

Doppler Scorer
EKG Computer

12



COMPUTATION NOTE BOOK

43-648

Course Del. Marceering

Name W. Thornton

Del Mar Engineering Laboratories

LOS ANGELES, CALIFORNIA

PROJECT COMPUTATION RECORD

SERIAL NO.

Nº

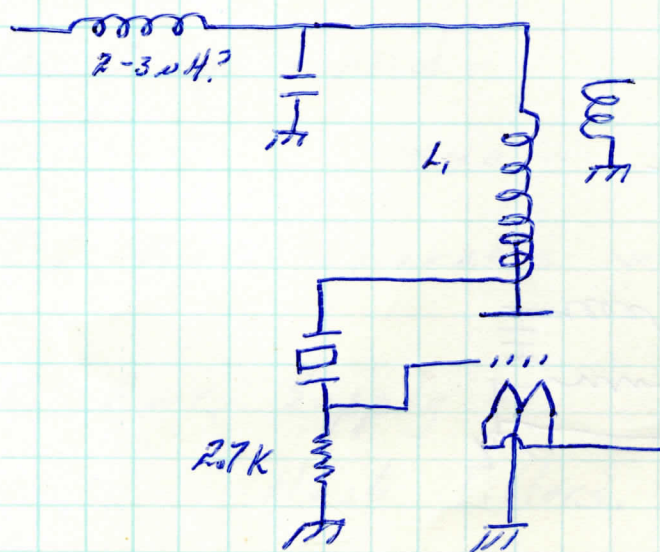
79

MK I Doppler

7-28-60

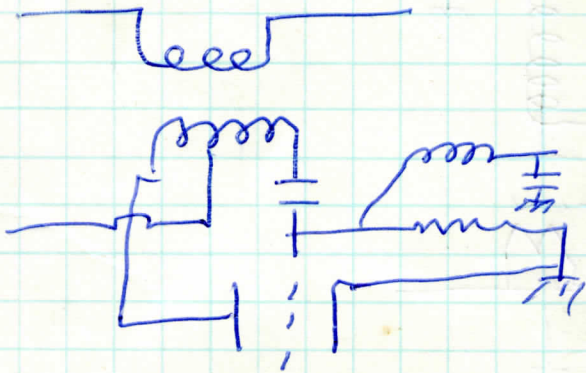
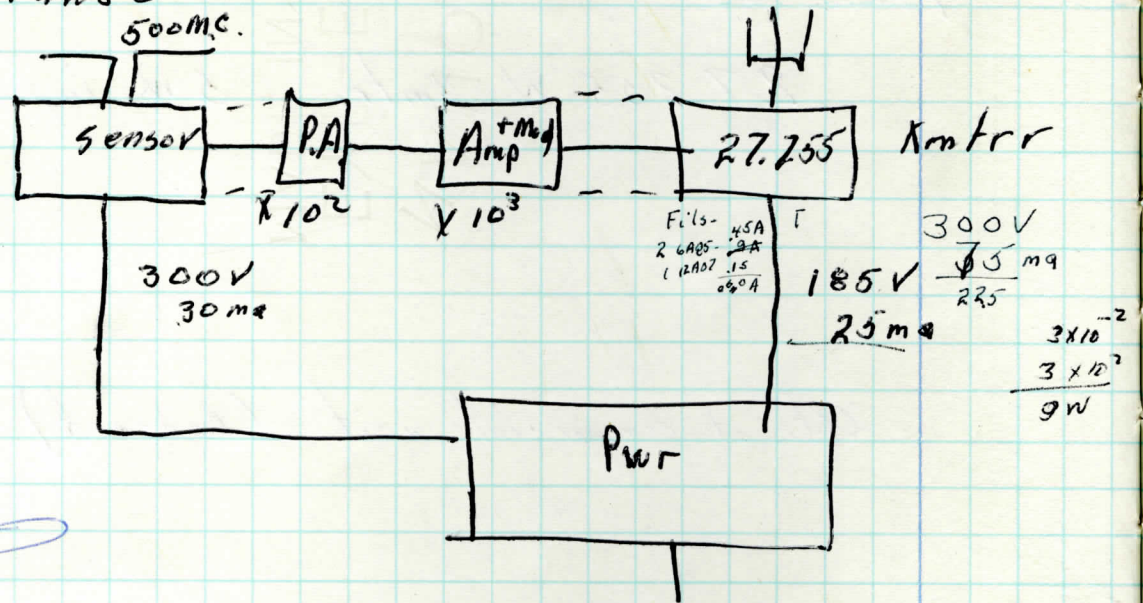
27.255 W. Xmtro. 5W input

ckt. of commercial unit (Babcock)



$L_1 - 8T$ on $1.5" dia$ $12" long$

Test Trans -



7-28-60

Build Rea + mount 1 set on tgt. bulkhead

A. Battery Box $\bar{c}$ 2 6V. Nicads -
3 A. For Fils 2 A For Pwr

B. Sensor -

C. 27.255 Xmt. Xtal, 5w into Final

D. Amp + Mod -

440 -

50W

E. Ant. harness + switch -

F. Pwr. Supply -

Hash Filters.

Receiver (Truck)

