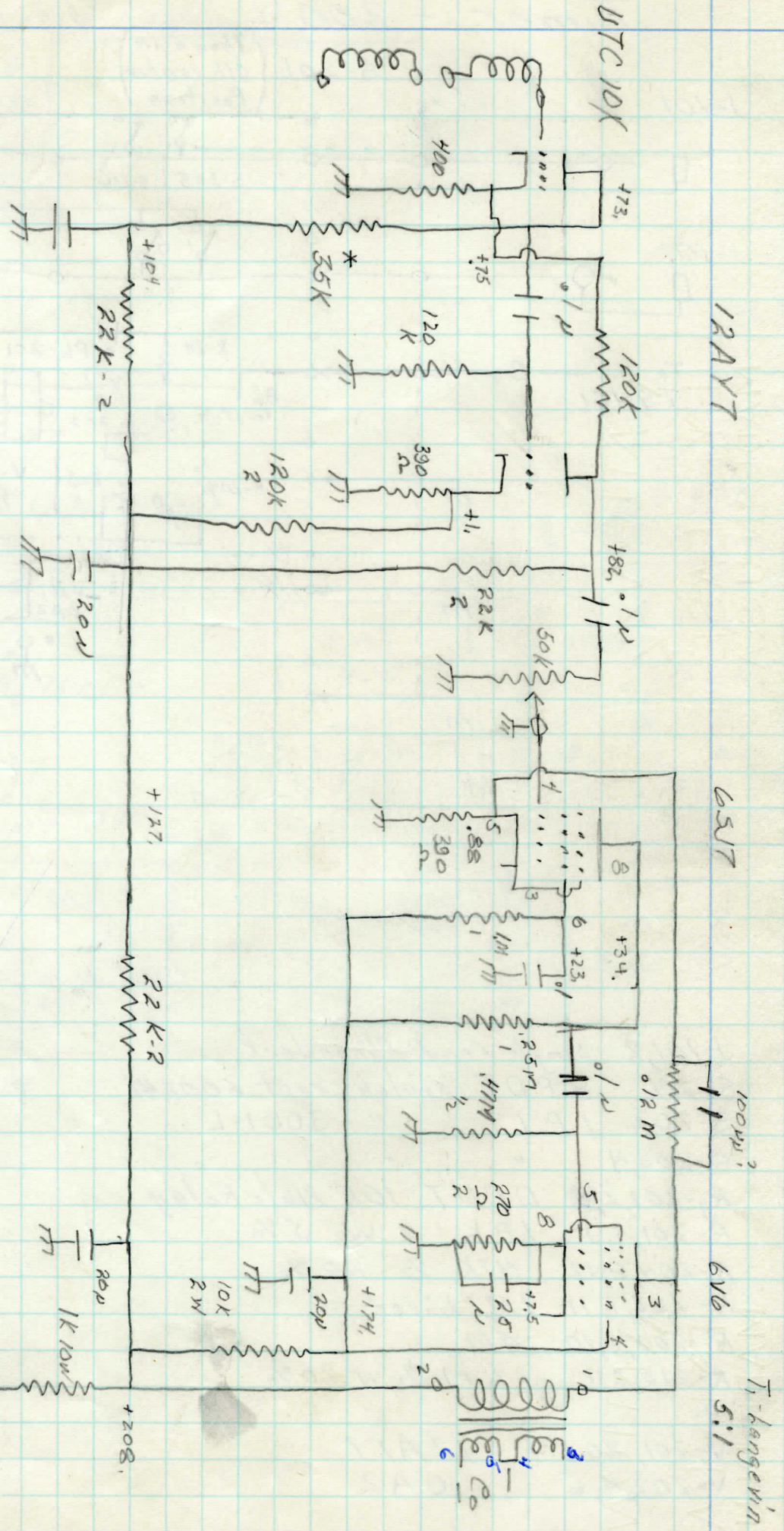


Timer - 200

See P. 72 for Chg.



- J-101,2 Single Cond. Phone Jack
 S-201 8 PDT switch craft 60024L
 S-202 1 P 1 T " 3001-L
 S-203,4 " " "
 R_y-201,2 DPDT 10K Plate Relay
 R-201,5,9 18K 2 W 5%
 R-204,8,12 47K 1/2 20%
 R-203,7,11 1M Linear
 R-202,6,10 5M "
 R-210,211 .22 M 1/2 W 20%
 R-
 V-201, 203 12AT7
 V-202,4,6 6AR5



$E_0 \approx 6V6$ Grid Shorted - openckt E_{mv}

$$E_0 = 2mv \text{ RMS } \approx 270\Omega / \text{load}$$

$$W = \frac{E_0^2}{R} = \frac{(2 \times 10^{-3})^2}{2.50} = \frac{4}{2.5} \times 10^{-6} \approx 2 \times 10^{-6}$$

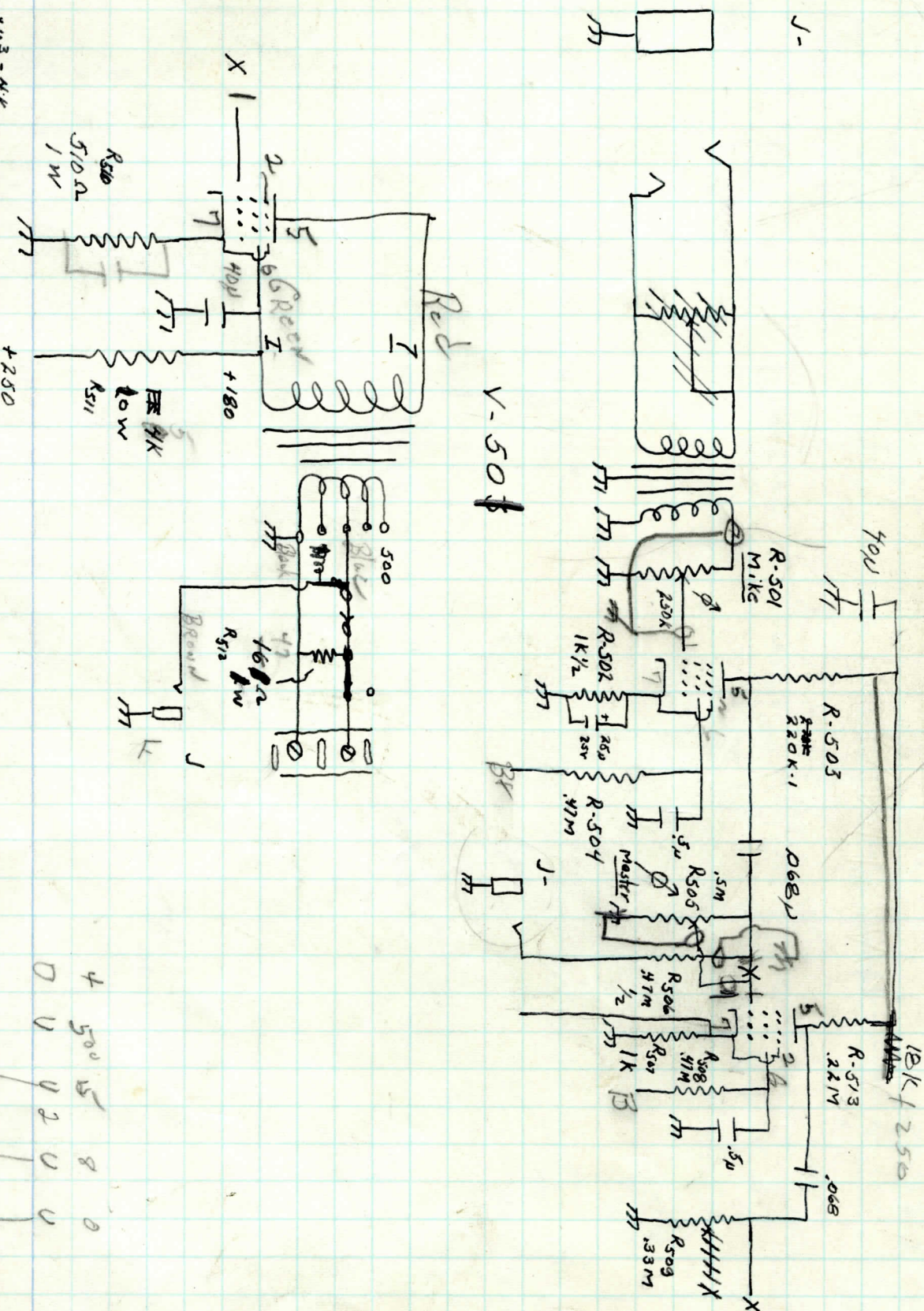
$$\frac{2}{2 \times 10^{-6}} = 10^6 = 80dB$$

For 5KHz $\frac{5 \times 10^3}{(5)^2} = \frac{5}{25} \times 10^3 = .2 \times 10^3$

Monitor Amp - 500

$$R_{511} = 70 \times 10^3 = 7K$$

$$17.5 \times 10^{-3} \times 7110^6 = 44.5$$



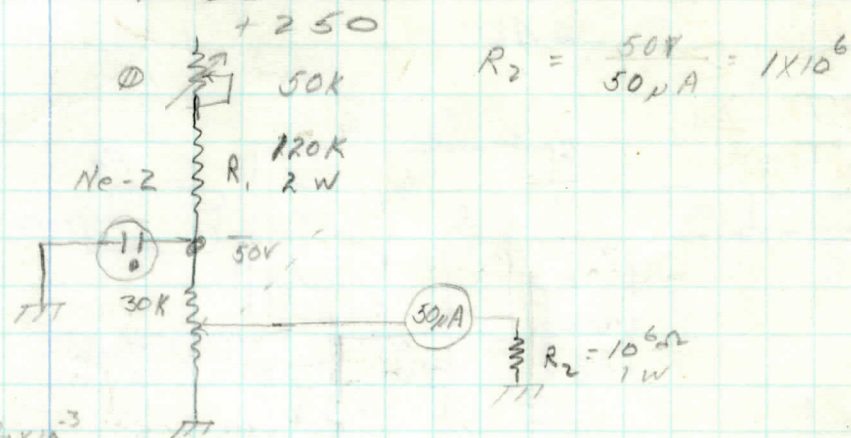
4 500 8 0

0 0 0 0 0

Bk Br Black

Balance Indicator

Basic ckt.



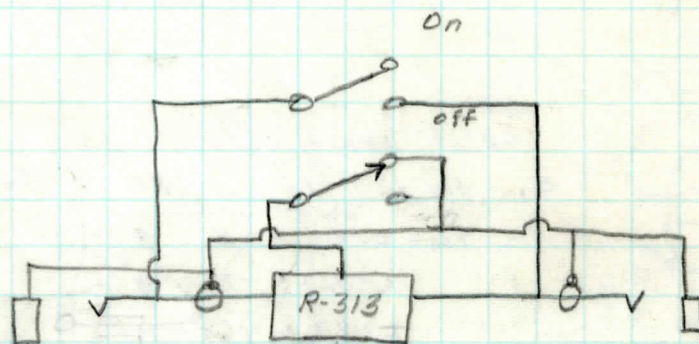
$$I_s = \frac{250 \times 10^{-3}}{150}$$

$$1.66 \text{ mA}$$

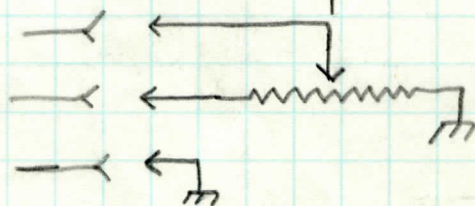
$$W = 2 \times 10^{-2} \times 2.5 \times 10^2$$

$$R_1 = 5 \times 10^{-1} = \frac{1}{2}$$

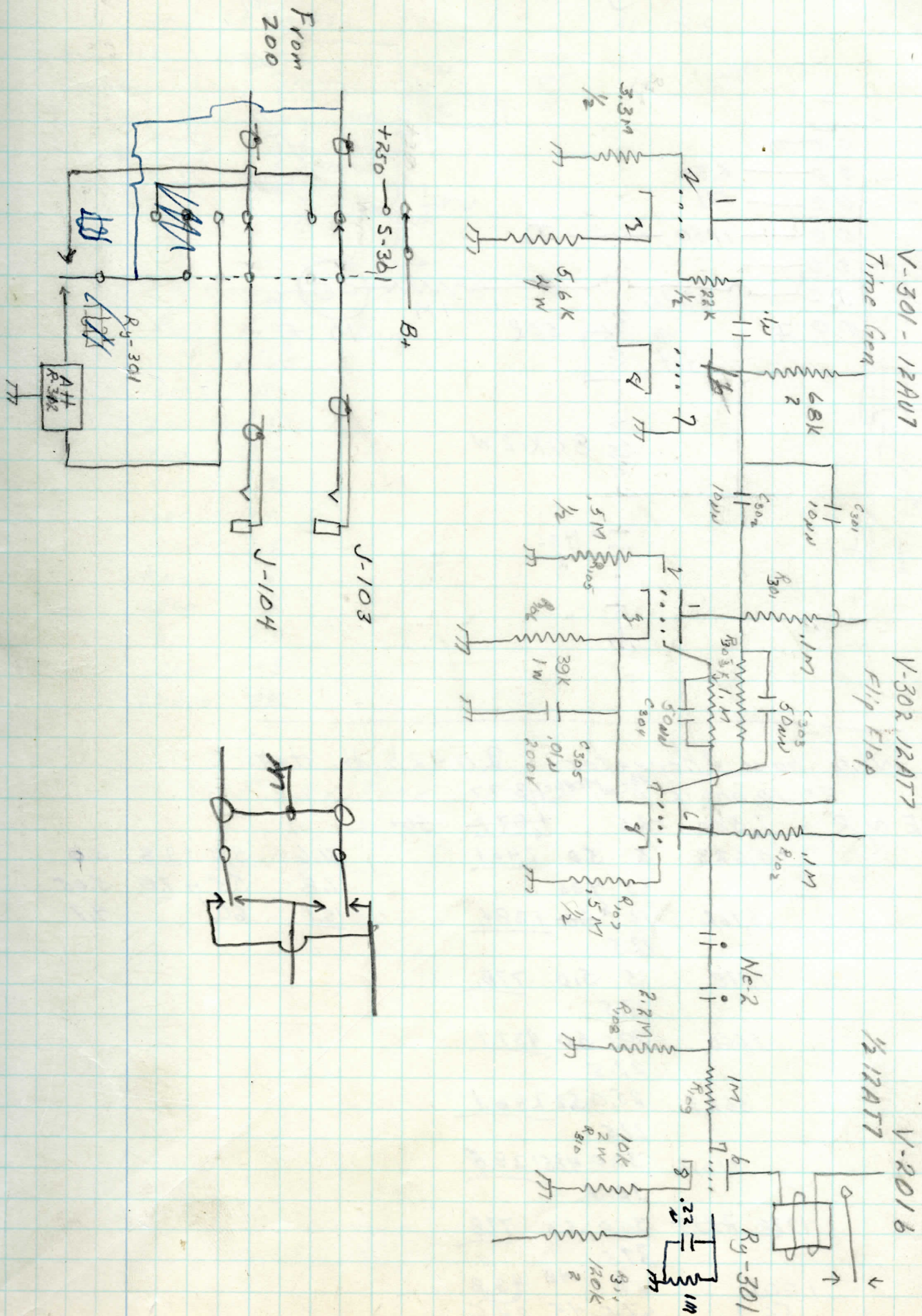
100K



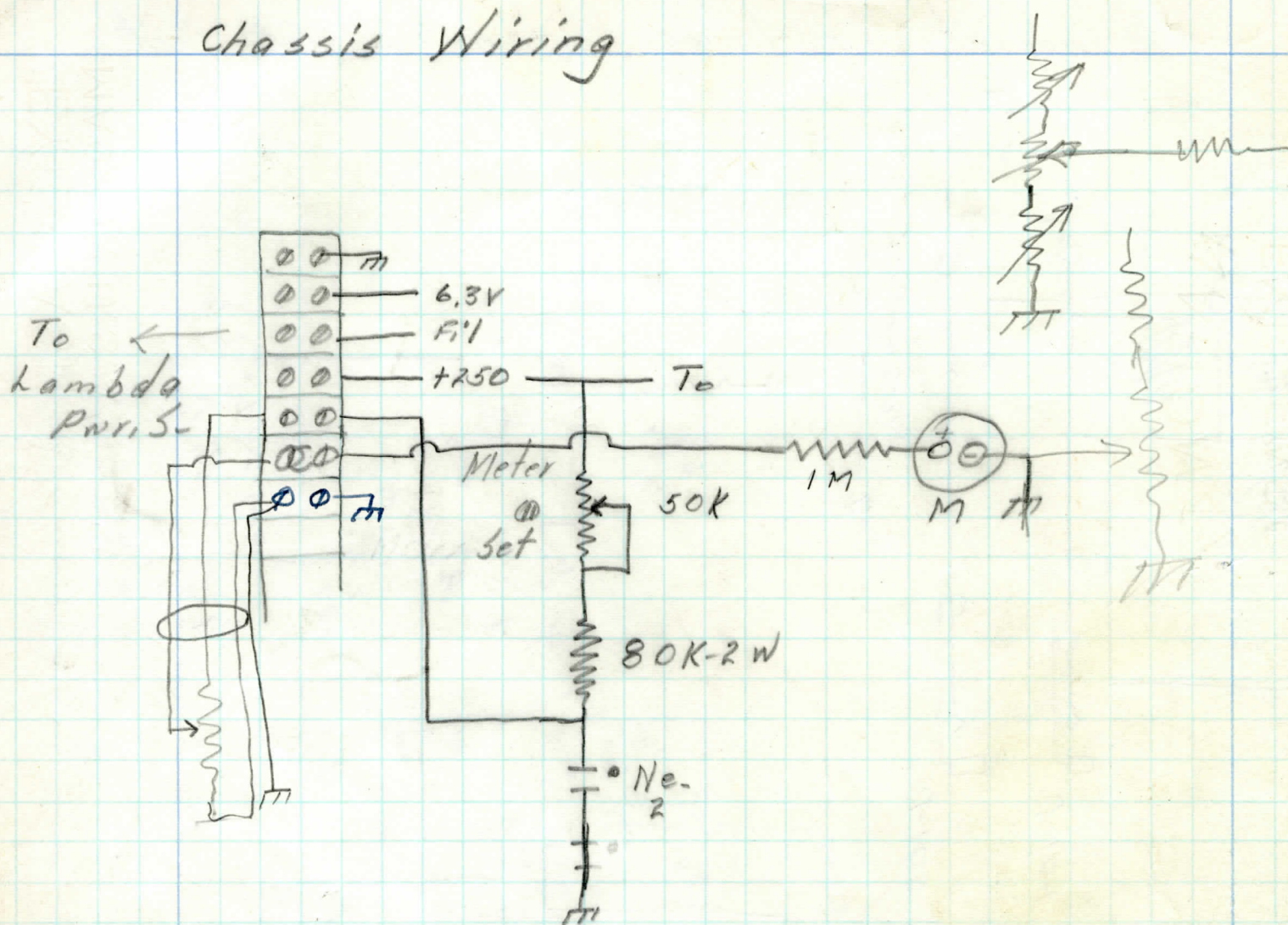
P-301 J-301



Binaural Loudness Balance - 300 sec



Chassis Wiring

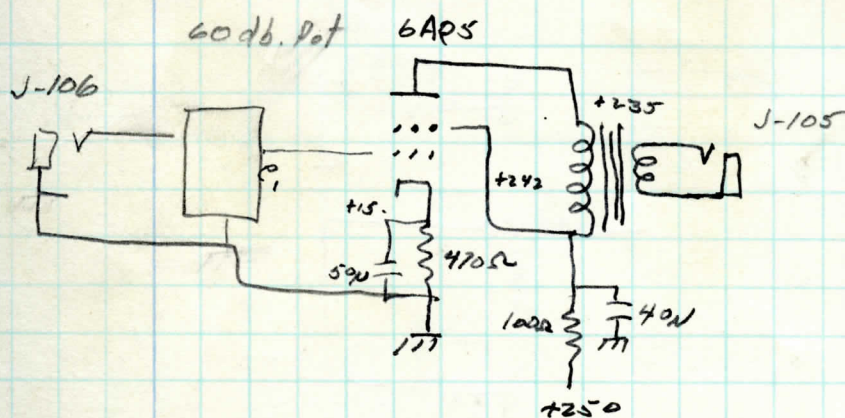


White noise Attenuator - 20 - 2 1/2 db. steps.