A- Align, Check, + Run Curves on Rec,

B. Tape Recorder

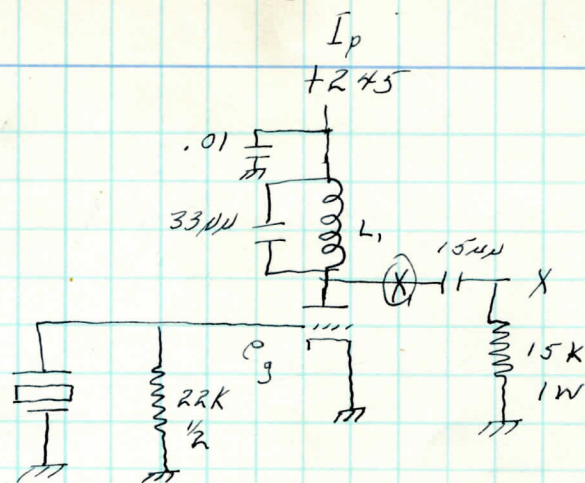
C. Command -

D. Ant. - 27mc $\frac{1}{2}$ w 72 Ω dipole $\bar{c}$ reflod

T-28-60

27 Mc Osc.

Ckt. from
P-57
Dec '59
Radio -
Electronics

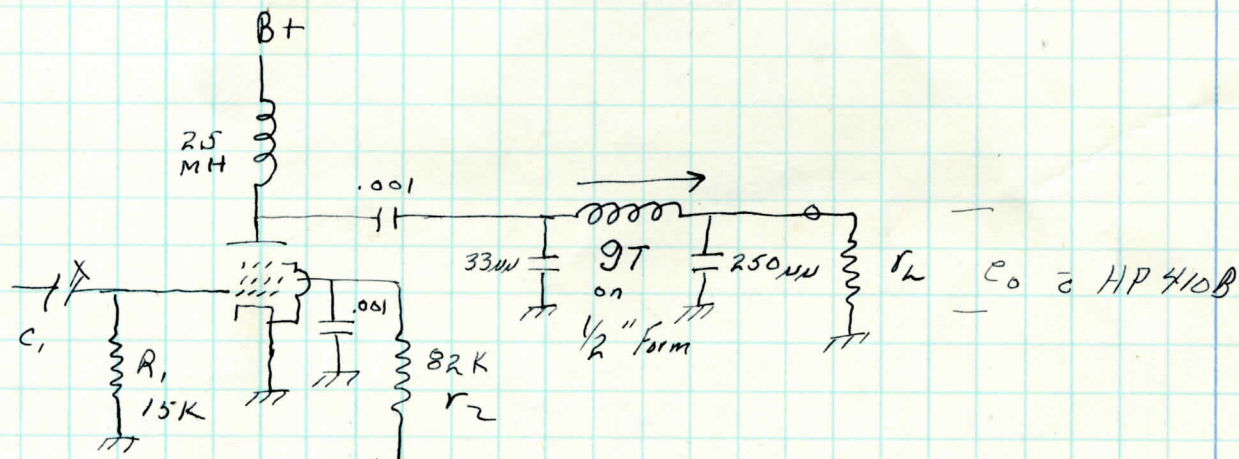


$L_1 = 12$ T enamelled on $\frac{1}{4}$ " slug tuned Form -
reduced to 10 T - meas. made @ broken

B_+	X_{tal}	I_p	X_{tal}	C_g
150	13.	13 ma	-37%	-4.0
200	18.	18 "	-41%	-4.5
→ 250	24.	23 "	-42%	-4.8
300	27.	32 "	-38%	-4.0

Plate input at 250V =

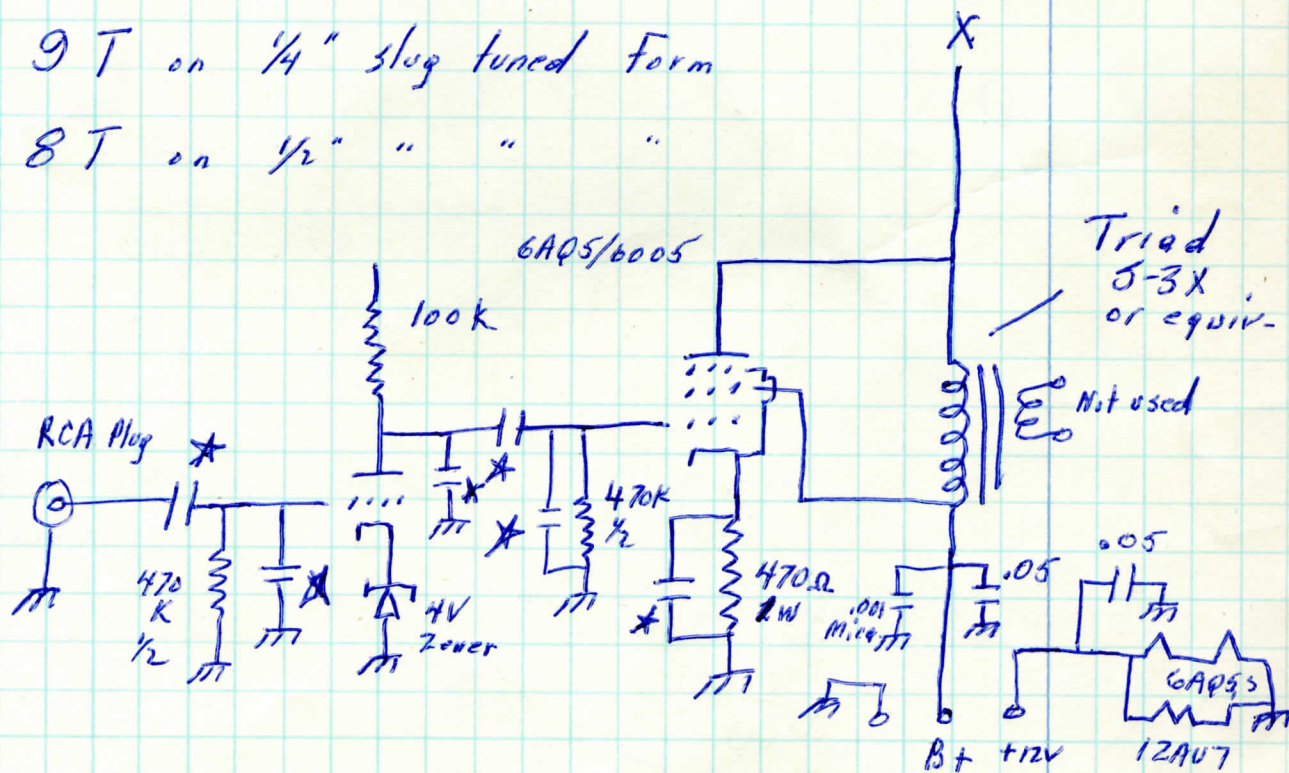
$$W_p = 2.5 \times 10^2 \times 2.3 \times 10^{-2} = 5.6$$



$\bar{C}_1 = 47\Omega$

B_+	I_p total	B_+	C_0	W_0
$\bar{C}_1 = 20\mu$ 300	51 ma	+70.	8. VRMS	1.36 watts
$\bar{C}_1 = 15\mu$ "	65 "	+140.	10.5	2.25
" 250	50 "	+115.	8.2	1.42

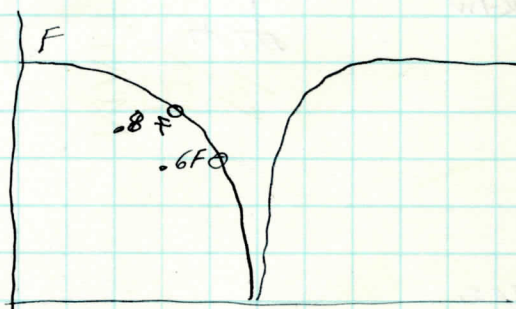
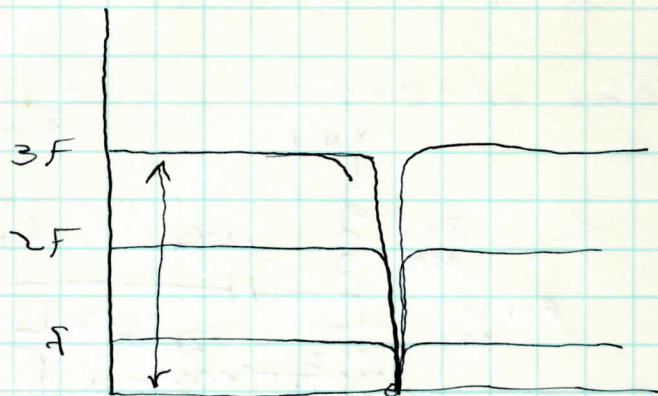
$L_2 = 8T$ on $\frac{1}{2}$ " " " "



Build on a completely enclosed Al. chassis
* to be determined

10^5

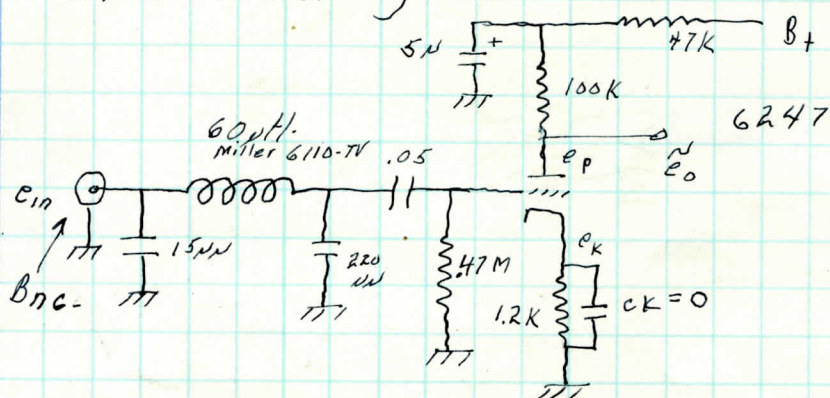
150×10^{-5}



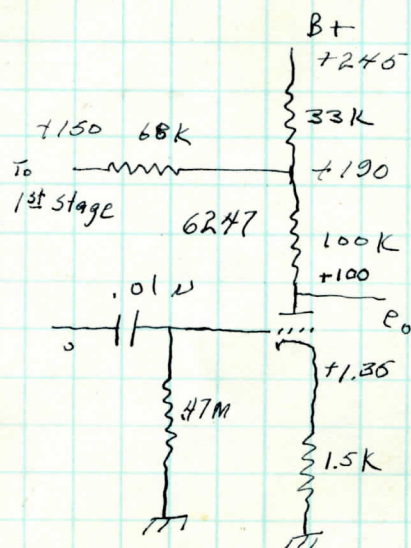
①

29-60

Low noise pre-amp - shock mount For mechanical noise immunity -



B+	e _p	e _o	e _k	ck	B+	e _{in} p.p
	150	100	1.85	0	183	5.1



80 max $\hat{e}_o$

$$\begin{aligned}
 e_{in} &= .027 \text{ rms} \times 2.8 \\
 &= .075 \text{ V.P.P.} \\
 &= 8 \times 10^{-2}
 \end{aligned}$$

$$\begin{aligned}
 e_o &= 40 \text{ V.P.P.}
 \end{aligned}$$

$$\begin{aligned}
 G &= 5 \times 10^2
 \end{aligned}$$

3 stages
 0.0016
 1.6×10^3

$P_o = P_d$
 40×10^3
 20×10^3

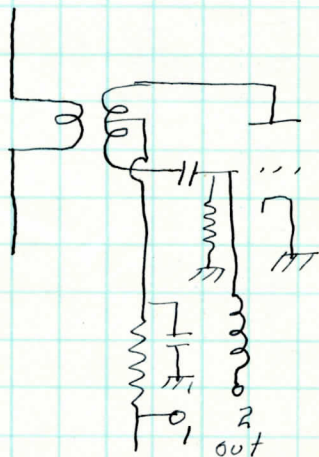
3-1-60

Sensor

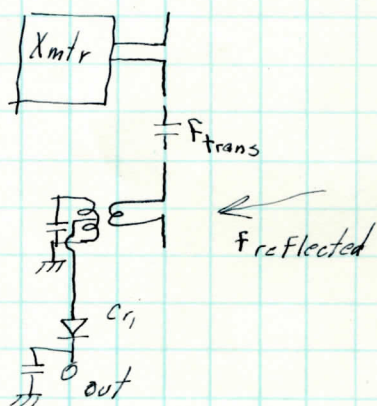
Three possibilities for present situation -

①

Audio directly from power osc.

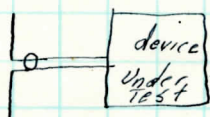
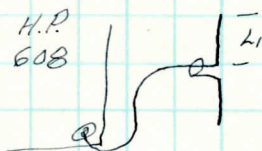


②



In this case Cr-1 might be a vacuum tube mixer or a low power osc.

To compare sensitivities set up the following.



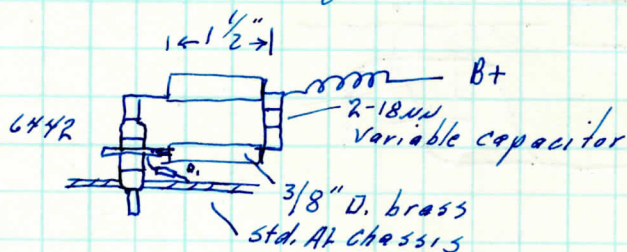
Nominal - 480 mc. $\lambda/2 = \frac{462}{480} =$
 For Conv. Use $F = 462 \text{ mc}$ then $\lambda/2 = 1' \text{ or } 12''$

From ARRL Hand book $R_o = 56 \Omega$

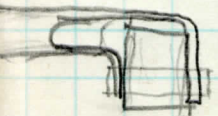
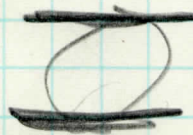
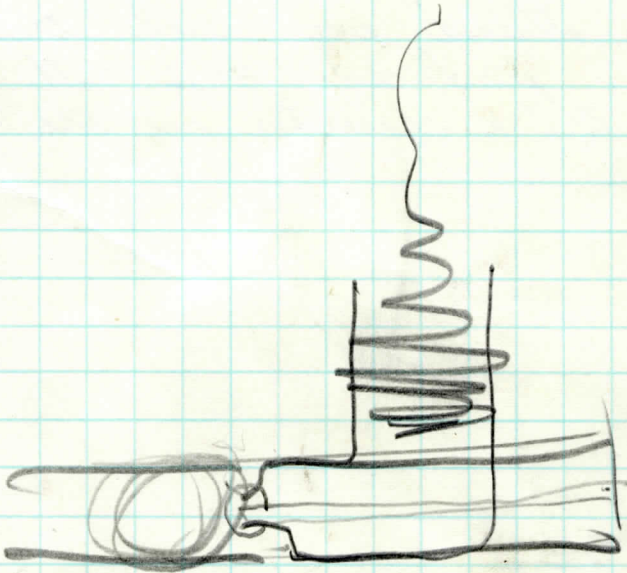
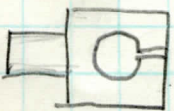
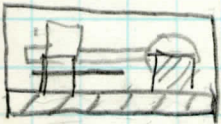
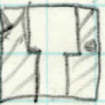
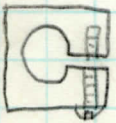
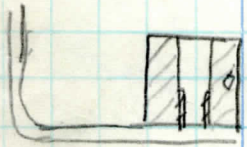
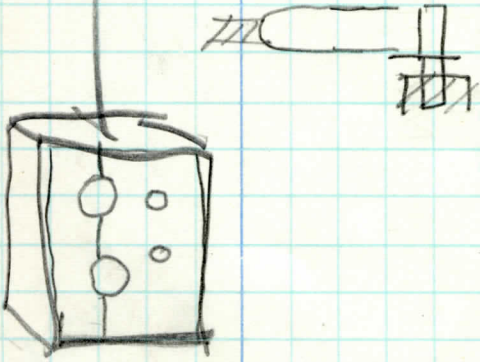
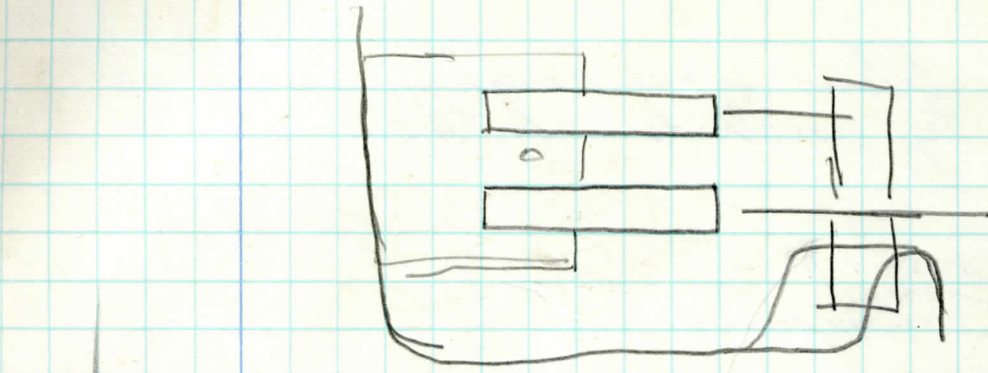
From $R_{eff} \frac{12}{.25} = 48$ + $K = .96$