		$Z = 10,000 \text{ K}$		$\text{Mean } 4.377$			
E ~ R	7,500	-2.5		1.877	50		
	5,623	5	5.0	2.461		31.6	50 13.8 5.0
		7.5	4.95			17.8	55.7 7.8 5.05
	3,162	10	5.0	1.384		10.0	60. 4.7
		12.5					
	1,778	15	5.0	778.			
		17.5					
	1,000	20.0	5.0	437.7			
		22.5					
	562.3	25.0	5.2	246.1			
		27.5					
	316.2	30.0	4.85	138.4			
		32.5					
	177.8	35.0	5.3	77.8			
		37.5					
	100.0	40.0	4.8	43.8			
	56.2	42.5	4.5	24.6			

*Hp VTVM +
HK Sig. Gen.
at 2 KC

Audiometer - Rear Panel



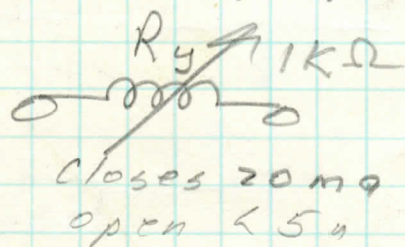
At 1Kc

 $e_{in} = 5.3 \text{ v RMS}$

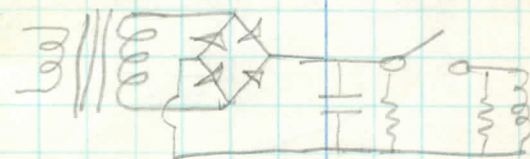
$$\frac{(4.1)}{10} = 1.68 \text{ W}$$

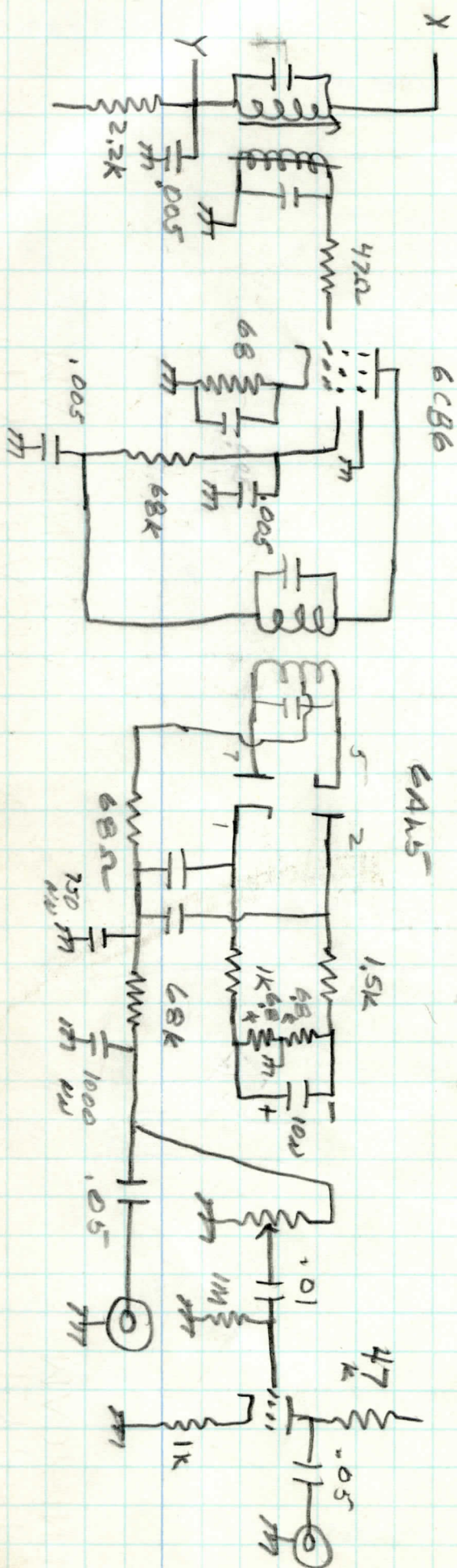
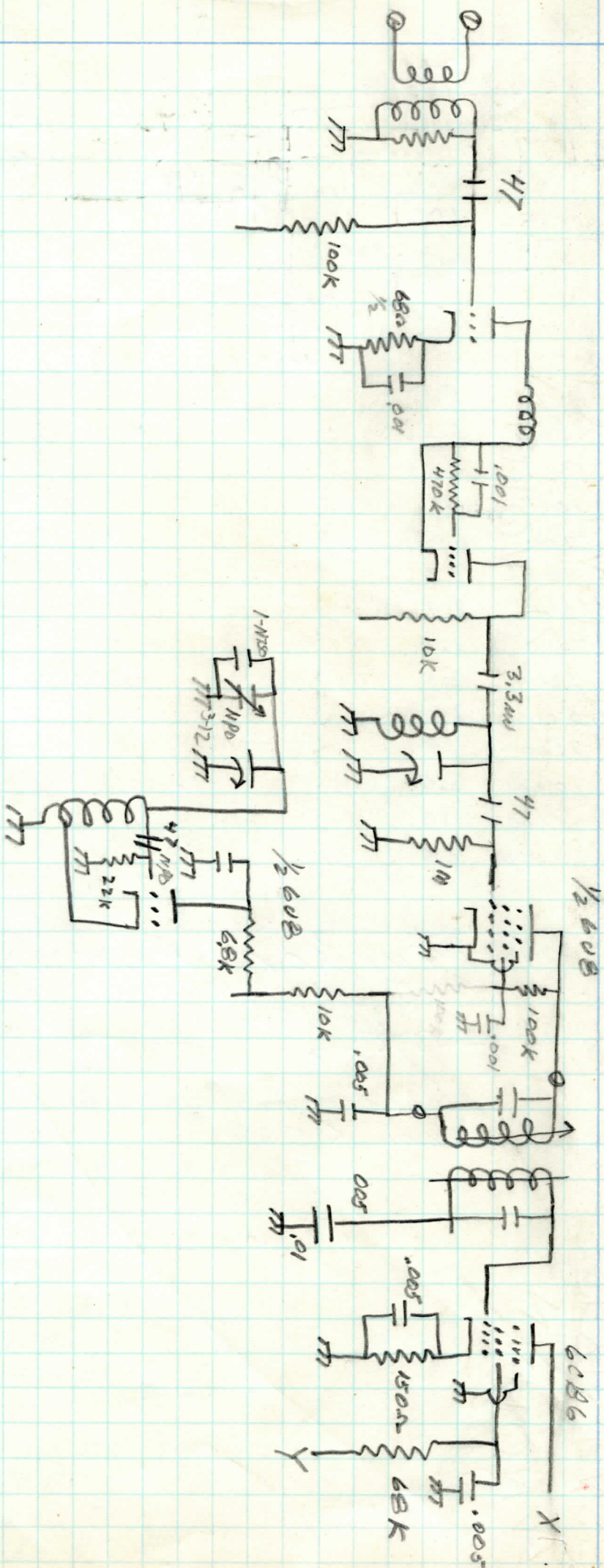
f_{req}	E_o	E_{in}
30	0.565	
100	1.07	
200	2.55	
400	2.3	
800	2.7	
1600	3.0	
3200	2.5	
5000	2.6	
7500	2.8	
10,000	3.0	
15,000	3.3	
20,000	2.8	

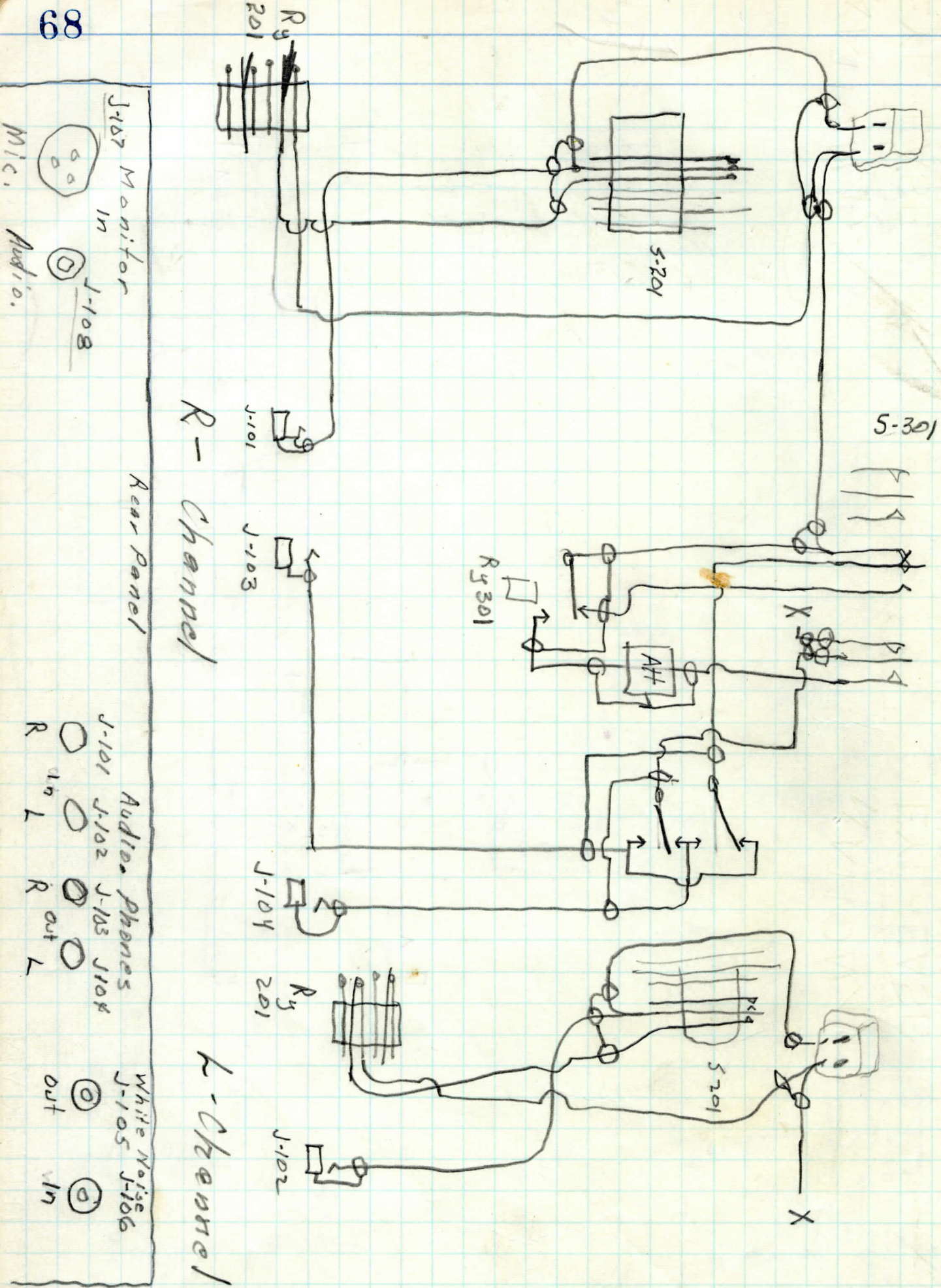
Pwr for Marker For E. Angus



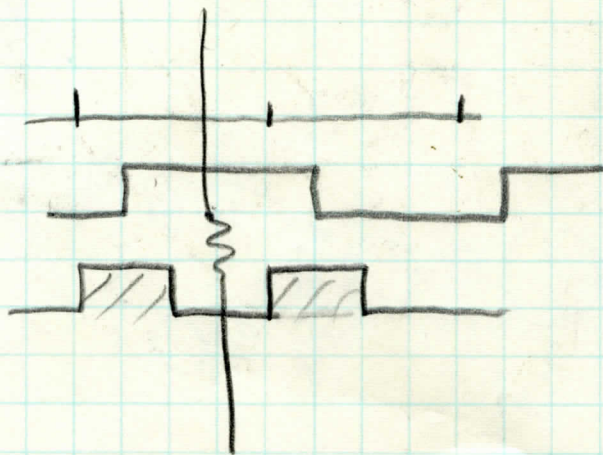
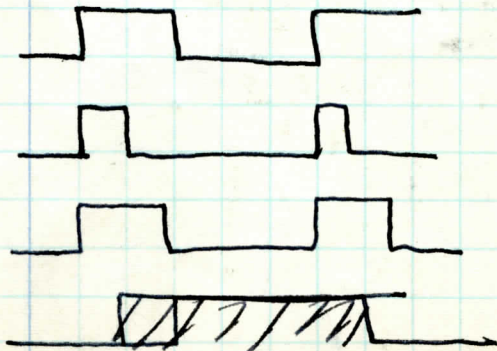
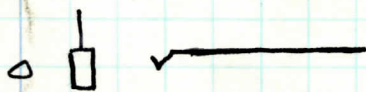
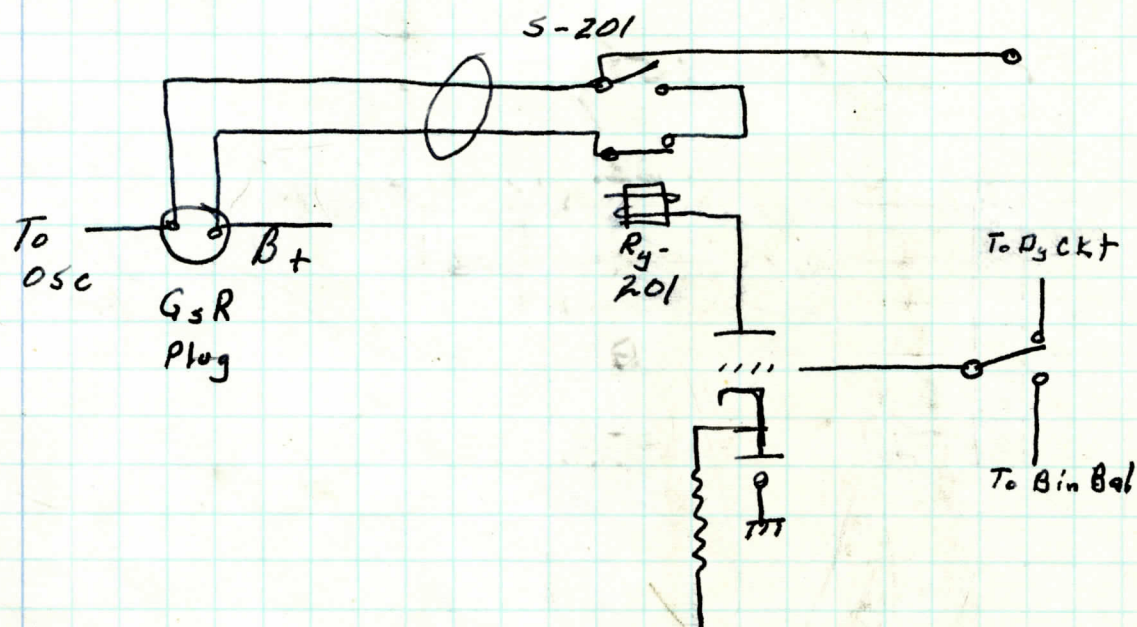
20V





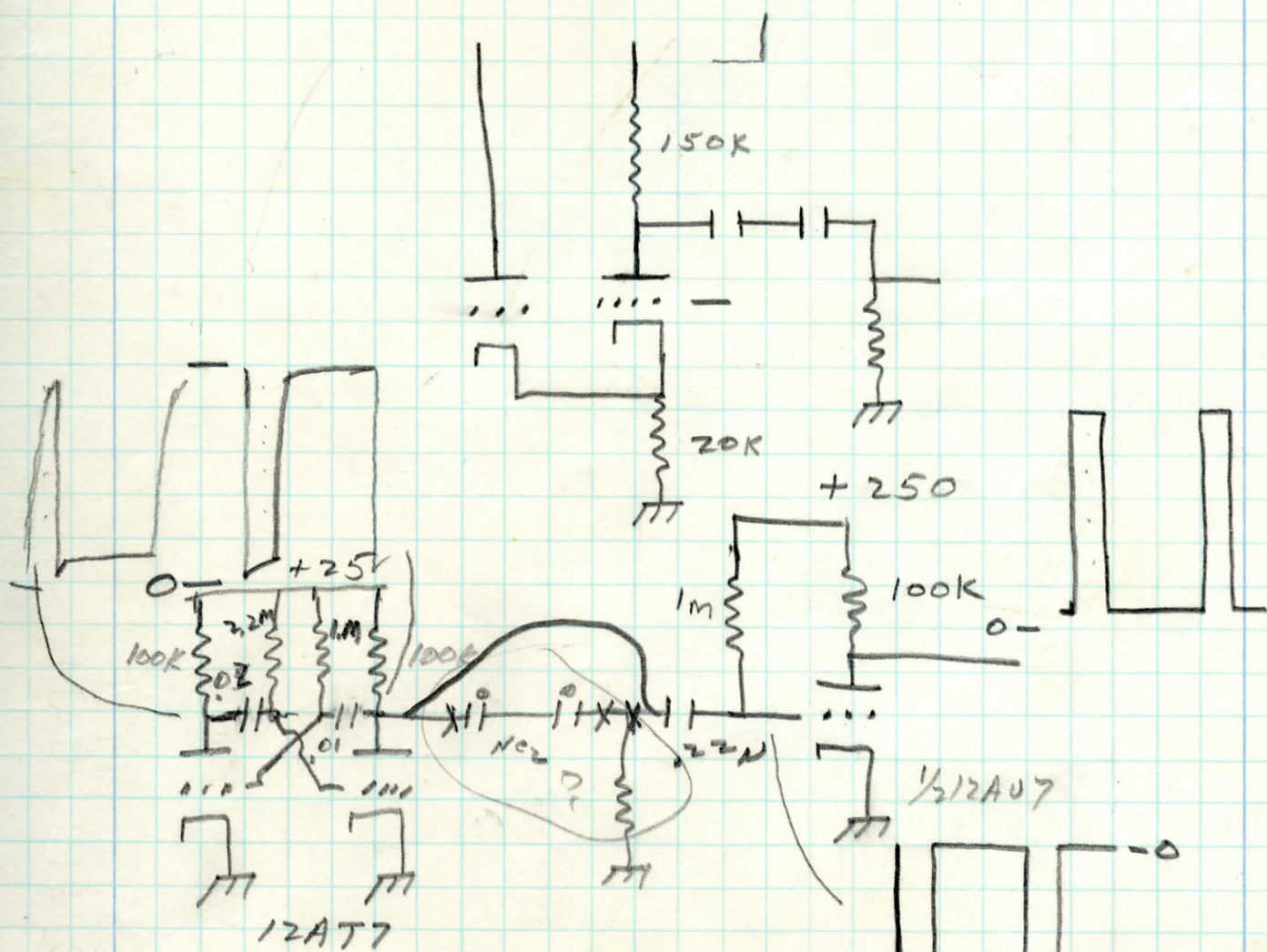
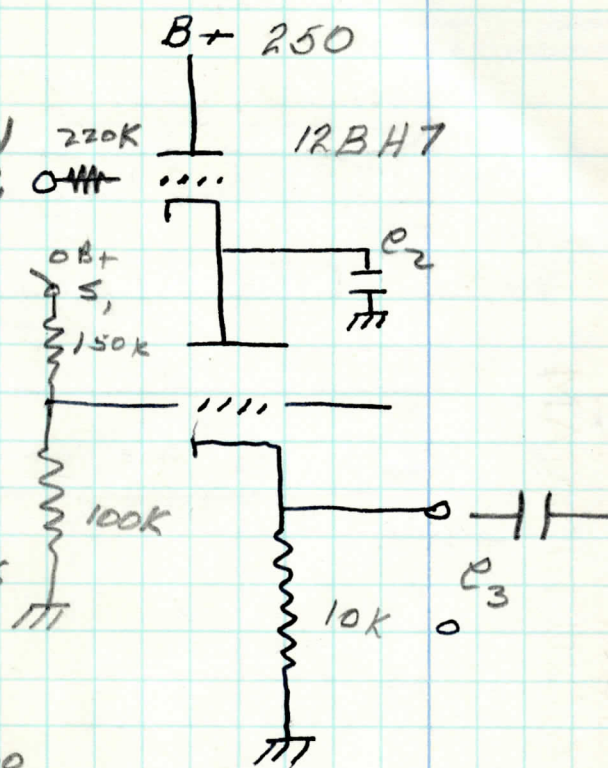