-1-60

The arrangement below was roughly lashed up and cut and try methods resorted to.



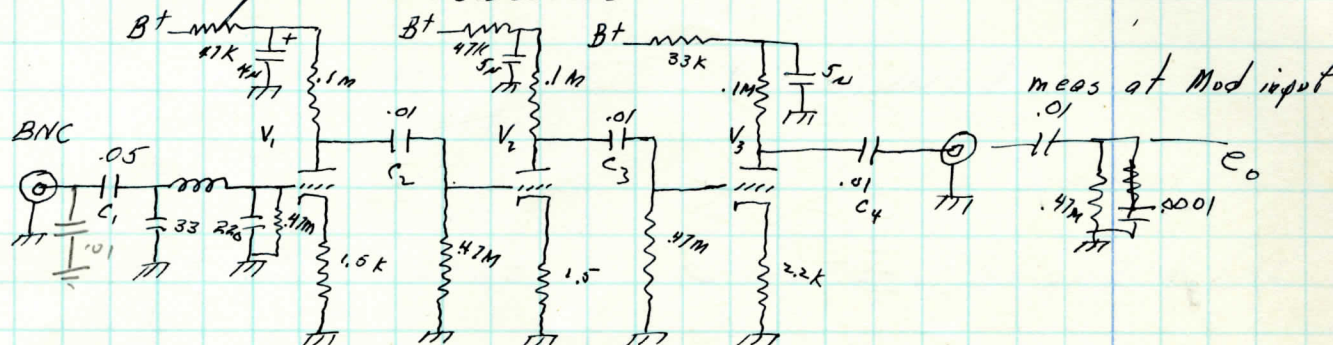
Using the antennas of the preceding page power out puts of up to 6. watts were obtained at VSWR of 1.0. Sensitivities obtained were such that a 12" CB wave at 40' produced ≈ 0.2 volt output measured across a 2.2 K resistor in the plate.



9-1-60

System check out.

Audio - Preamp characteristics:



$$V_{1,2,3} = 6247$$

Max undistorted Voltage at 1KC = 70V P.P.

$$B+ = 130.$$

Freq.	Gain -	E_o Volts P.P.	E_{in} Volts P.P.
10		2.4 x 10⁻¹	26X 2.8 x 10 ⁻² P.P.
50		2.4 x 10 ⁻¹	
100		3.5 x 10 ⁻¹	
200		3.8 x 10 ⁻¹	
400		4. x 10 ⁻¹	
800		4 x 10 ⁻¹	
1600		↓	
3.2 KC		3.7 x 10 ⁻¹	
6. KC		3.4	
9. KC.		3.1	
12 KC		2.5	
15 KC		1.1	
25 ↓		1.4	

P.P. Noise @ 62 in = .1 V eq. to in .
 " " ∞ " = .2 V

9-1-60

Receiver Characteristics - Hammarlund HQ-120 + HP 608

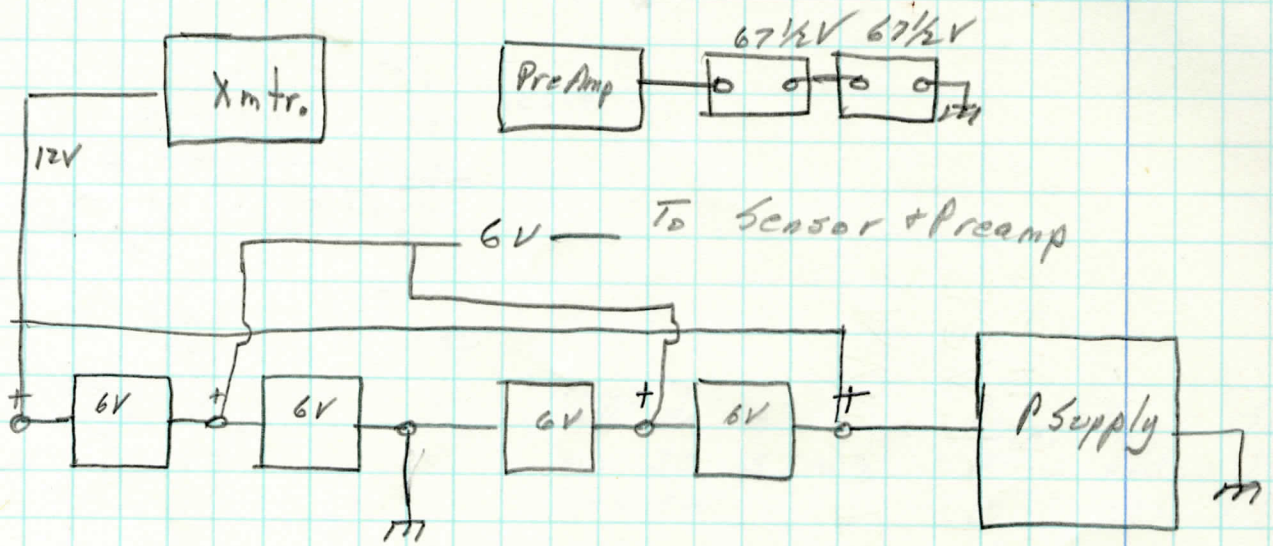
Sens. at 27 mc. 50% Mod 400 μ V

$0.6 \mu V$ For S:N. 1:1 Quite Distorted
 $3.5 \dots$ " " 10:1

Freq. - 50% Mod 27 mc e_0 ref = 20V at grid of 6V6
 10 - 12.
 50 - 20.
 100 - 17.
 500 - 17.
 1K.C. 17.
 3K.C. 12.
 5K.C. 5.
 10K.C. 0-

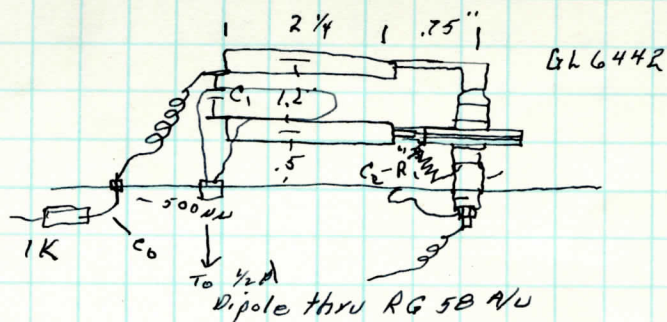
S' meter	Signal μV
2.0	0
3.0	4.0
4.0	10.
5.	19.
6.	35.
7	50.
8	100.
9.	170.
10.	450.
20.	1700
30	10 ⁴

-2-60



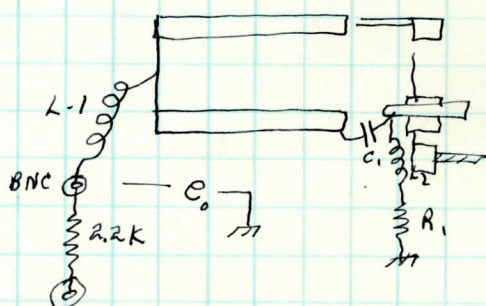
9-2-60

Sensor



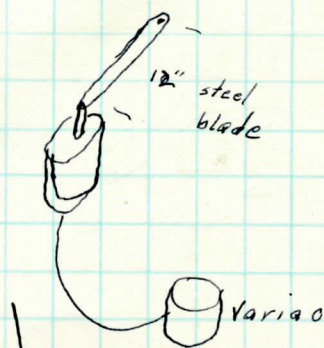
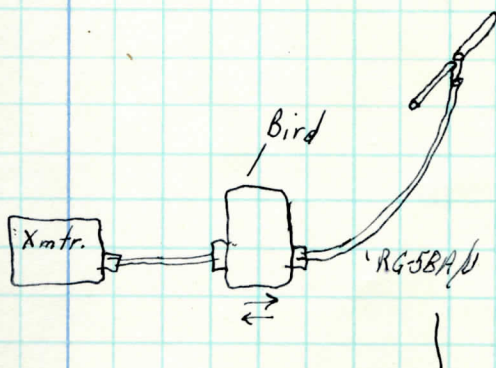
S.W.R.	C	C ₁	Quench Freq. N	R ₁ K Ω	C ₂ μ F	Power In Volts Ma	h	P _o W. H _s	Freq. Mc	Sens.
3:1.0		1.5 + 2.2 μ F	0	7.5	0	310 30	5 T. on 1/4"	.07	525	1/2 V.
3:1.2		"	5 $\times 10^6$	"	27	340 28	"	.09	523	7 1/2 V
2:1.3		"	0	"	36	410 15	"	.1	"	0-
1:1.5		"	10 ⁶	10	24	300 25	"	.04	"	high
5:1.3		"	1/3 $\times 10^6$	"	"	460 28	"	2.5	"	"

After very intermittent results especially after placing a loose cover over the osc. assy. the ckt and arrangement was changed to the one below.



L₁ = 10 T enamel
L₂ = above
C₁ =

The following arrangement was set up in an effort to determine sens.