In order to overcome rise time problems & eliminate any possibility of switching transients revise the previous tone interrupt and linear bal. ckt as follows -



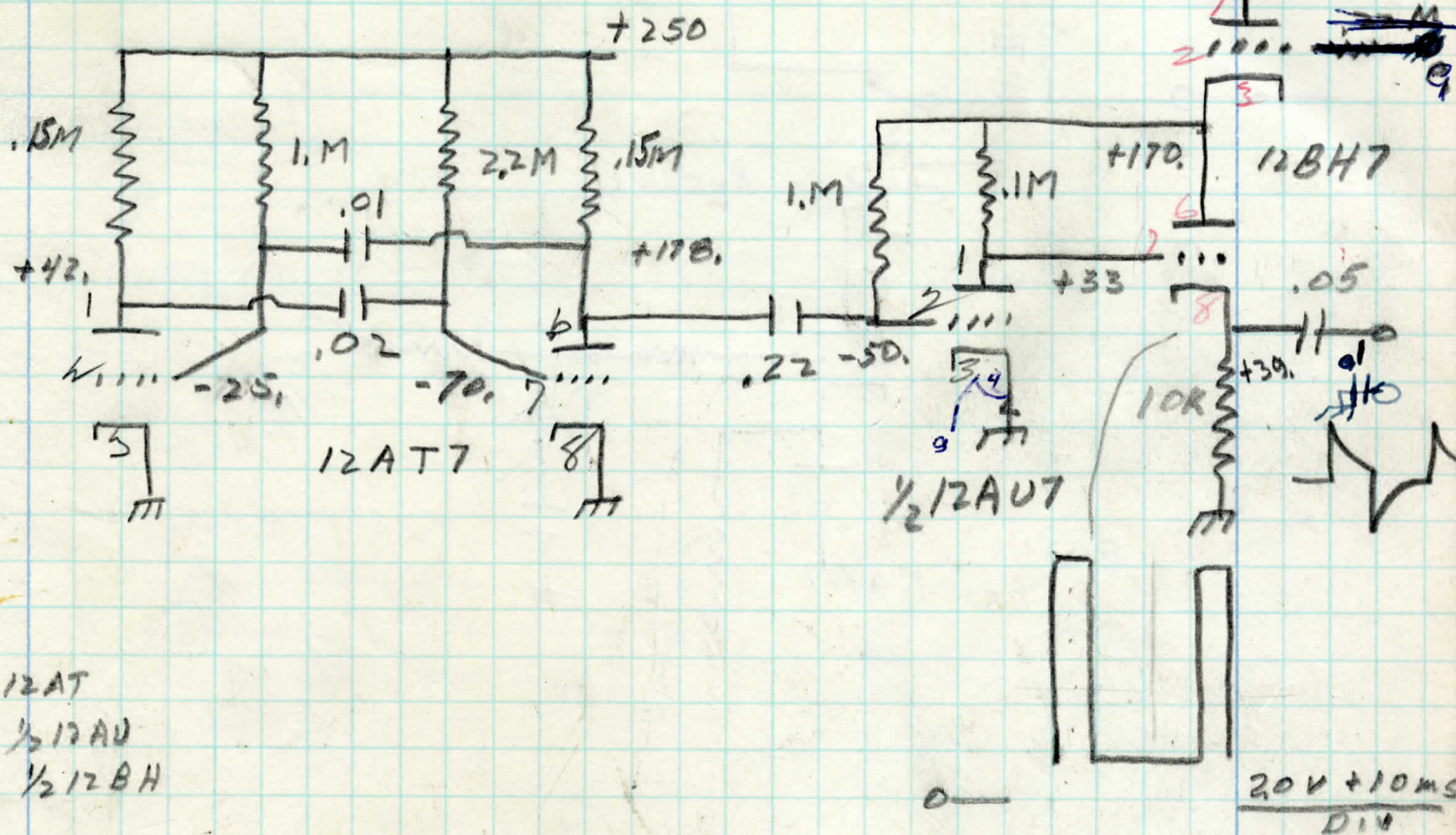
~~Delay Uni Vis -~~ 5t, in -

Volts D.C.		S_1 open S_2 closed	S_1 closed S_2 open
e_1	e_2 S_1 open	e_3	e_3'
0	+17.5	+1.35	15.5
30	+45.	+3.0	+36.
60	71.	5.	+52.
90	99.	7.	+69.
120.	127.	8.	+85.
150	155.	10.	+90.
200	200	12.	+95.



All wave forms 50 V/div. V_1 + 10 ms/div. H_1

Proto type stim -

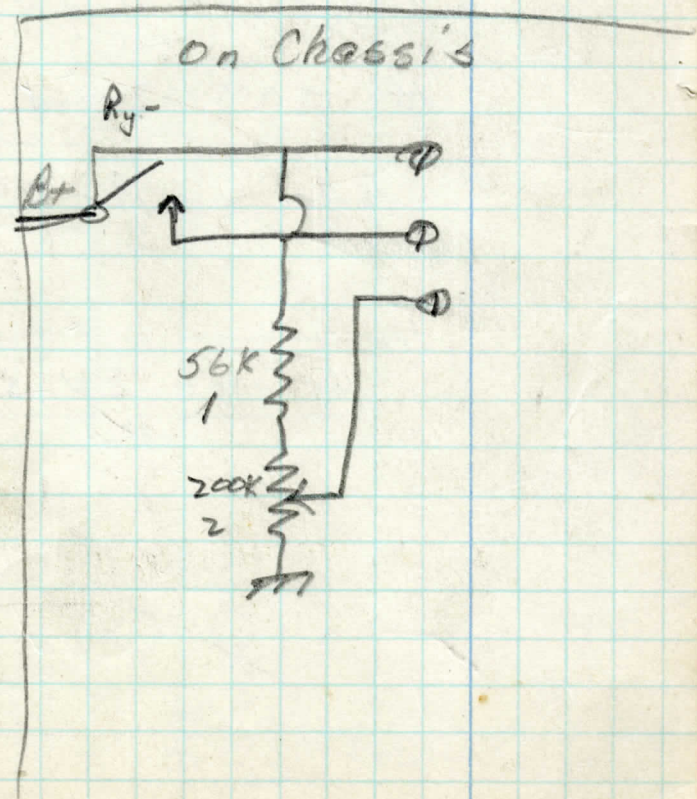
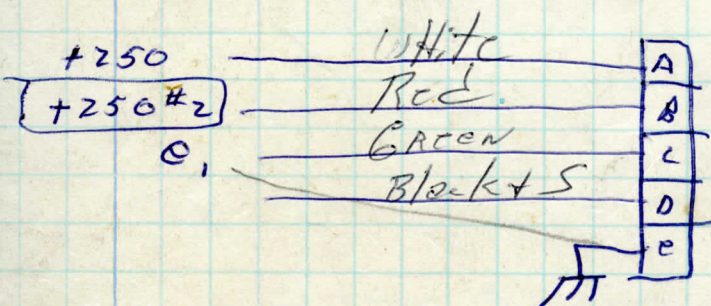


Fil

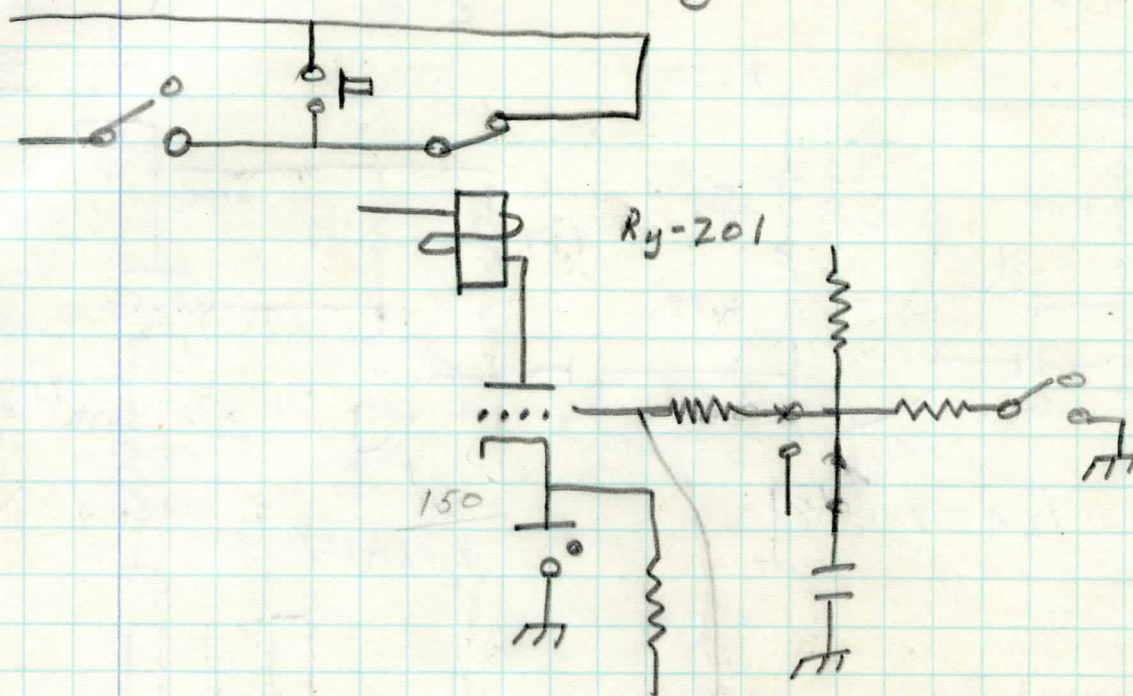
- .3 12AT
- .15 1/2 12AU
- .6 1/2 12BH



to file in 11



Revised CK try - For Audio Switching



2-Relay

o 1 ry + 4P DT 5W

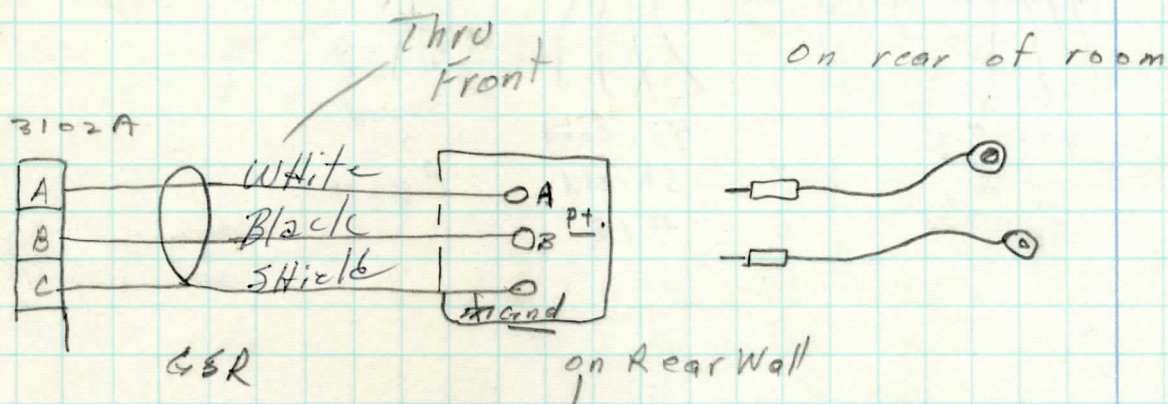
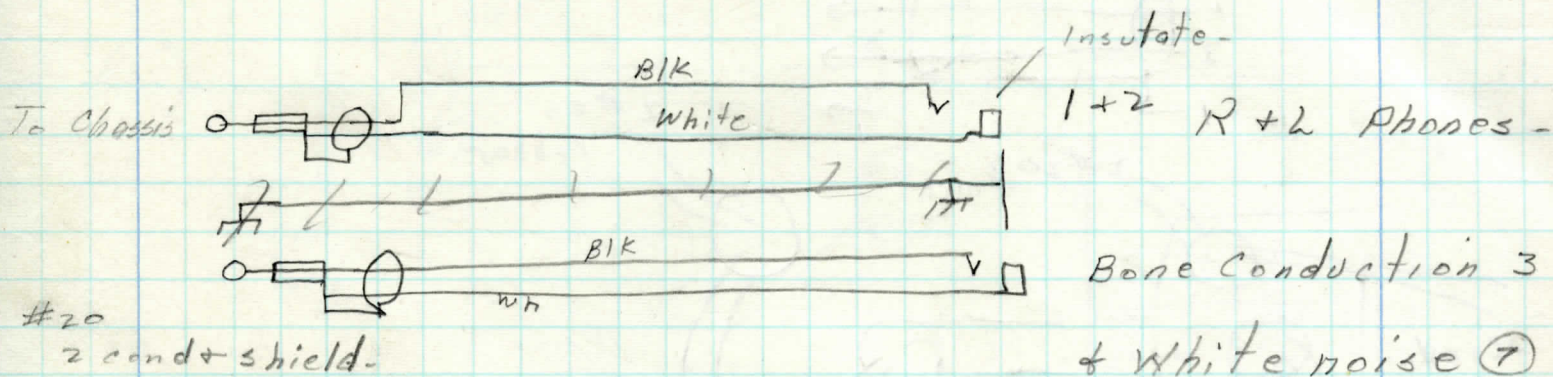
16 50' 3 cond shielded

4 Diodes 3A-50V

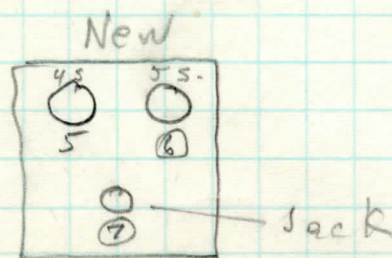
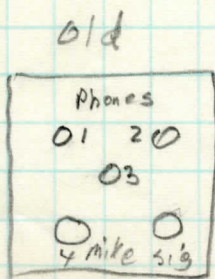
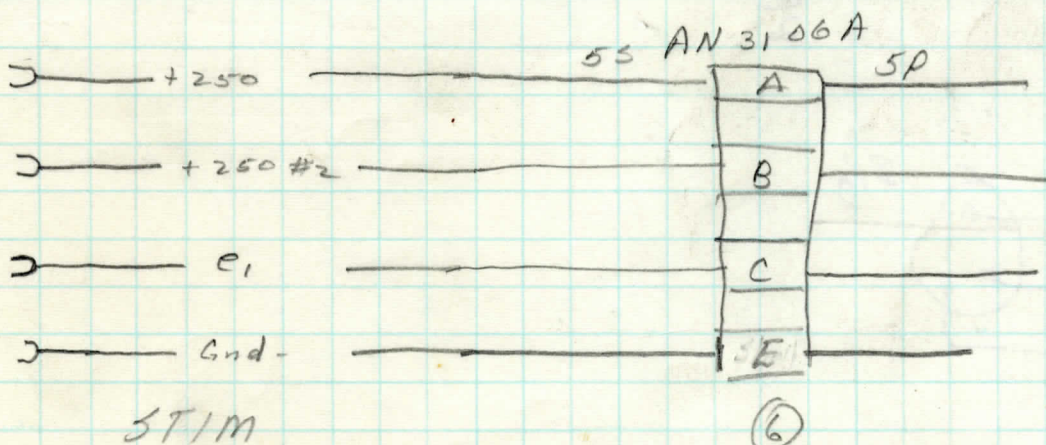
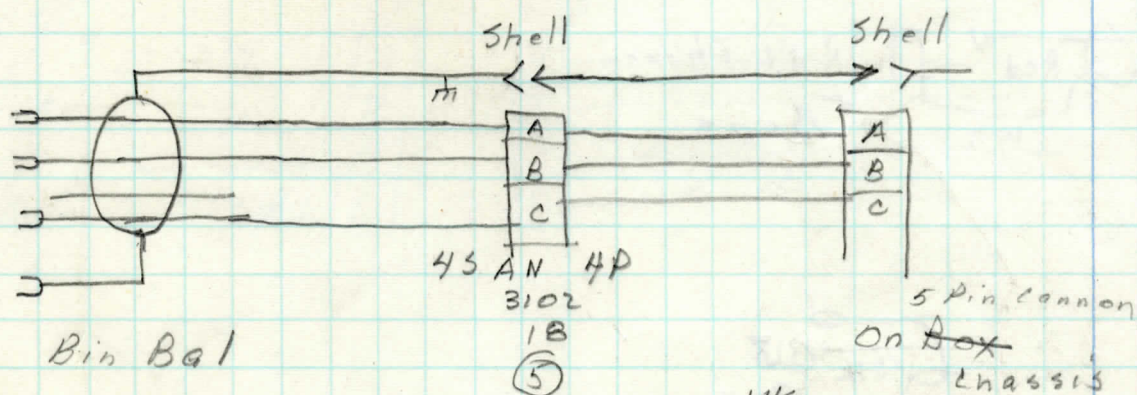
Iron -

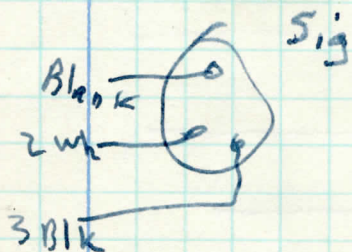
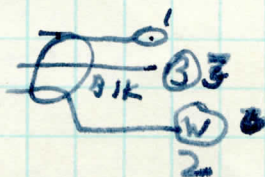
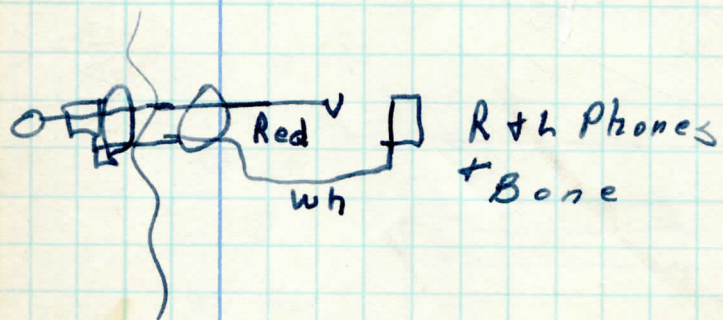
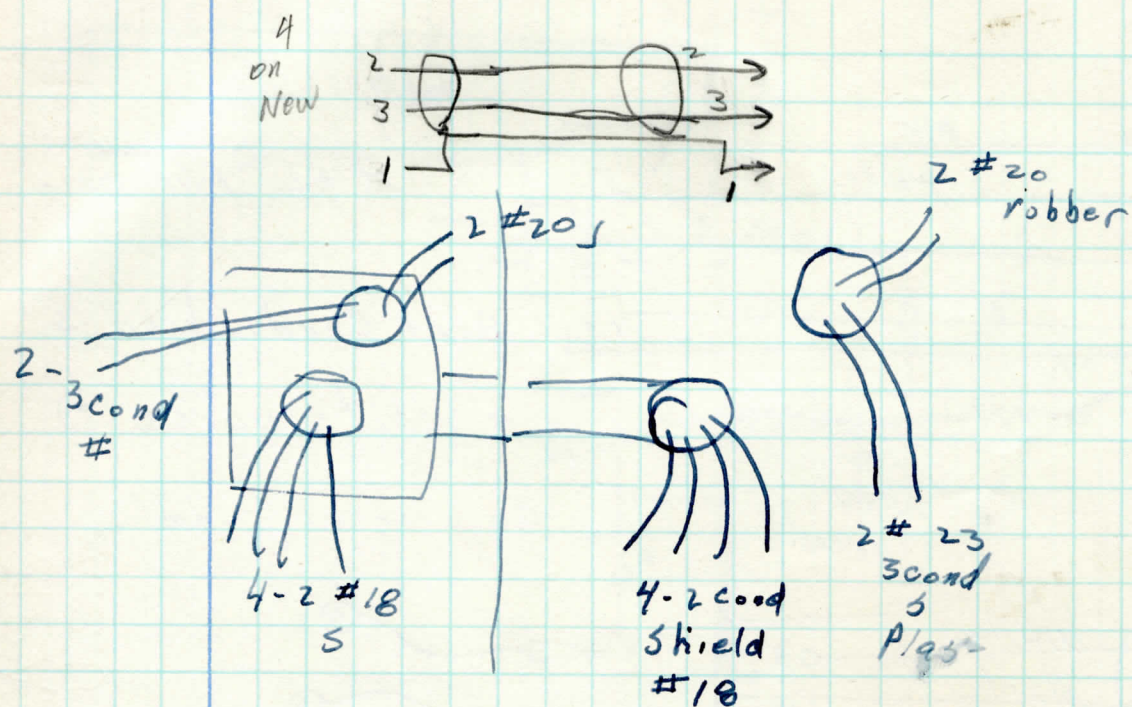
Hexacon 24 5-Tip

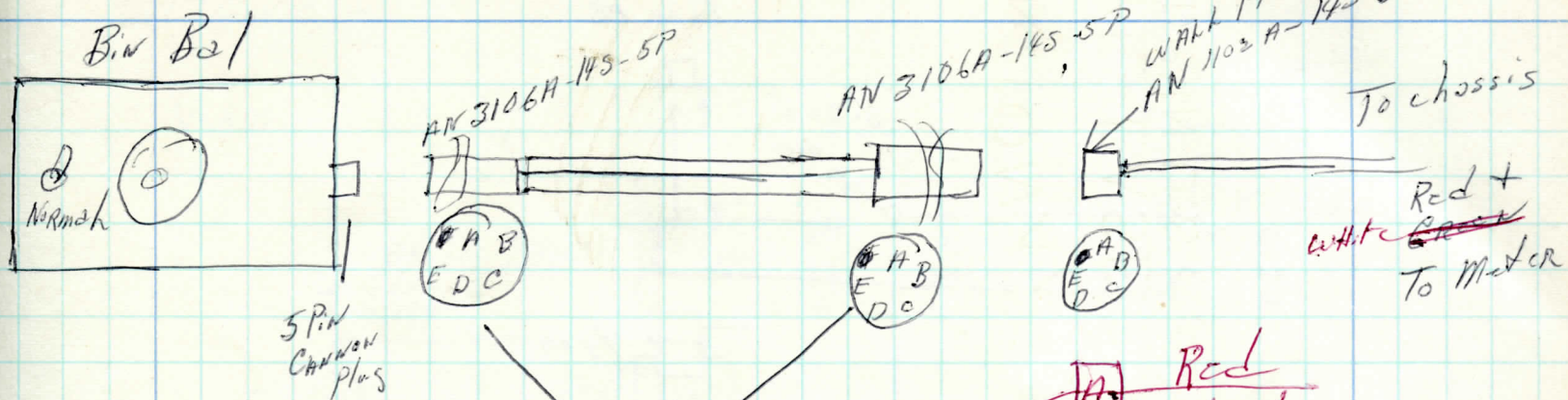
Wiring



Red + Green to Meter







A Red
B Black
C GREEN
D White
E Shield

A Red
B Black
C White
D Shield
E Shield

Red +
White ~~Green~~
To Meter

ST/M

+250

+250 ±2

e1

SAH

White

Red

GREEN

Black & Shield

A

B

C

D

AN 3106A-18-4P

AN 3102A-18-4S

A

B

C

D

White

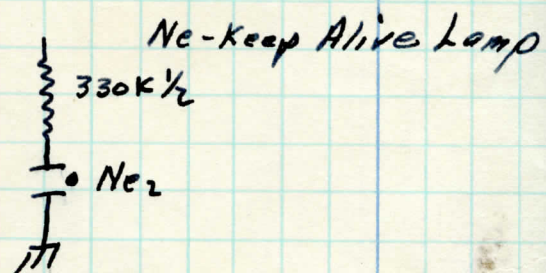
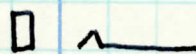
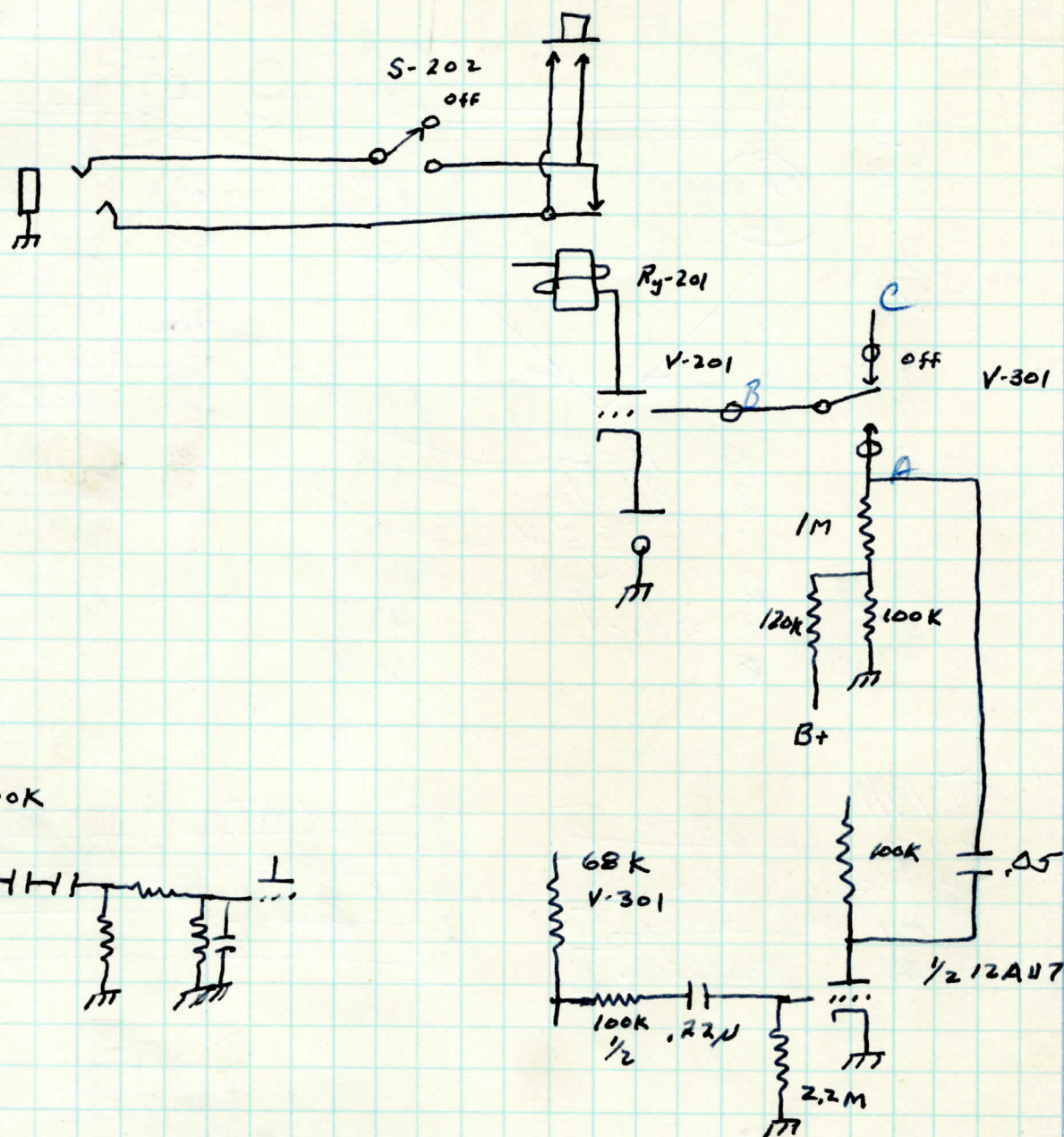
Red

Black

Shield

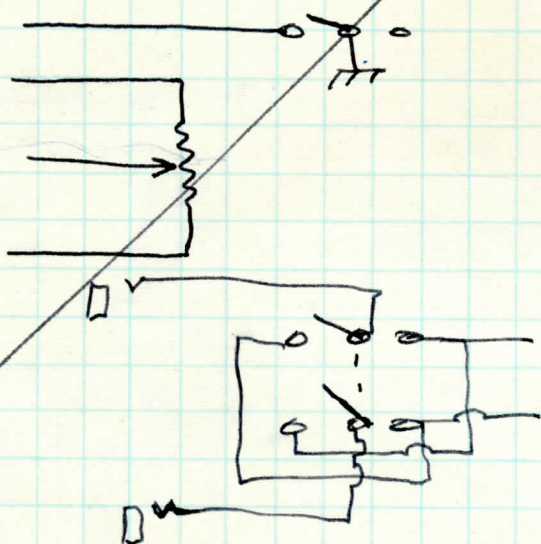
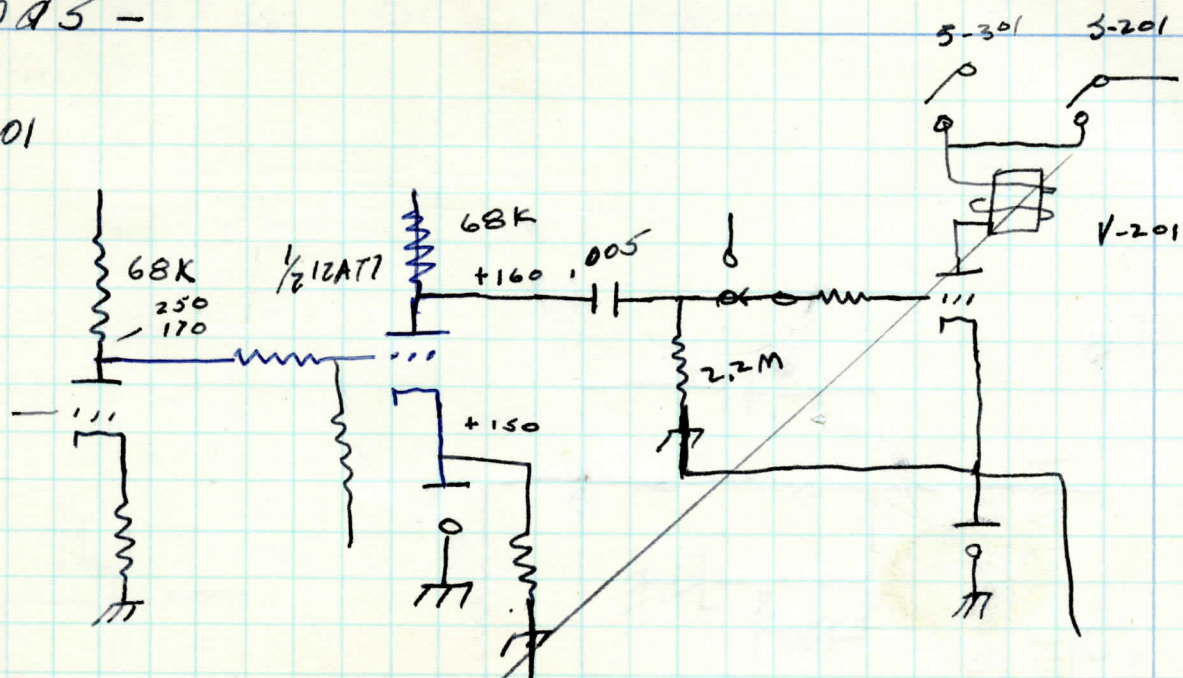
To chassis