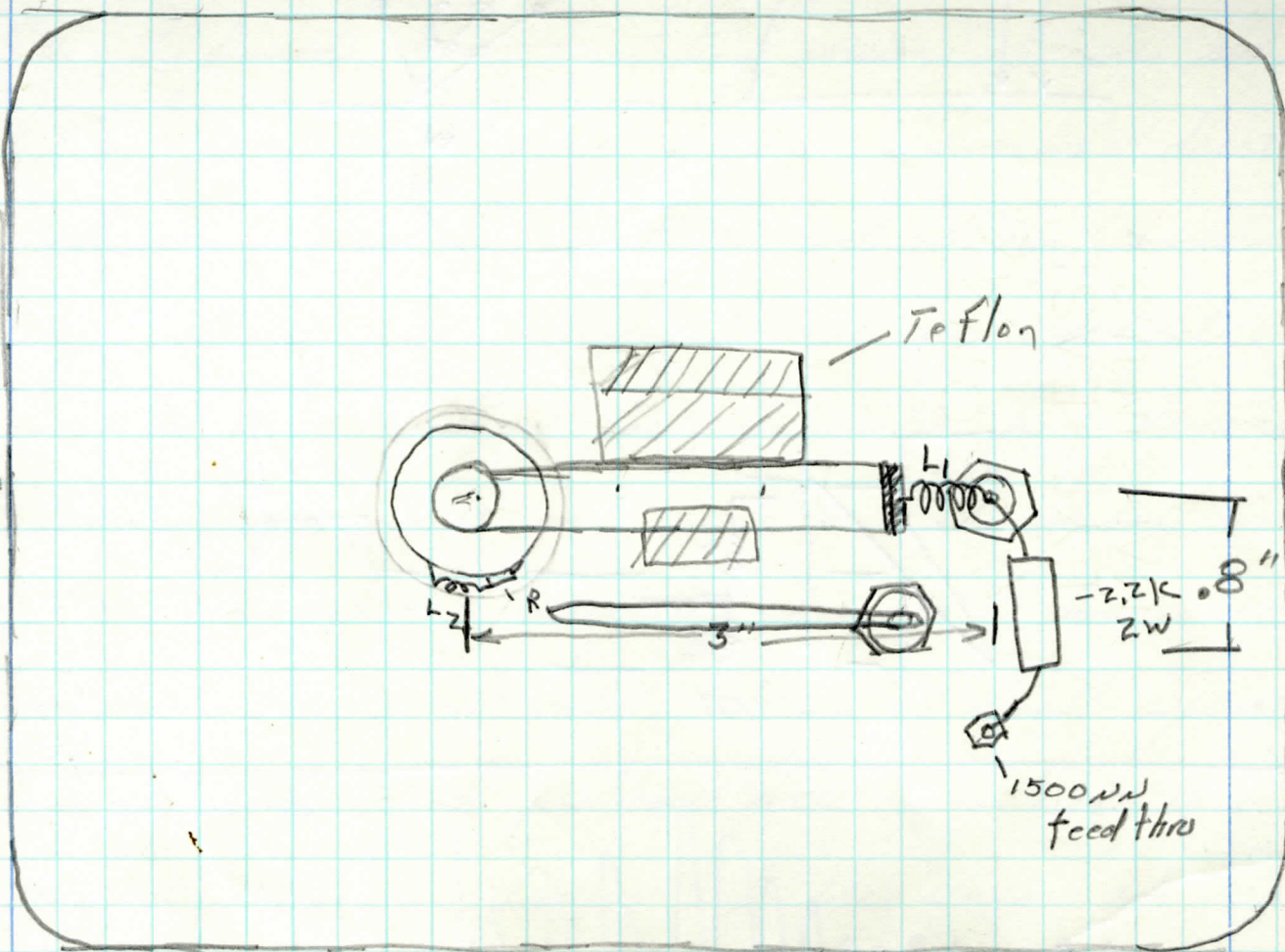
9-2-60

Preceding CKT $\bar{c}$ Loose 6x6
Al cover

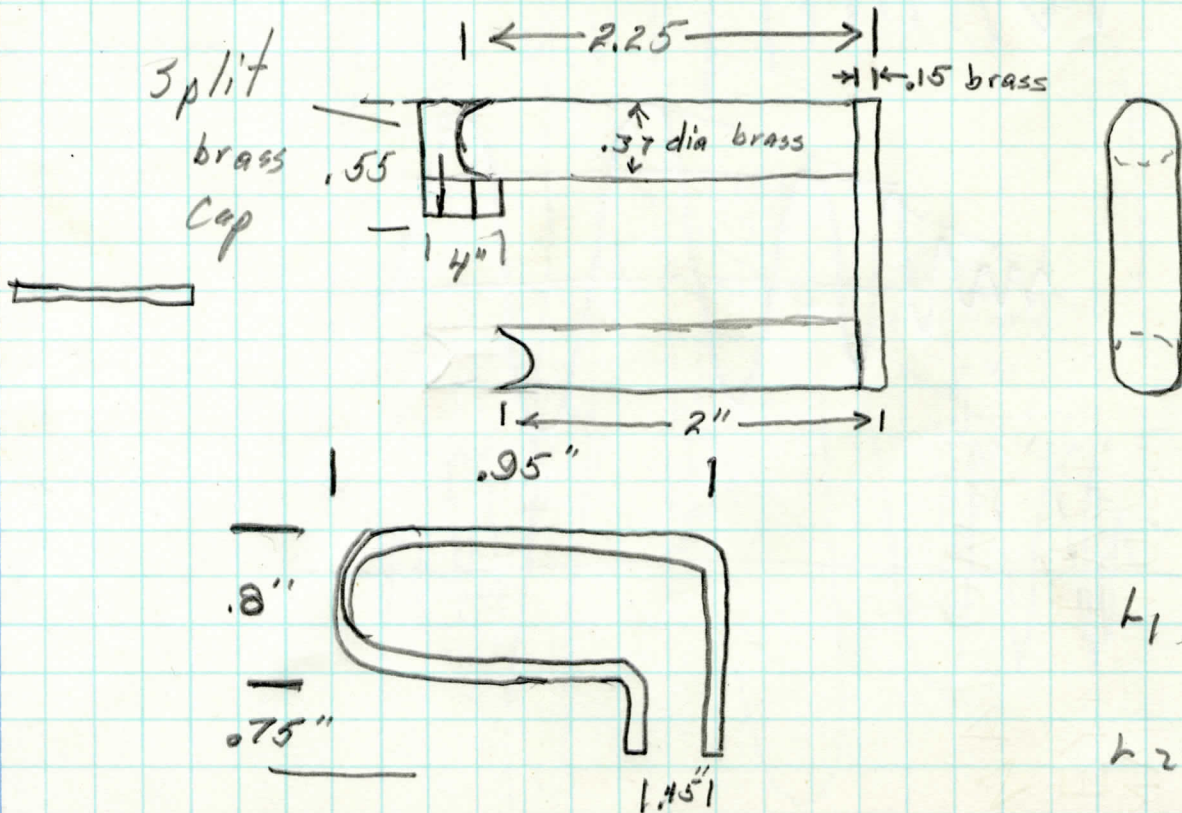
Freq Quench	Osc Mc.	B^+ Volts	$\bar{I}_p$ Ma	R_i k Ω	C_i μF	SWR	P_o Watts	E_o
0	430.	410	15	4.7	4.7	.2:3.7	3.5	.25
0		"	18	4.7	4.7+	.8:3.4		.01

5-60

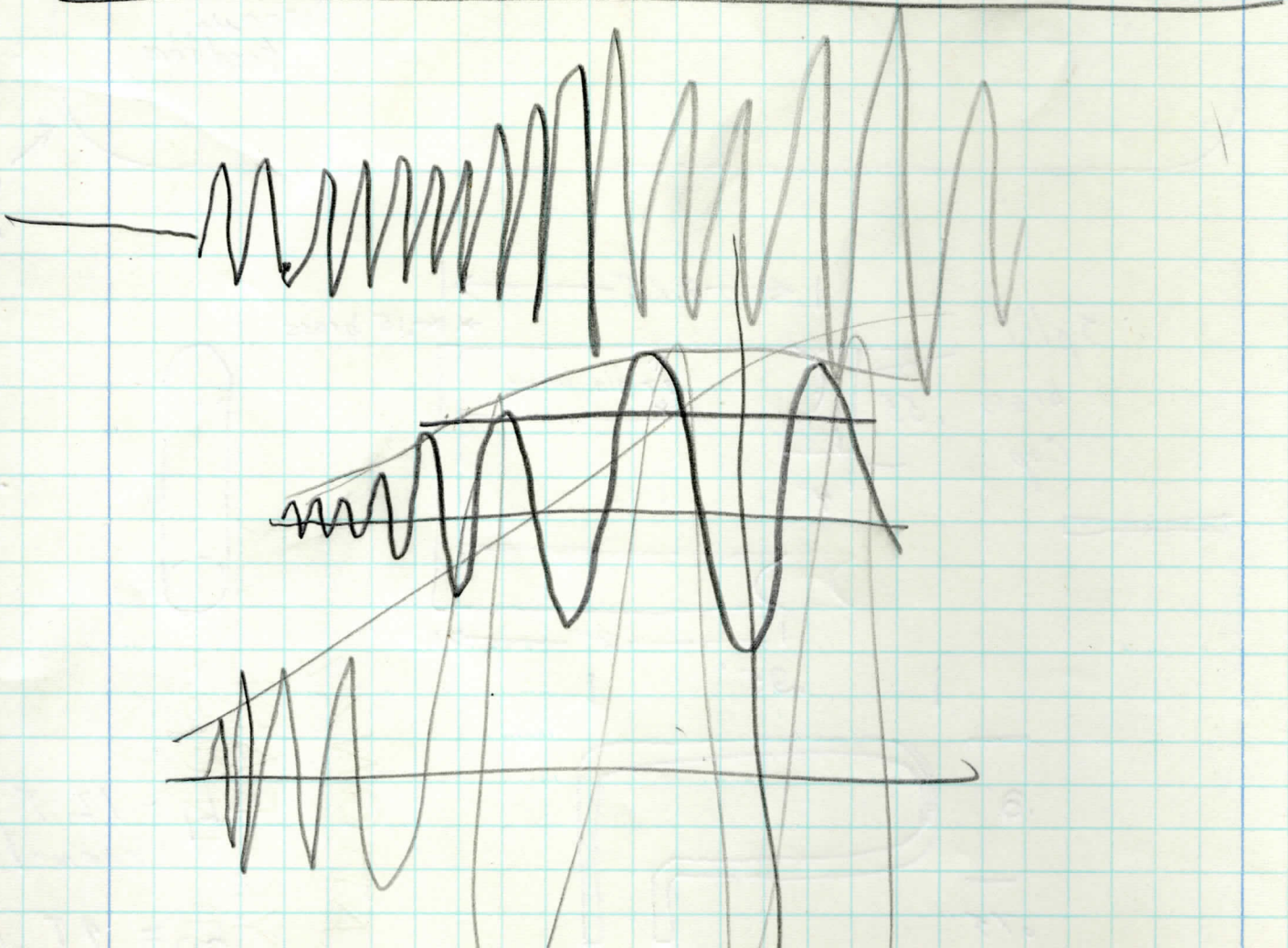
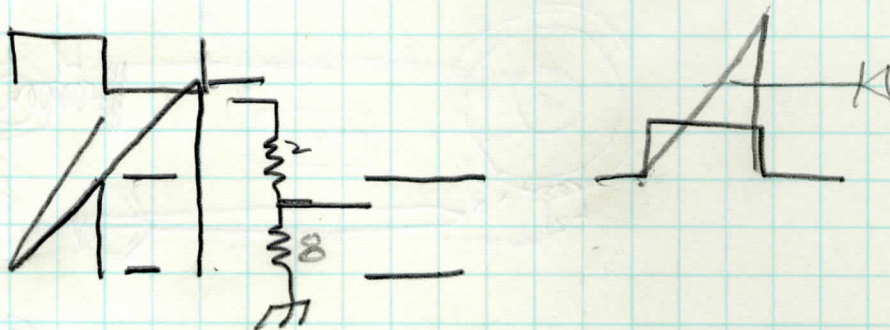
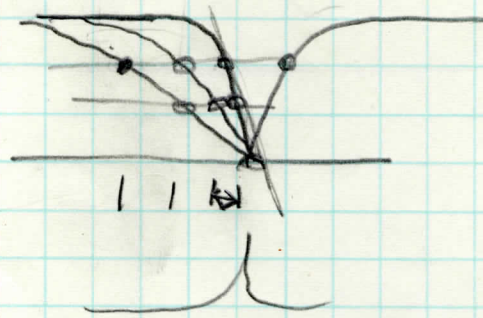
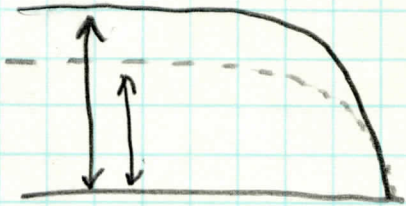
Xmtr. Layout-