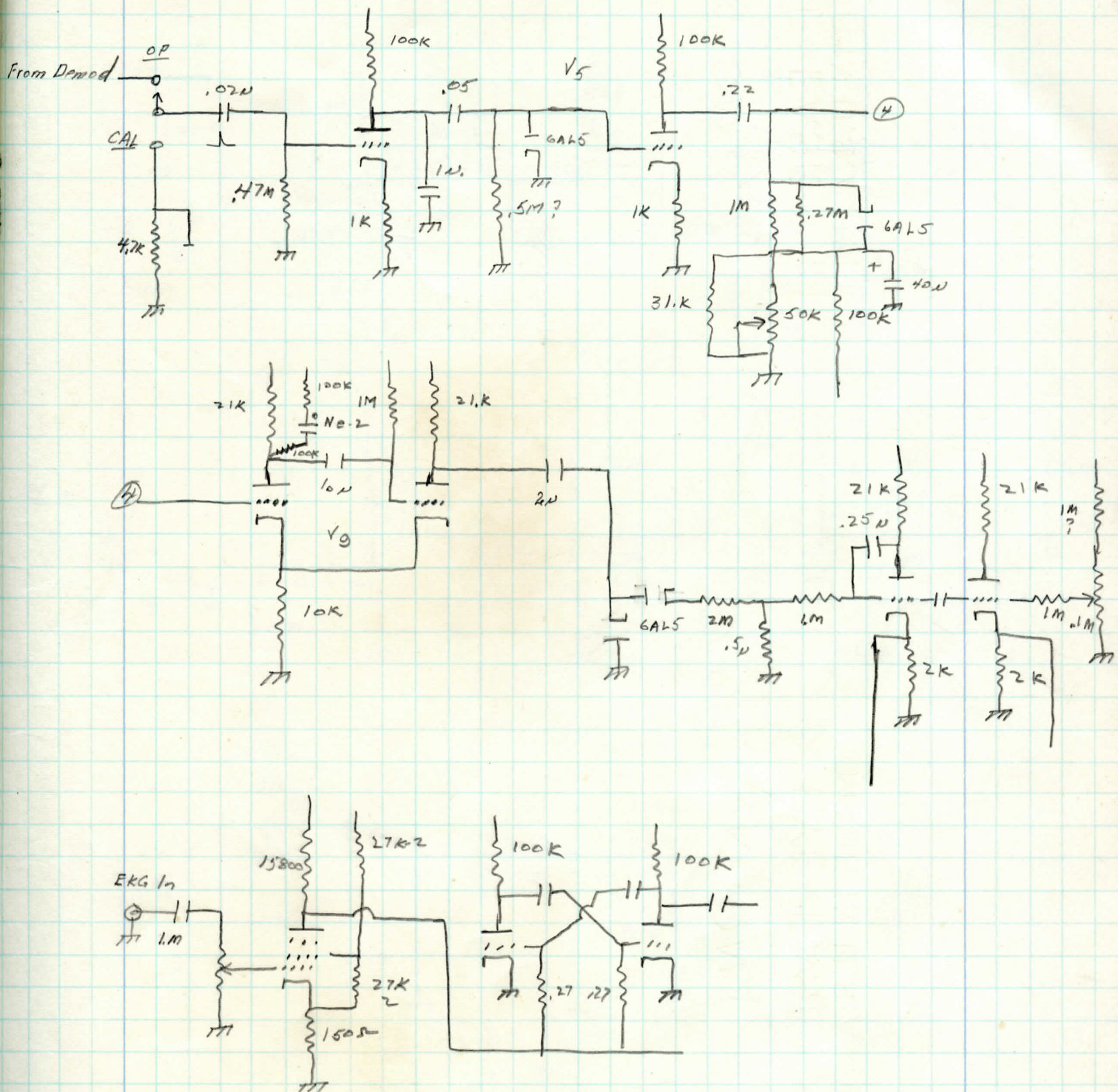
Tone PB



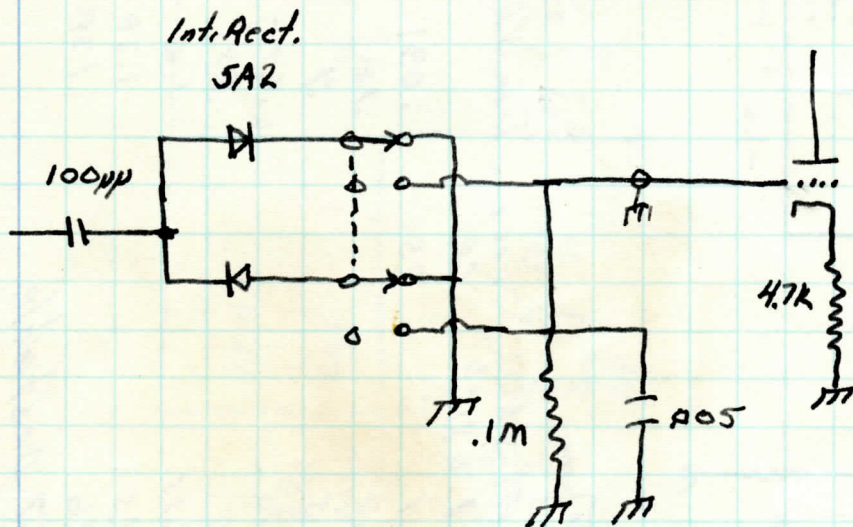
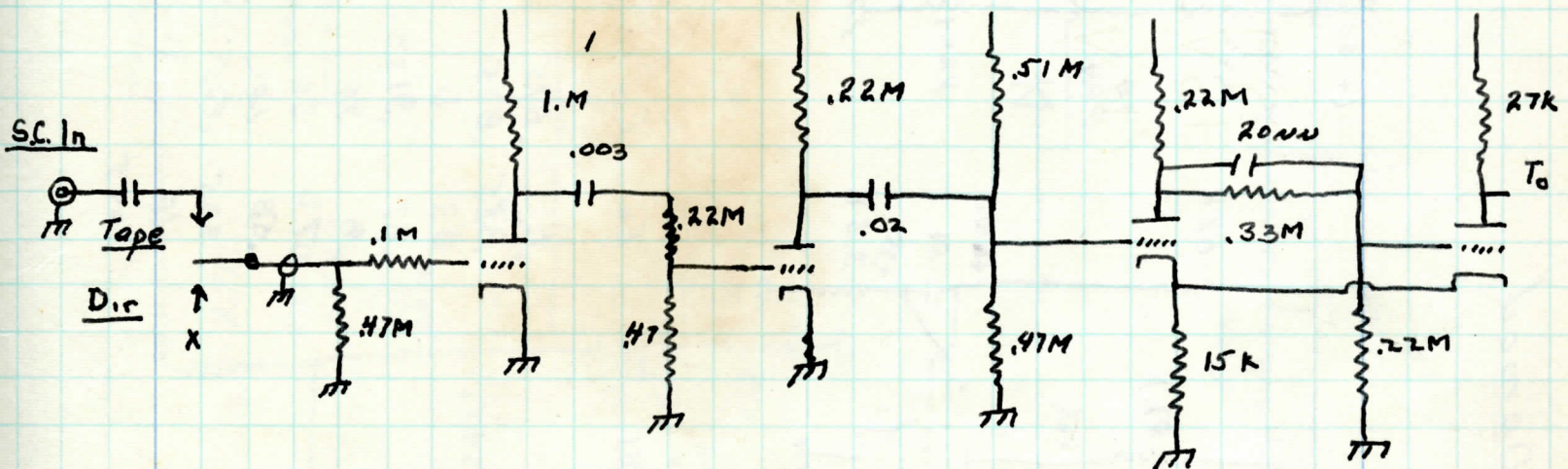
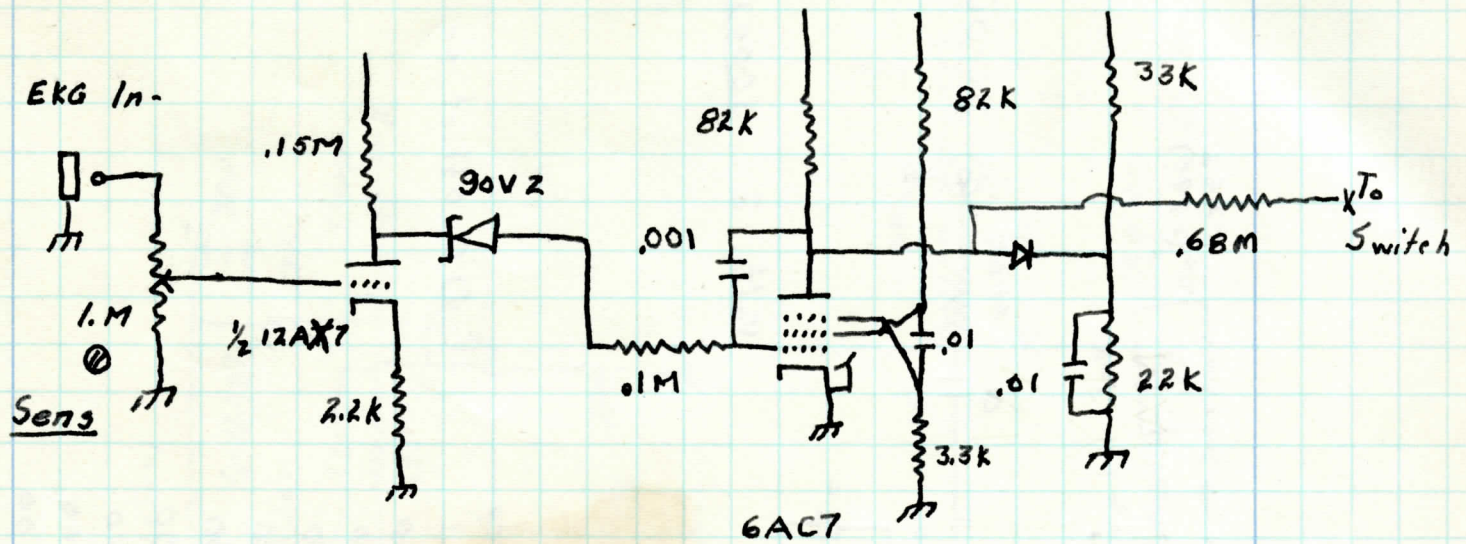
Mods -

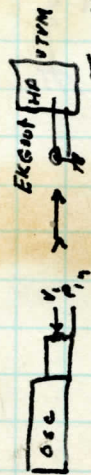
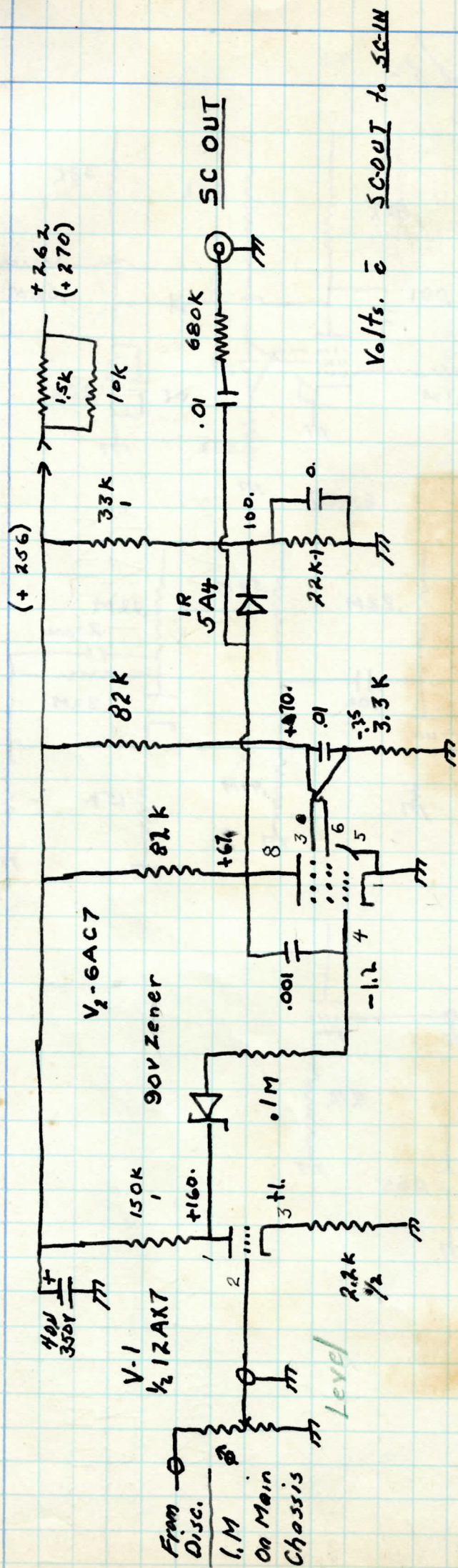
V-301





Cornell MKI Mods.





Noise Gain May

$$E_0 - V_{RMS}$$

Freq

E in VRMS

79

42

Free

1. 2×10^{-3}
.
.2
.5
.75
1.
1.25
1.5
1.6
1.7 unstable

25 cps

160.

1.

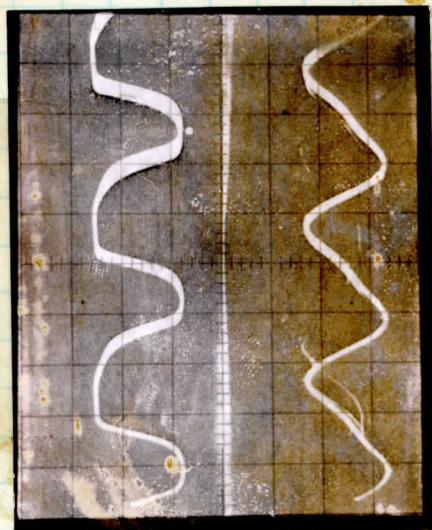
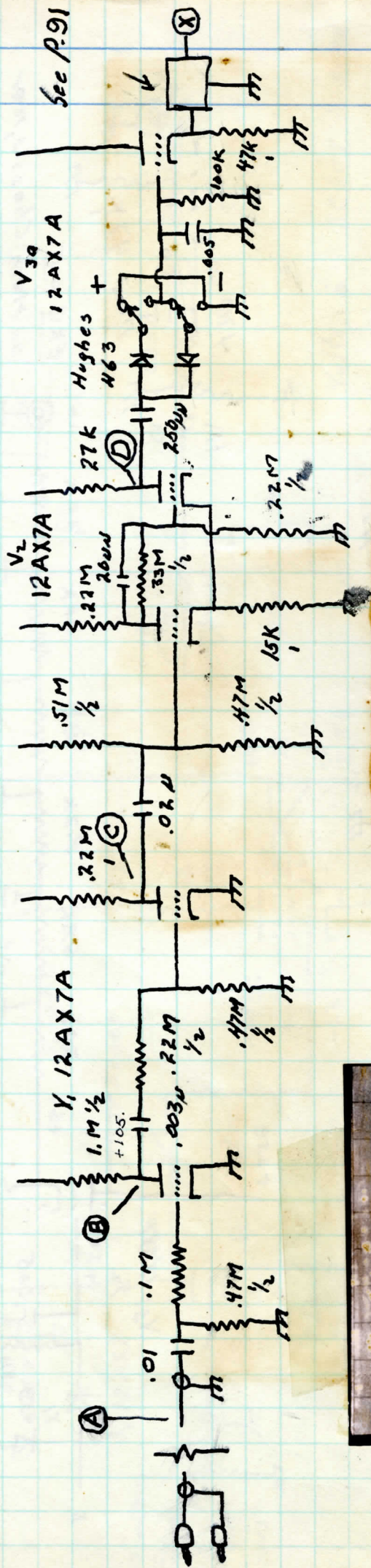
875

20

D.C. offset on output

Computer #2 (Cardiology) Demod, S.C.

Volts, $\bar{e}$ 100VVTM + Sig. Present



(B) 50V/cm
D.C.

(A) 2V/cm

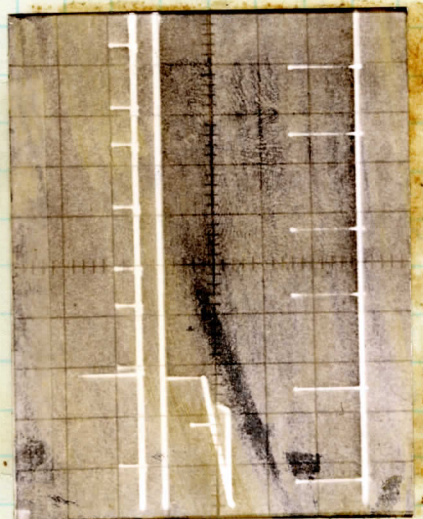
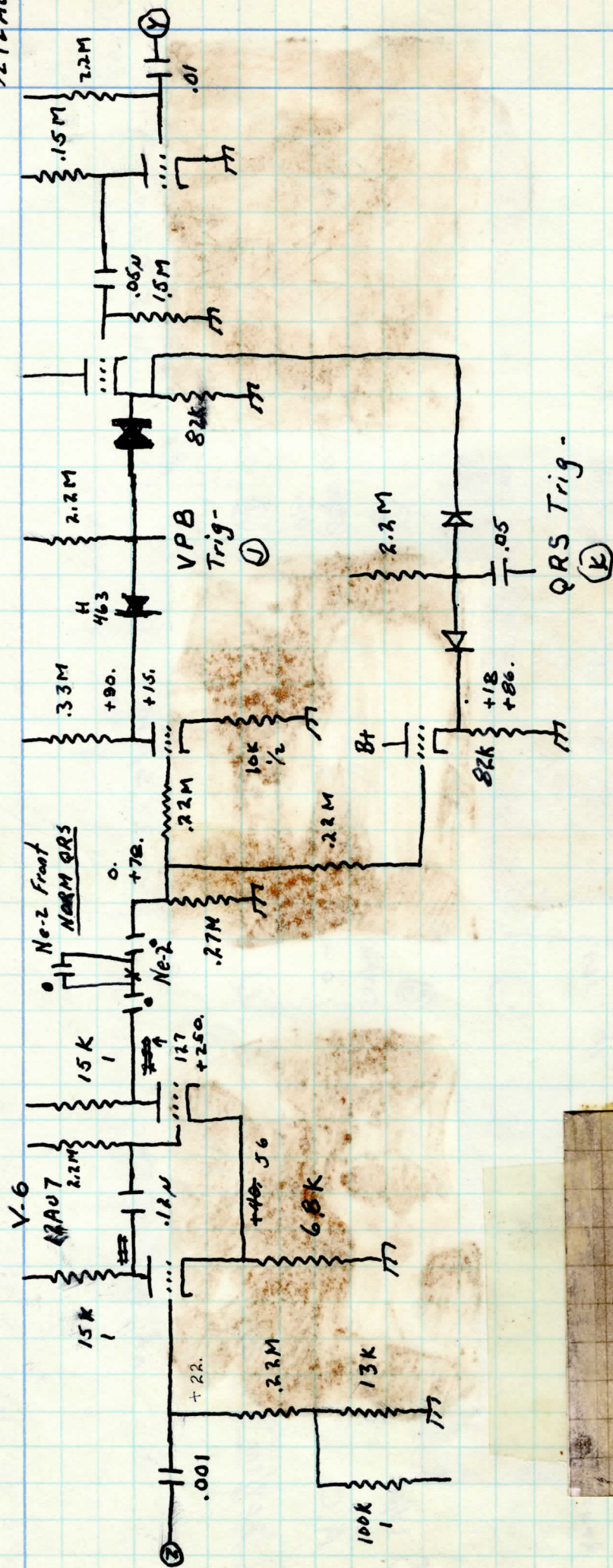
0.1 msec/cm



(C) 50V/cm

(D) 100V/cm

0.1 msec./sec.