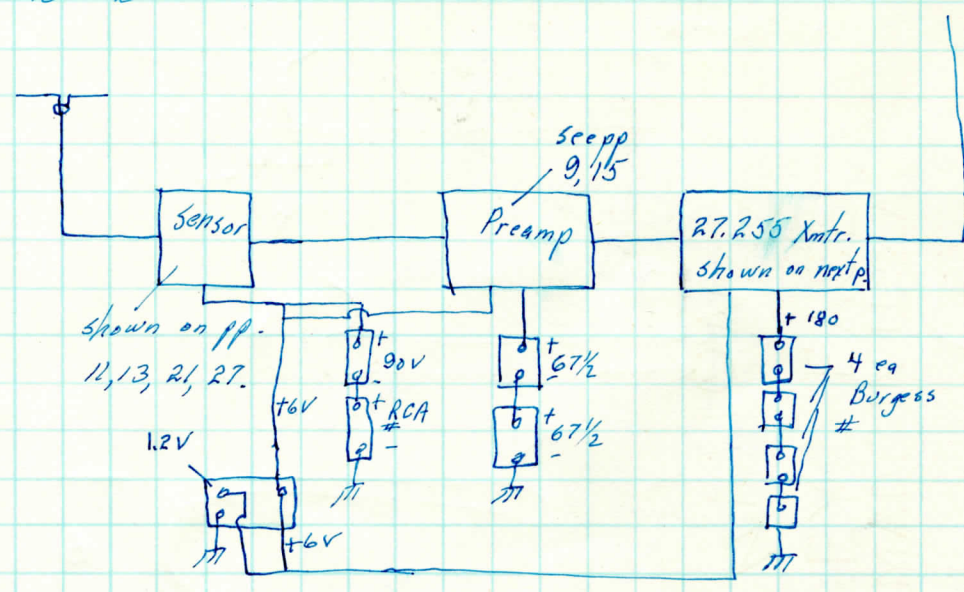
.18
Al



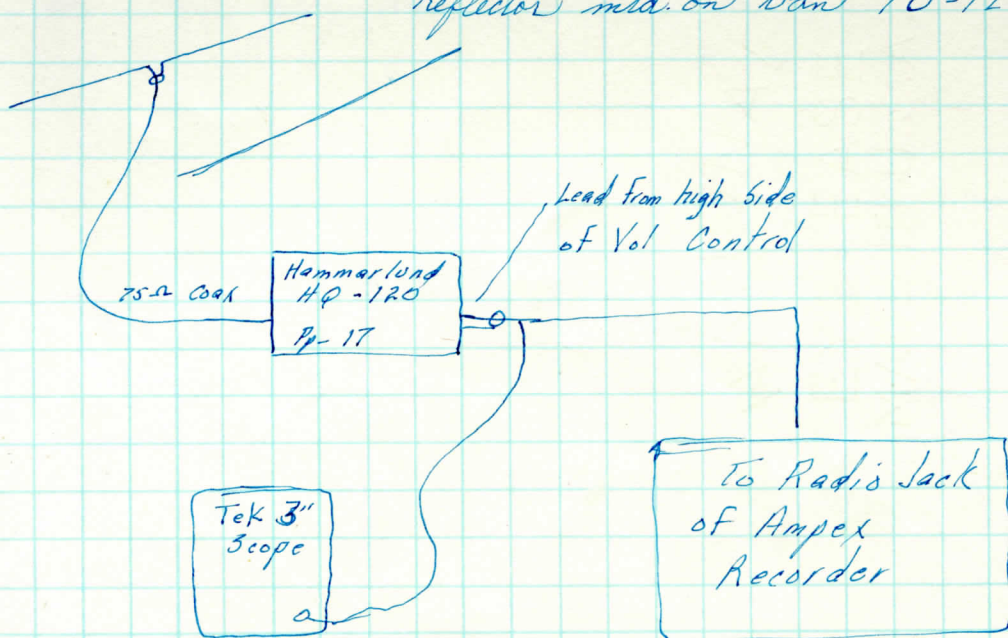
$L_1 = 12 T \frac{1}{4} " D,$
channel
 $L_2 = 4 T \frac{1}{8} " D,$
channel