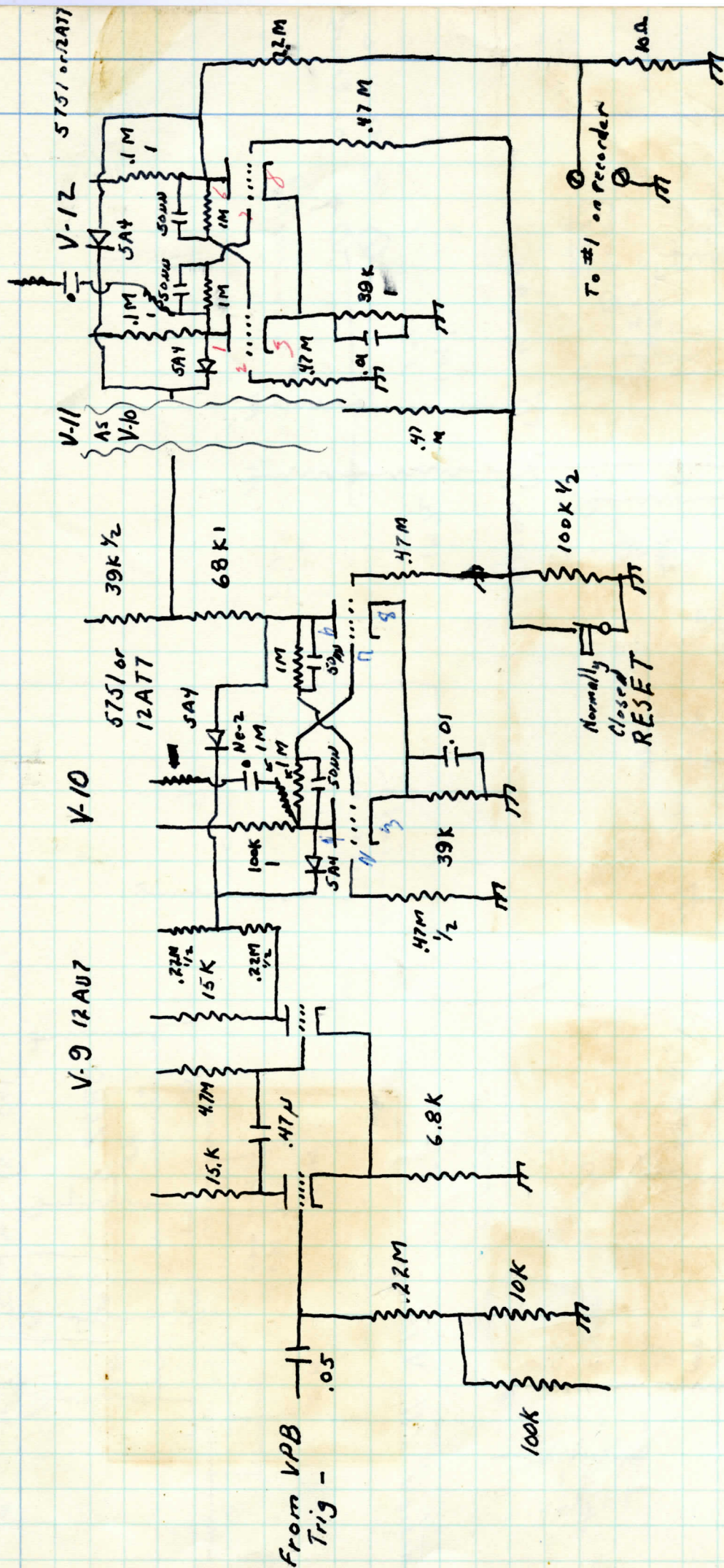
①

 50 V/cm

④

0.2 ~~5~~ s/cm

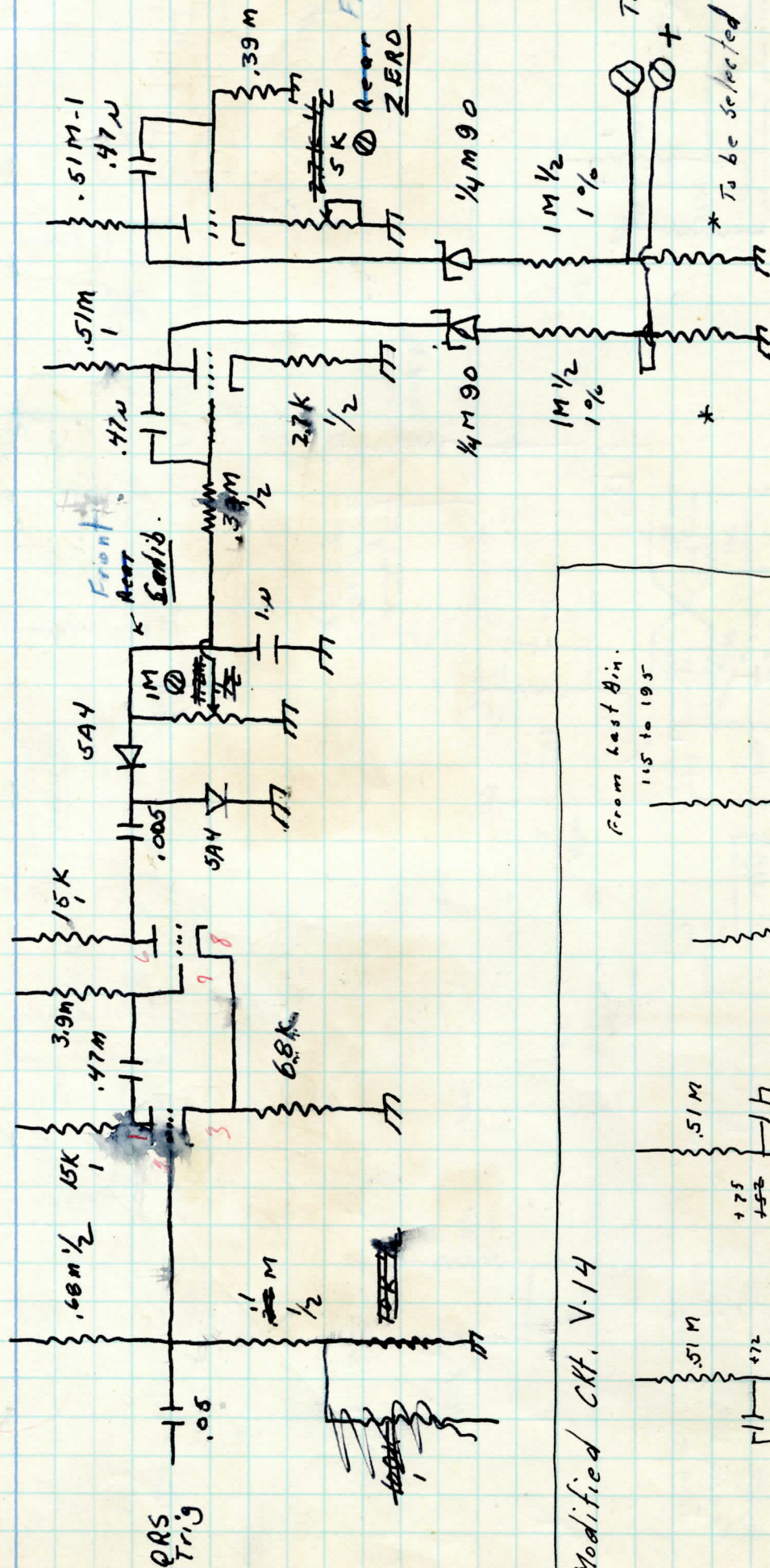
#2 Computer Counter



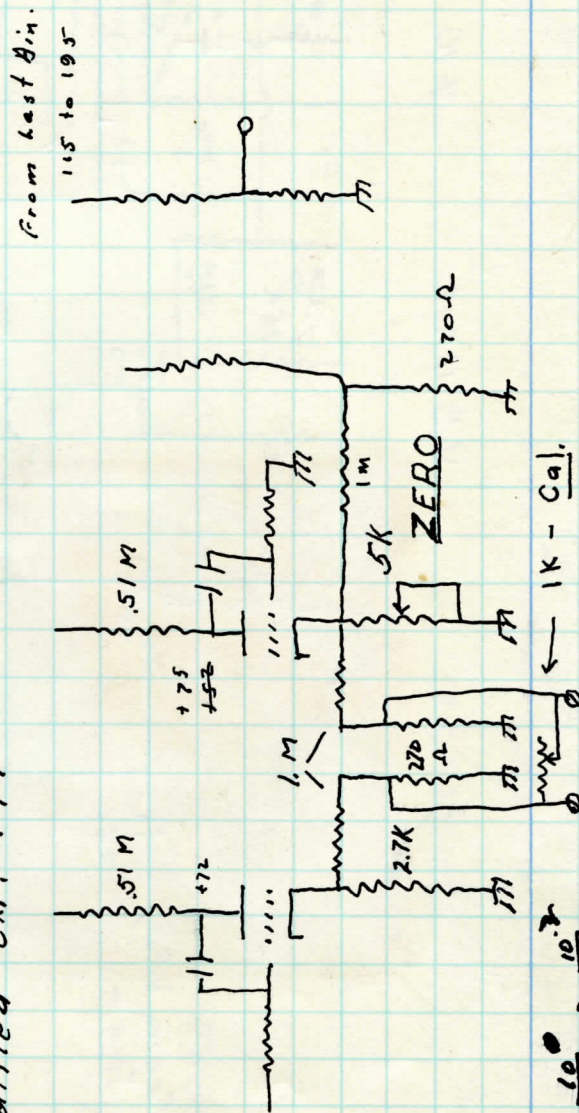
#2 Computer-Cardio Tach

V-13 12 AUG

V-14 12AX7



Modified CKT. V-14

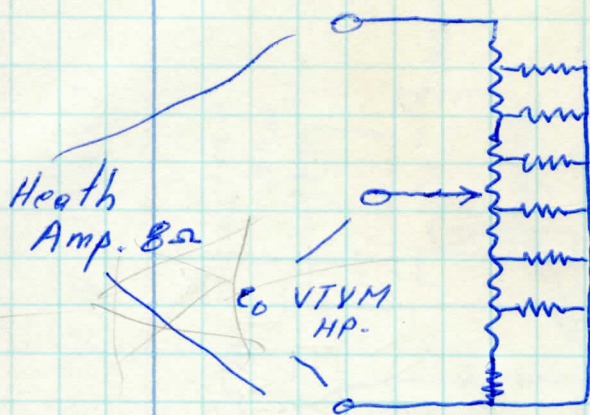


$$\frac{10^6}{10^2} = 10^4$$

$$\begin{array}{r} 75 \\ 22 \\ \hline 97 \end{array} \quad \begin{array}{r} 10 \\ 10 \\ \hline 20 \end{array}$$

ck. of Beltone pot.

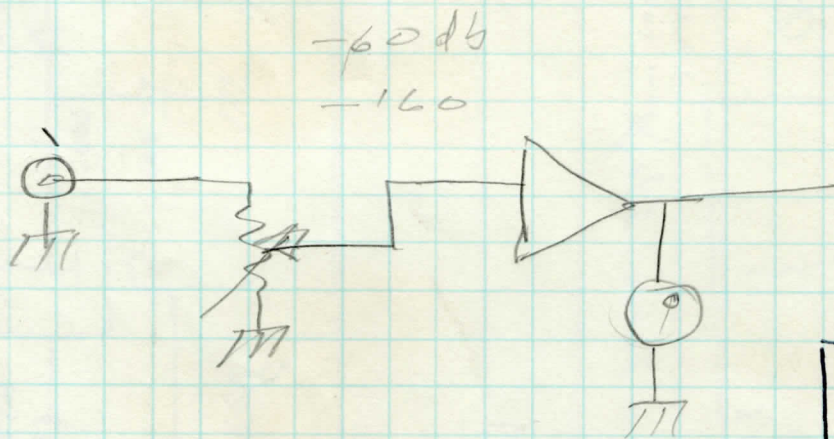
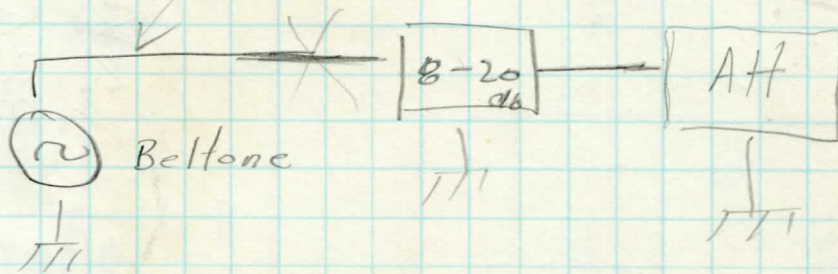
6.5



Dial	Scale	Meter	Meter
100	0	0	0
90	0	-5.6	-5.7
80	-10	-5.8	5.9
70	-20	-5.1	5.5
60	-30	-5.8	5.4
50	-40	-6.0	6.2
40	-50	-6.0	5.8
30	-60	-5.0	-4.9
35			-6

$$W = \frac{E^2}{R}$$

$$R = 10$$



Cap. leakage

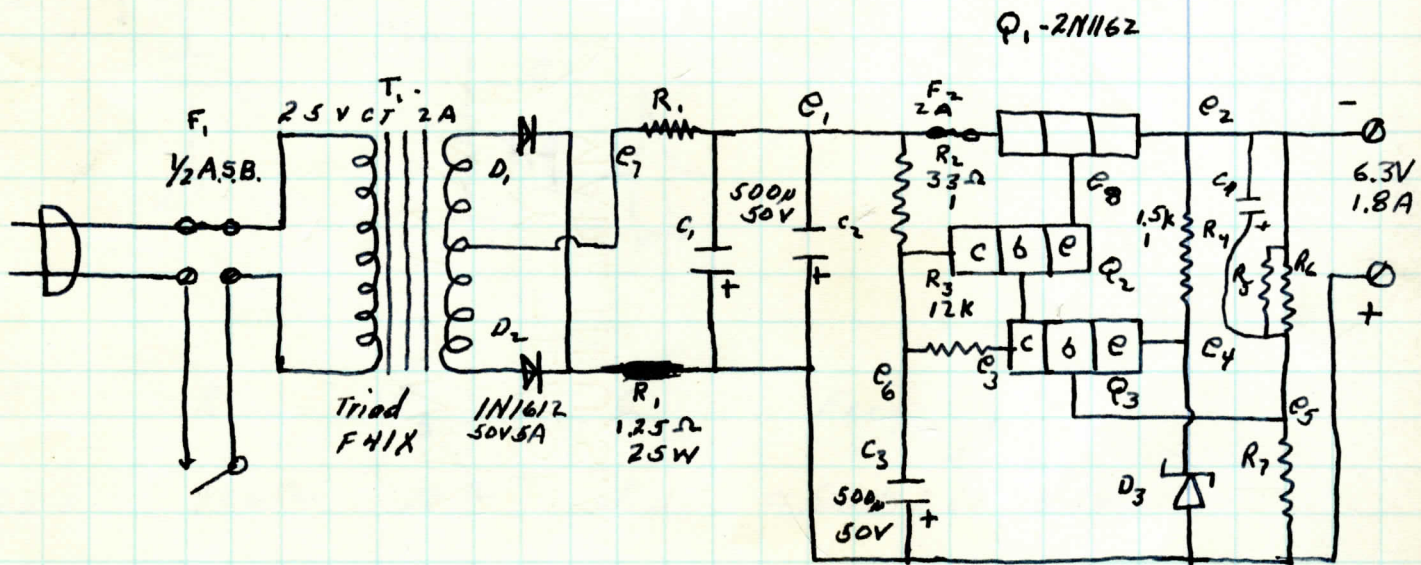
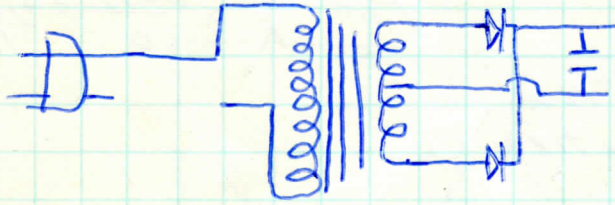
6V	I_r	R_{eq}	E_0	$C_{1,2}$
	$\frac{I}{C_1}$			
	$\frac{I}{C_2}$	600	.01V	Test. 470
	$\frac{I}{I+}$			10V
		1M	6mV	50uF

250
500
1 KC
1.5 KC
2 KC
3
4
6
8

$$R_{eq} \approx \frac{6}{10^{-21}}$$

Line
100
105
110
115
120
125
130

6.5 Pwr. Supply for Gross Preamp. 1.8A, 6.3V.



$Q_{2,3} - 2N508$
 $D_3 - 1/4 M 2.4A Z$
 $C_4 - 50 \mu 50V$

E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	I_{load}
12.2	6.2	6.5	2.15	2.23	11.8	14.2	6.4	1.8 (3.53 ohm load)
			D.C.					
			VAC PP					

4. 5 mV, 7.5 1.8

Line Volts.

100
 105
 110
 115
 120
 125

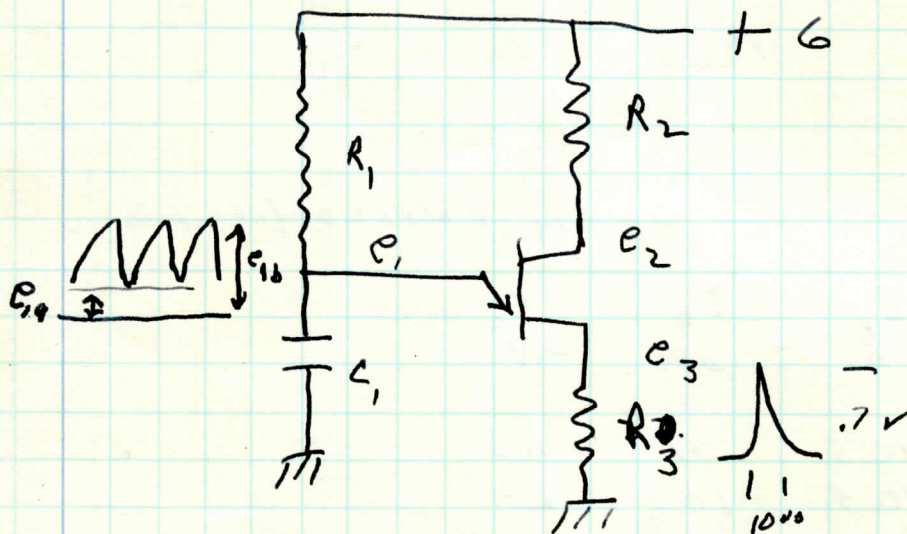
VDC ACPD VDC
 5.9
 6.0 10 mV
 6.05
 6.1 7 mV
 6.15 7 mV
 6.2 8 mV

6.05
 6.25
 15.2

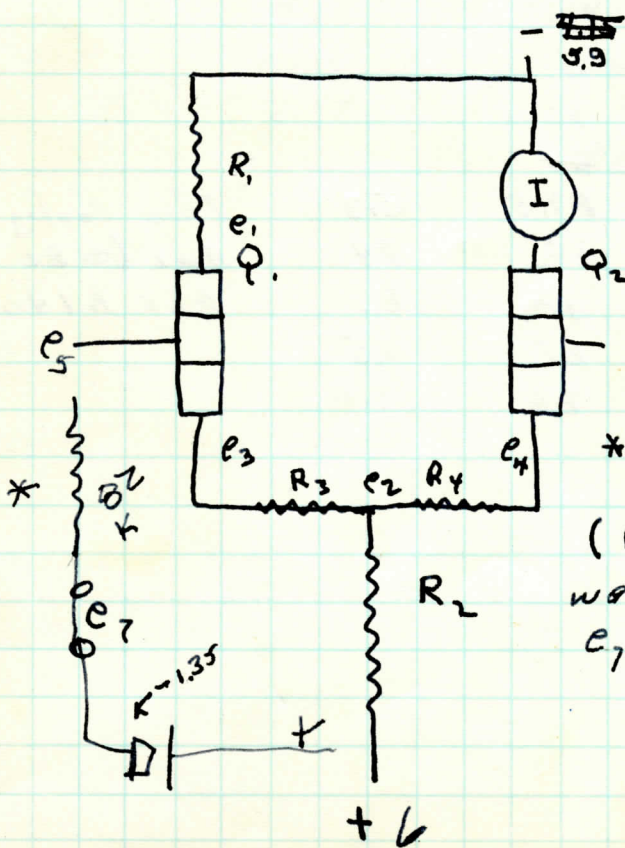
1.8
 7 ohm
 47 ohm min load

Low level S.C.O. ckt.

15.7mm



R_1	R_2	R_3	C_1	Freq	e_1
33 K	120 Ω	27 Ω	0.1 μ	≈ 500 Hz	1.2V 3.5V
"	"	10 Ω	"	1.1	"



$Q_{1,2} - 2N508$ $R_1 - 10^4$ $R_2 - 18K$
 $R_{3,4} - 970 \Omega$

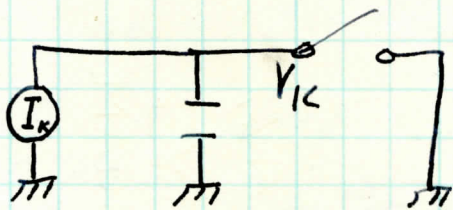
$I_{Q2} - 2.9$
 $875 - 4.5$

$e_3 \quad e_4 \quad e_5 \quad e_6$
 $\leftarrow -16.5 - 17.5 \rightarrow$

When these CKTs were combined
 (R_1 repl. by I_{Q2}) - a linear sawtooth
 was generated which varied
 $e_1 = 0 \rightarrow \infty$ to $e_1 = -1.35$
 $6.5/20msec$ $8.8/20msec$ $13.5/20msec$

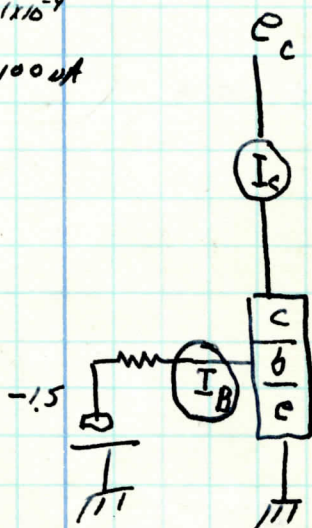
CK. of const. I methods

6.11.

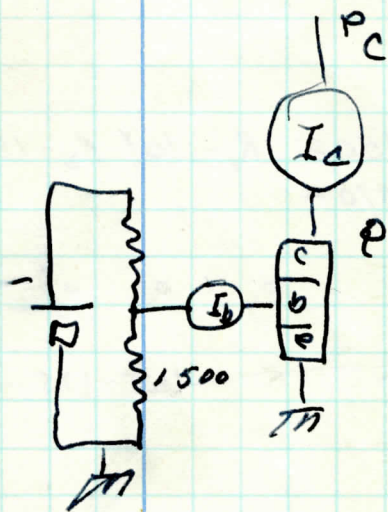


$$\frac{6V}{6K\Omega} = 1 \times 10^{-4} \\ = 100 \mu A$$

Q: Ray 2N1623 (cheap Si)



I_b μA	I_c μA	V_c $-V$
10.5	97	1.3
10.5	100	2.8
11.0	100	3.0
11.5	104	4.4
11.5	107	5.9
11.5	110	7.1
11.5	112	8.6
3	16	5.9
5	33	
6	50	
14	155	

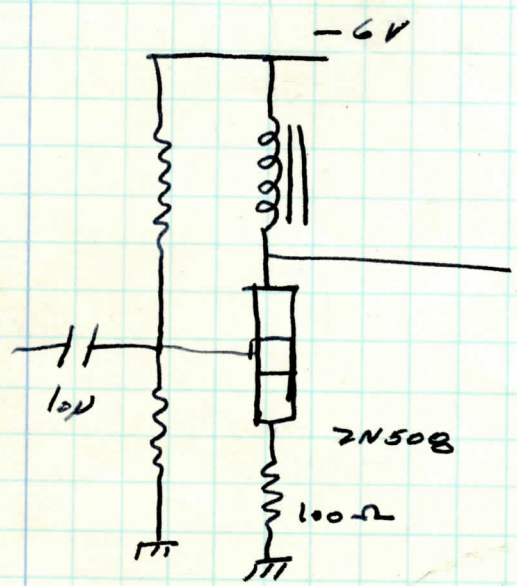


I_b	I_c	V_c
-9.5	87.5	5.9
9.0	88	7.4
9.0	90.	8.7
9.0 +	87.	4.5
9.0	86.	3.0

This config is T sens
Amb (≈ 80 to $98K$)
87.5 to 140 μA I_c

6.11.63

Amplifier to Extend range of HP VTVM -



Use Grass

Scale Calib. of of Beltone Pots. Db. Ballantine

Scale	Calib. of	of	Beltone Pots.
100	3.5		
90	13.		
80	3.75		
70	13.25		
60	3.75		
50	13.75		
40	4.5		
30			
20			
10			
0			

x10 Amp

After Trim.

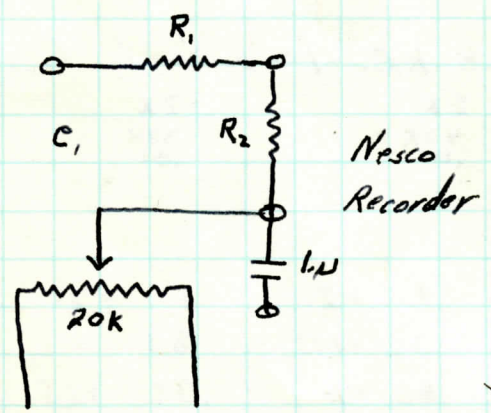
~~16.75~~ 4.75 14.00
5.25 4.50
16.00 15.00
8.00 ~~6.00~~ 4.75

ck. of MK II circuitry

eld)

$$\begin{array}{r} .045 \\ 2.2 \overline{) 100} \\ \underline{88} \\ 120 \end{array}$$

$$\begin{array}{r} 1.35 \\ .15 \\ \hline 675 \\ 540 \\ \hline 6.075 \end{array}$$



Across supply of xtr.

$$e_1 = 1.35V.$$

$$R_1 = 2.2 \times 10^6$$

$$R_2 = 10^4$$

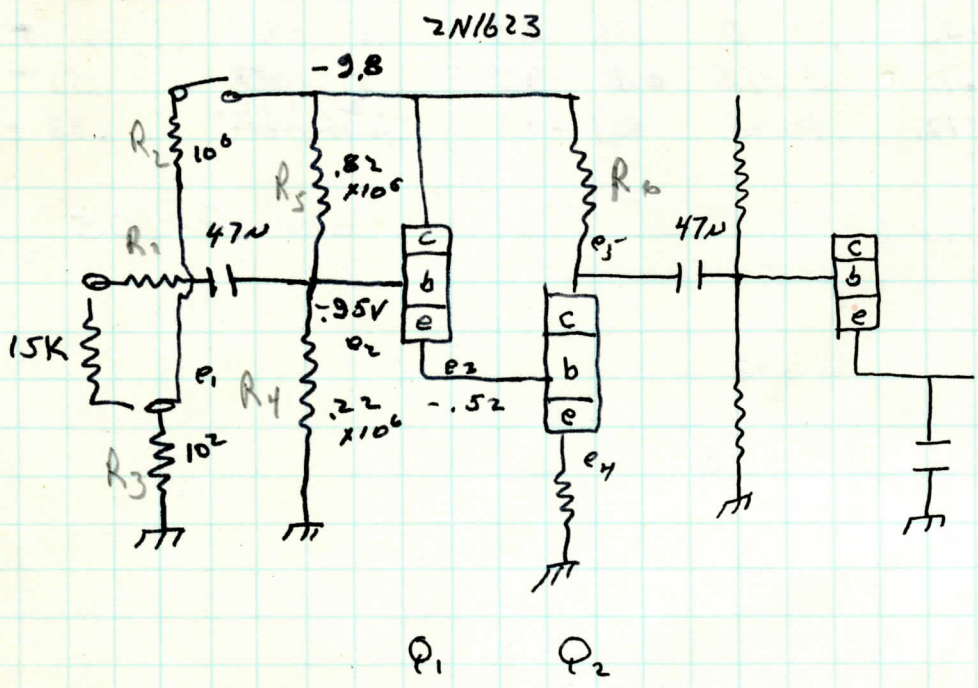
$$\frac{10^4}{2.2 \times 10^6} \times 1.35 = 6.075 \times 10^{-2}$$

$$Rec. Defl. = 6.8 \text{ cm}$$

$$Sens = \frac{6.075}{6.8} \approx .1 \times 10^{-2}$$

Assum 1.0 mV -

other records made i Offner - See App. See Harm. Card. for Drift.



Filter for Sherwood S-3000 III EKG Conversion

Low Pass - D.C. to 100 CPS Corner -

Imp. of Det - 6.8 KC. (Imp. to ↓ Fout to 1/2)

Dial Error	R-91M C-81, X10 ⁻⁸	47K .01	2X 47K .01	2X 33K .01	2X 47K .005
Freq	V. Db.				
20	0	20	1. 2.	1. +2.	1. +2.
40	0	40	1. 2.	.95 +1.75	.95 +2.
80	+1.5	80	.92 1.5	1. +2.25	.88 +1.
120	+1.	120	.9 1.2	.82 +.5	.93 +1.5
160	1.5	160	.84 .75	" "	.90 +1.2
200	2.0	200	.6 -2.	.74 -.5	.86 +1.
100		300	.45 -5.	.91 1.	.65 -1.5
		400	.35 -7.	.53 -3.0	.8. +5.
		800	.2 -12.	.75 0.	.5 -4.
				.36 -2.5	.7 +1
				.5 -1.5	.57 -2.5
				.01 -9.5	.37 -6.5
				.01 -17.	.075 -20.
					.33 -7.

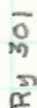
Check of MK II Xmtr. see P-105
Davis Red (Chesnut)

R5 - 1.2 M P5 - -3.
R4 - .22 " Amp Gain = 50X



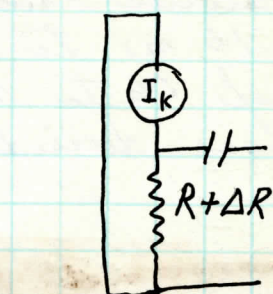
T-502-UTC-S-15

Hand-drawn circuit diagram on graph paper, showing a 50mA meter movement and various resistors. The circuit includes a 50mA meter movement, a 50K resistor (R-805), a 250V source, a 84K resistor (R-802), a 100K resistor (R-803), a 1M resistor (R-804), a 15M resistor (R-806), a 2.2M resistor (R-807), a 5K resistor (R-808), a 100Db Pot., a 20K resistor (R-801), and a 50mA meter movement. The diagram is labeled with component values and resistor codes.



Telemetry of Audiometry - Audio Signal, G.S.R. + Stim.

GSR-



Equiv - Ckt.

$$I_k \approx 15 \times 10^{-6} \text{ A}$$

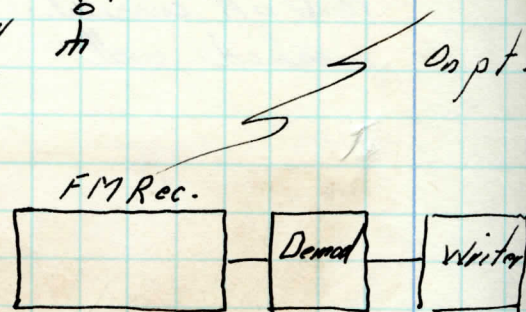
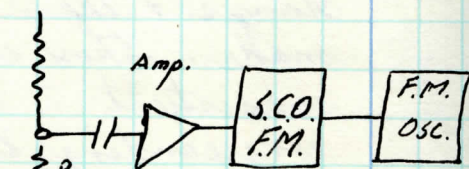
$$R \approx 50 \times 10^3 \Omega$$

$$\Delta R \sim 10^2 \text{ to } 10^3 \Omega$$

$$E_o = 15 \times 10^{-6} \times 10^2 = 15 \times 10^{-4}$$

$$\text{to } " \times 10^3 = 15 \times 10^{-3}$$

See Prev. Page.

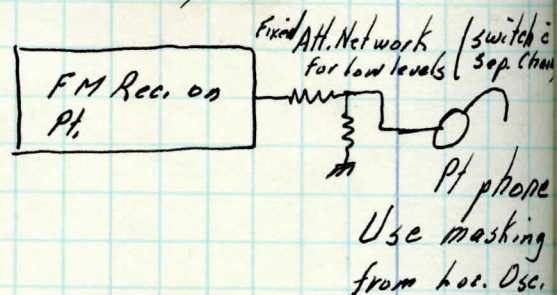
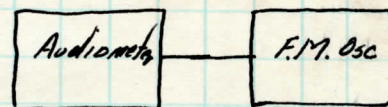


liquid elect.

Audio - Feasibility

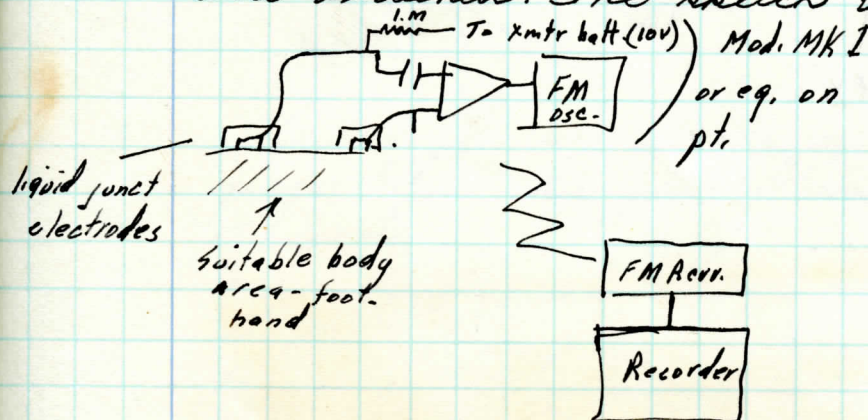
3 freqs. at 3 levels
Change freqs. manually
Key freq. at one of
three levels - (to pt.)
Earphone input will be used.

Desired Variable freq. + Input level.

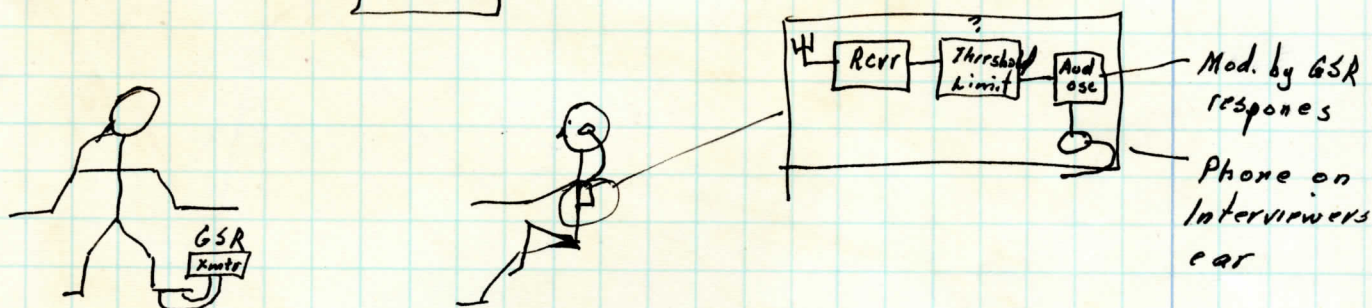


June 29, 1963

This evening, using a MKI X-mtr. & I_k source in various configurations excellent telemetered records were obtained. The sketch below shows an arrangement for audiometry testing.



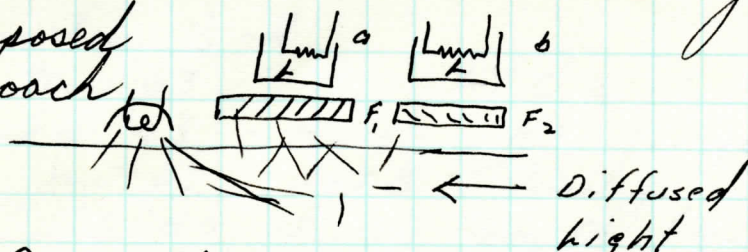
This ~~unit~~ ^{scheme} should be of considerable value in testing of psychiatric pts. & in psychological interviews & the like. For example:



In this situation an analyst ^{or interviewer} could attach the X-mtr. to the pt. and by means of a small portable receiver tuned to the X-mtr. which modulates an A.F. tone & ear phone monitors GSR responses as well as other responses during the interview. An alternative ~~addition~~ ^{addition} might be a receiver connected to a dual track magnetic recorder. One channel would record by means of a S.C. the GSR responses while the second would record the conversation from a mike. After the interview conversation and the worked GSR's could be received by ~~reconversion~~ ^{reconversion} of the S.C. by a demod and displaying the reproduced GSR on a suitable indicator, meter, scope, writer, etc.

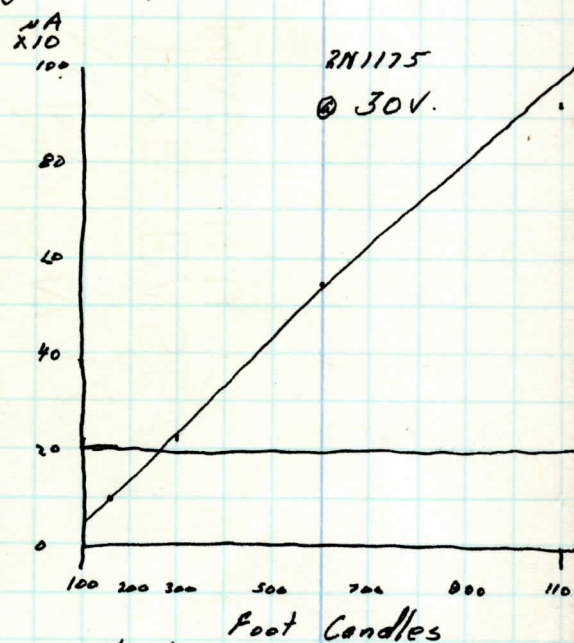
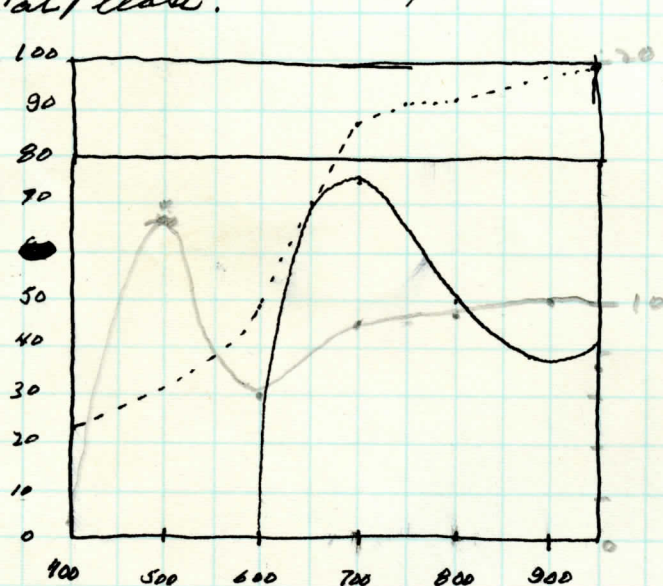
7.1.63 Gastric "Blood Flow" by spectro-photometry

Proposed Approach



Problem is superficially similar to oximetry & will be subject to same limitations?

Pinna of ear is opaque below 600 mμ. Blood (Hb O₂) is also opaque below this point & remains varying transparent to 10³ mμ at least.



The I.R. portion of the emission must be removed & transmission characteristics of gastric mucosa checked.

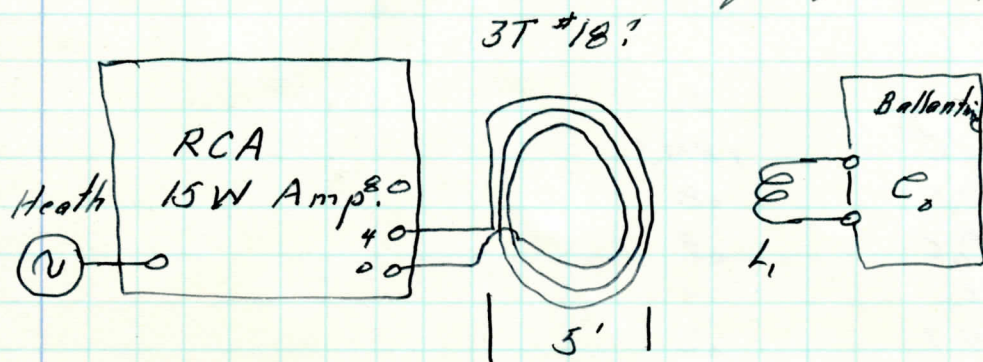
7.9.63 - A 1" segment of ^{gastric wall} mucosa was removed & placed in normal saline until being plastered on the wall of a cuvette (10-15 min.) • Transmission meas'd w/ Beckman DU

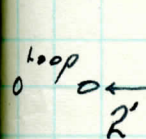
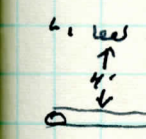
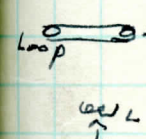
Order of meas.	λ-mμ	% Trans	Check	Recheck	Muscularis
	1000	7.5		45? mins. after	λ-mμ %Trans
	900	10.	% Trans	start	1200 4
	800	9.5	11.	% Trans	1000 3
	700	9.0	10.		800 3.2
	600	6.0	6.0	4.5-550 mμ	600 1.5
	500	13.5	14.5	1.5	480 .3
	400	0.6			
	300	0.3			

1200 mμ 14.5

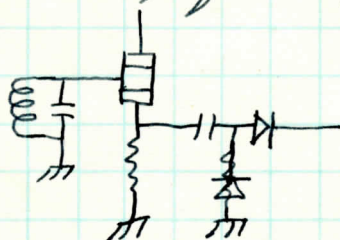
7.4.63 Bone Control X-mtr.

Examine direct low freq. coupling.



Location	L ₁	Freq	C ₀ X 10 ⁻¹
	#2007 Miller Loopstick	2 KC	8 mv.
"	"	6 "	20 "
"	"	600 N	3
	"	6 K	15 20 mv.
	15-20 H choke 1 1/2" sq. c core removed	"	1.5 .3
"	"	"	1.5 - 2 V

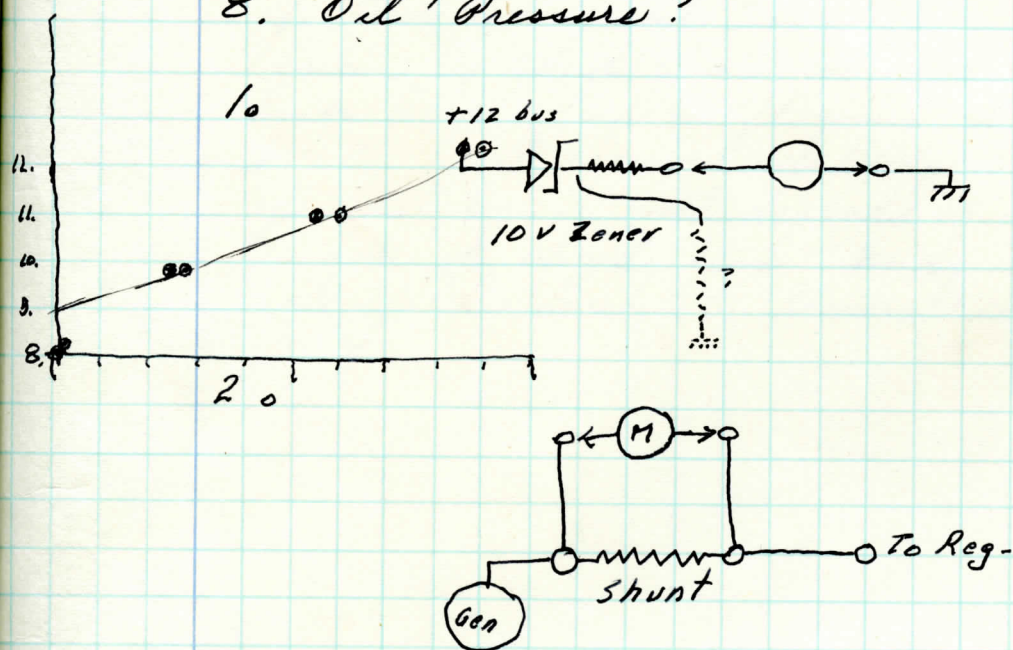
From this it seems reasonable to assume a min. of 1 Volt. in freq. range of 800 to 18000 N.



Auto monitor -

One meter & fixed switched scales for:

1. Generator voltage 10 - 15 Volts
2. " current 0 - 30 A
3. Tachometer 0 - 5000 RPM
4. Fuel level
6. Dwell $\angle$
7. Fuel pressure ?
8. Oil Pressure ?



$$Z_W = 5V \times 1 \times 10^{-3} = 5mV$$

12V 8.3	Meter (1mA)	R =
8.3	0	0
9.8	2.8	2.5
11.0	6.0	5.5
12.5	9.0	8.5

(2.2 shunt)

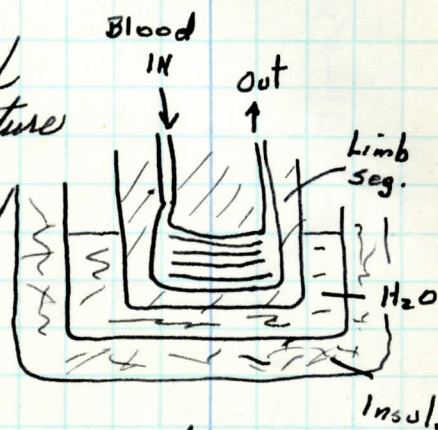
1 ma. 1 mv. meter -

30

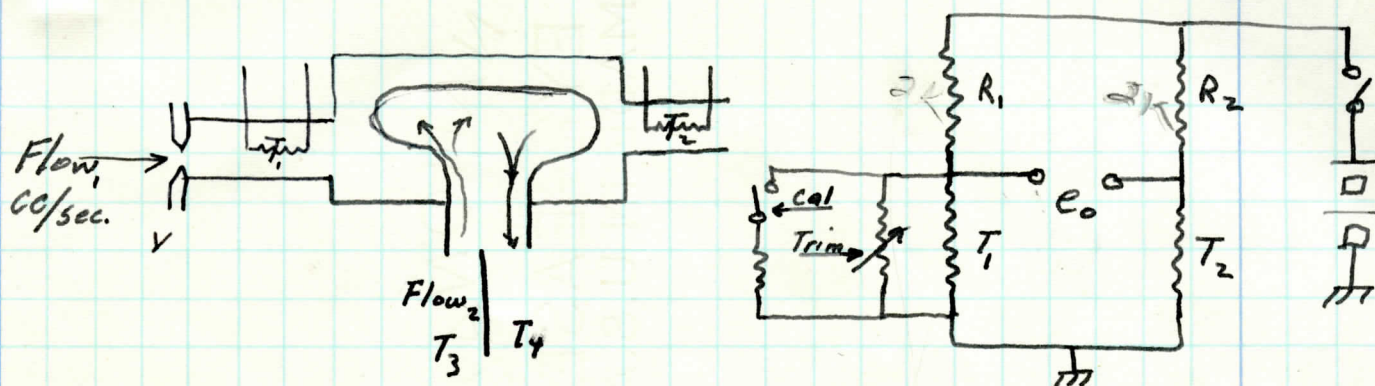
7.25.63

Calorimetric Determination of Changes in Blood Flow

Method: If a limb segment is placed in a liquid at a slightly higher temperature than that of arterial blood and the limb segment, heat will then leave the liquid by three paths: 1. losses independent of the immersed limb. 2. loss by conduction of heat to adjacent tissue in the limb. 3.



losses by conduction to blood at a lower temp which is flowing thru the segment - Losses 1 + 2 will remain relatively constant. Losses (transfer) of heat by 3 will depend on several mechanisms - 1. rate of blood flow and its distribution 2. Metabolic rate of the limb 3. Thermal resistance of the tissue



$$\text{Heat Lost} = Vol \times T_1 - T_2$$

$$= \text{Flow (cc sec)} \times \text{Time (sec)} \times T_1 - T_2$$

$$Vol_1 (T_1 - T_2) = Vol_2 (T_4 - T_3)$$

T_3 = Body Core Temp

T_4 = Venous Blood Temp

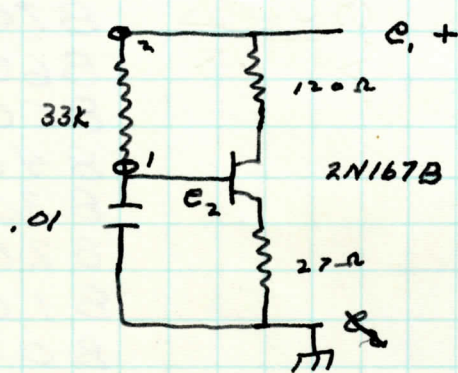
Also - P-101

143

Low level S.C.O.

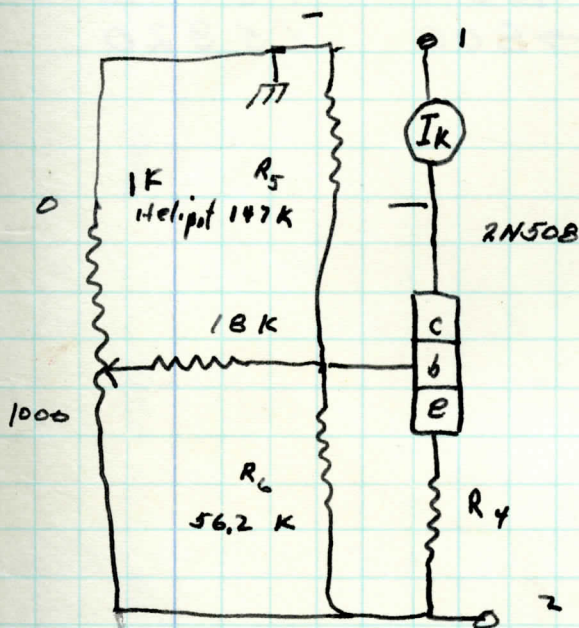
Plan: to use solid unijunction for gate & constant I for linear charging giving $T = K \frac{1}{F} + F = K E$.

I- Measure performance of unijunct. ckt. at varying voltages -



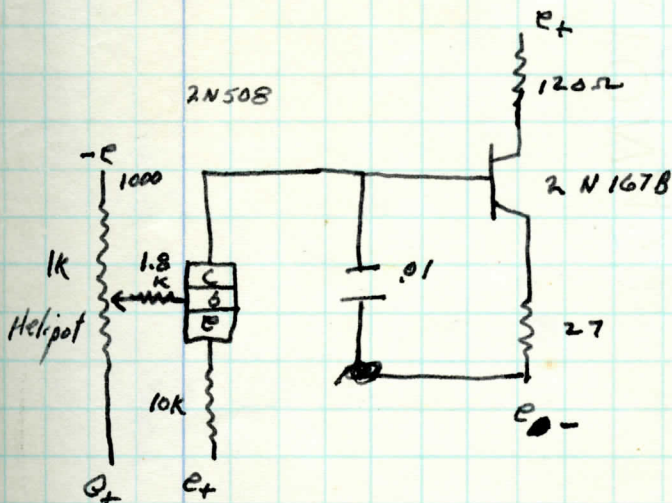
E_1 + Volts	F cps	E_2 A.P.
12	5122.9	6.5
12	5122.9	"
12	5117.8	"
6	3991.6	4
3	3814.5	2

started @ 2N167
at $\approx 95^\circ F$

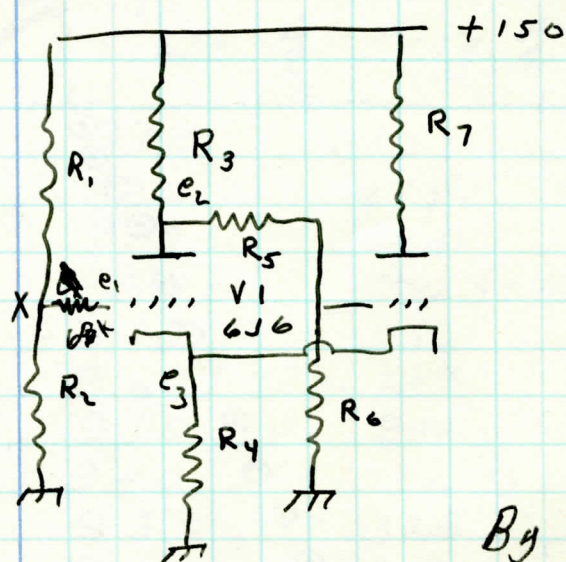


R_4
ohms
10f

12	5007.	≈ 7	Helipot
	8620.8		0
	8239.2		1000



Helipot scale units	Freq. cps	$E_1 - E_2$ Volts
968.4	968.4	-9
950	↓	↓
925	1440.	↓
900	1889.	↓
875		

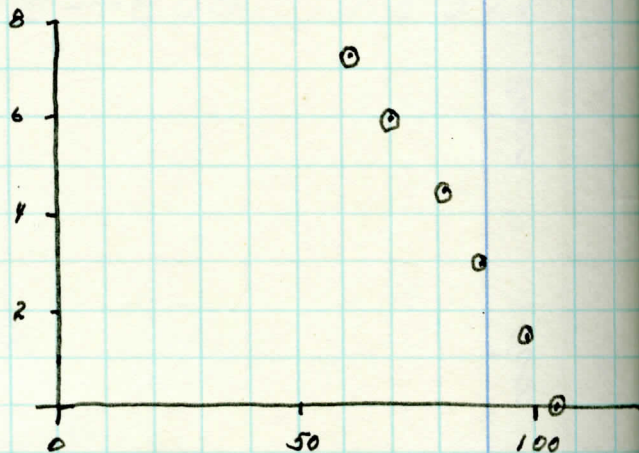
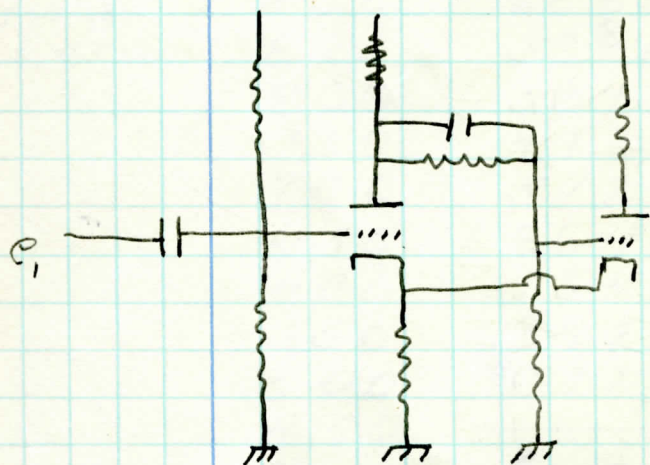


Σ	$R_{1,2}$	Daven	Volt. Div.	$+ R_3 = 10^5 + R_4 = 10^4$
e_1	e_2	e_3		
0	106	4.6		
+1.5	98	5.6		
+3.0	88	6.6		
+4.6	80	7.6		
6.0	70	8.5		
7.4	62	9.6		

Gain = 6.

By Dek Box

Optimum $\lambda = 0.30$ & $R_5 = 400K$ & $R_6 = 220K$
 & $R_4 = 10^4$ & $R_3 = 10^5$ & $R_7 = 33K$

Sens. E_{in} P.P. =

26 May 65

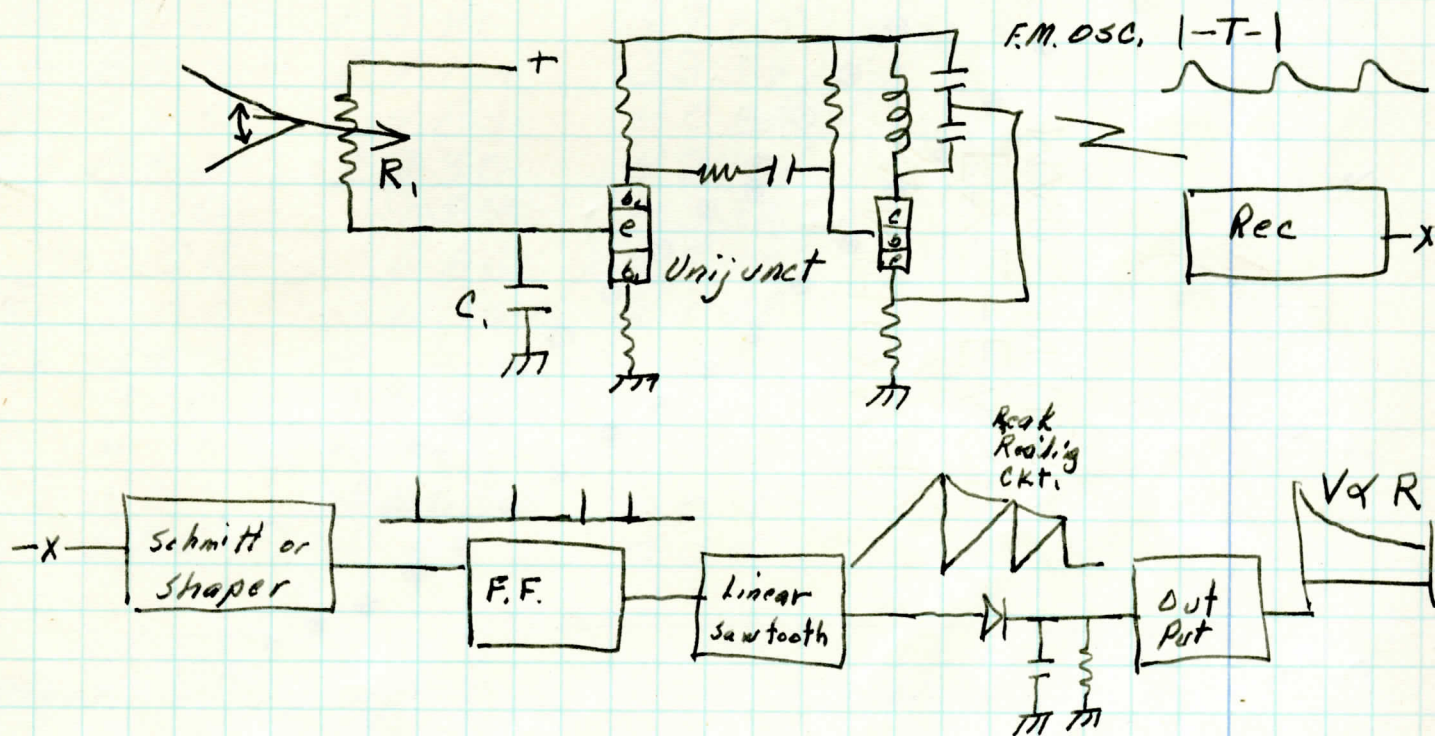
Vary freq. as f of Res.To reach a given point of volt $\bar{e}$ onR.C. Combination - $T = RC$ & $T \propto R$

$$f = \frac{1}{T} \quad \& \quad f \propto \frac{1}{R}$$

However by letting T control the peak voltage of a linear charging ckt.

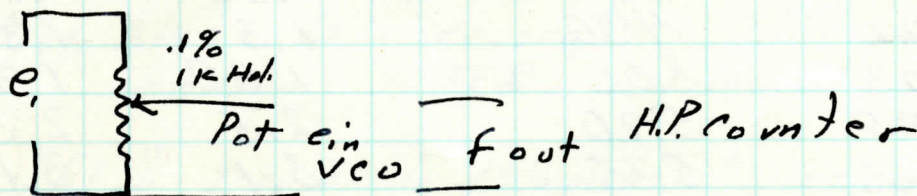
$$V \propto T \propto R \quad \& \quad V_{\text{output}} \propto R -$$

For Telemetered Goniometer -



Meas. of Mk I-A SCD + Demod - P. 90 + 91

Bt - 232 - F_o - 2902, 01, 00, 01, 03
 - 245 - F_o - 3040 - 3041 - 40 - 39



E_1 Meas
 6 DuMont
 VTVM

	scale (0-1000)	Freq	
E_1	0	2898	2895
1.45	100	2708	3077
	200	2517	3257
	300	2322	3439
	400	2136	3610
	500	1940	3775
	600	1715	3934
	700	1483	4083
	800	1230	4216
	900	954	4336
	1000	666	4440
E_1	100	3610	2140
6.2	200	4225	1234
	300	4901	0001
	400	4789	000
	500	4692	000
	600	4692	000

C.F. offset (Demod
 input gnd.) - 2.5V
 $\approx F_o \approx 3KC - 4.7V$

Meas. of Linearity -

Adj. for 1st
 2.6V

Adj. to buck out
 1st Offset

E_{in}	E_{out}
.1	.498 .90
.2	.1.98 .190
.3	.2.94 .295
.4	.4.00 .395
.5	.5.00 .505
.6	.598 .595
.7	.685 .69
.8	.785
.9	.87
1.0	.95
1.25	1.125
1.50	1.25