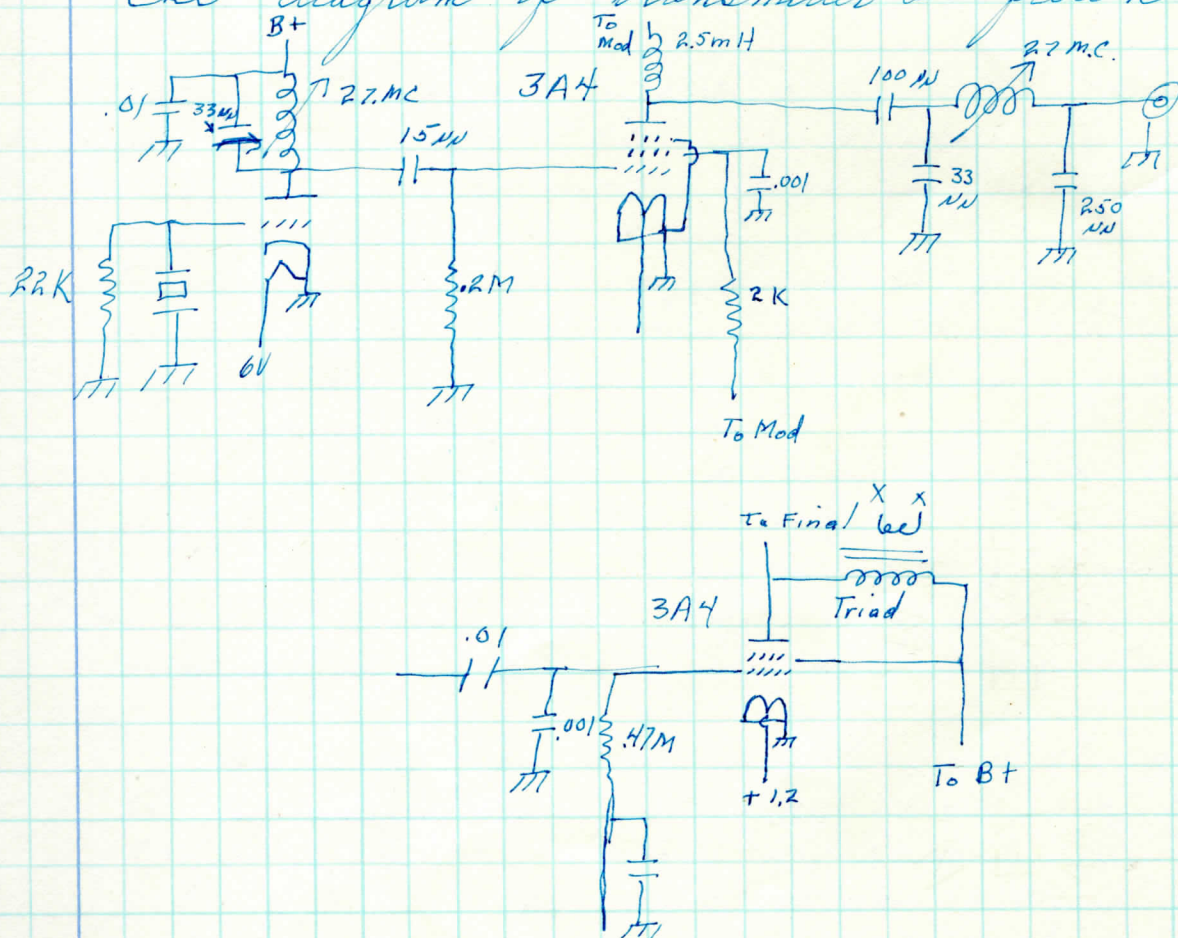
The arrangement shown below was flown in a 3 finned non-rotating version of the std. tgt. Tow line was braided nylon. Power was drastically reduced in order to replace the wet batteries/converter to dry batteries. This replacement was an expedient in view of the difficulty of hash elimination from the converter. Power was lowered even more on the sensor since it was impossible to adequately decouple a common battery supply. This necessitated adding a small separated supply. Additional problems were encountered thru the 27.255 MC. X'mtr. feeding into the sensor at high level. Block diagram of the tgt. borne equipment is shown below.



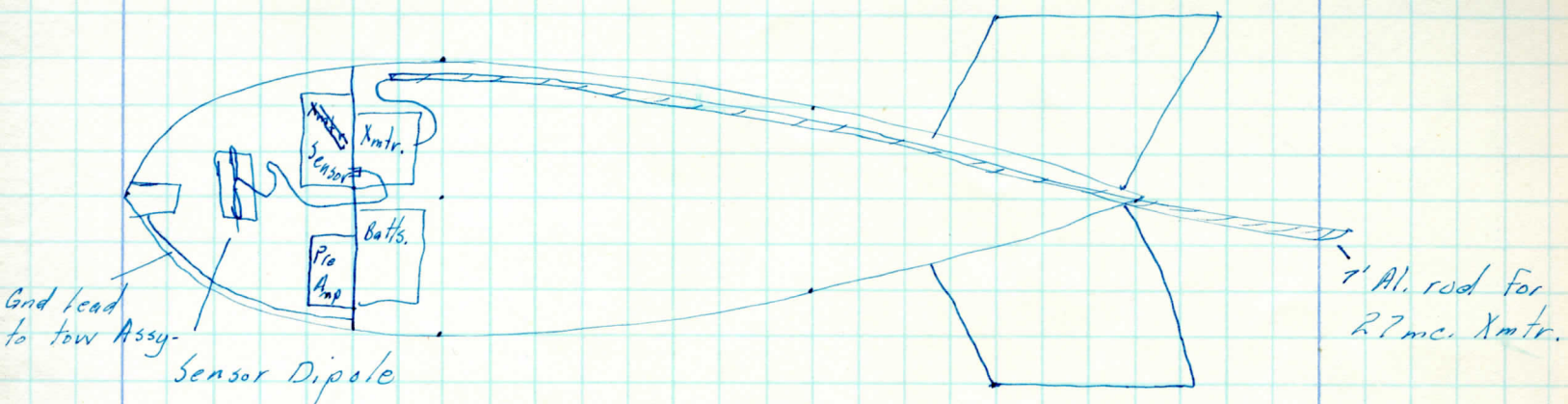
The receiving block diagram is shown below -
 27 mc $\frac{1}{2}$ dipole and
 reflector mtd. on van 10-12' above grd.



Ckt diagram of transmitter as flown



The gear as shown on p-31 was hurriedly checked out in the tgt. as shown below.



27.255 Mc. Xmtr. output was $\approx \frac{1}{2}$ watt
Sensor output was ≈ 460 MC and $\frac{1}{4}$ watt out.

Prior to takeoff a great deal of R.C. control activity was present on 27.255. The equipment was turned on and checked out in the 'basket'. Upon starting the A/C engine little modulation was present and this faded upon taxiing to the take off point. Signal strength faded until the A/C turned broadside. Modulation was completely absent and the T.O. aborted. Upon return heavy modulation was present which seemed more in the nature of vibration. The equipment was checked and a second T.O. attempt started. The modulation previously noted was present during T.O. and climb. The signal faded rapidly and R.C. control activity reappeared blocking the signal sporadically. Weather, low clouds, and spotty communication made position and configuration a matter of conjecture.

In view of this the following were my impressions. The high level noise ceased upon launch and was replaced at 25' out by a continuous modulation. The ~~noise~~ modulation level was lower at 50' out and seemed to be a more or less steady note. At this time the plane climbed from 200' to 1600' and the line^{out} was 7200'. There was little modulation - It was so quiet that it seemed the modulator or sensor might have failed. The pilot was instructed to reel in and return. Somewhere less than

8-5-60

50' propellor noise became distinct and rose in crescendo until the tgt. was recovered. After recovery the regular high amplitude noise ensued. Equivalent results were obtained for subsequent launch and recovery.

Results and recommendations.

The outstanding indication here is that a 'quiet' installation can be achieved. The sensor must be several times as sensitive but in view of the extreme quietness in absence of detectable objects no difficulty should be encountered.

10-60

Attempted to make a test flight to determine suitability of a different telemetry frequency, a high pass filter in the sensor line and in sight control of A/C. Moved the Van to Manhattan Beach and set up without difficulty. Good telemetry signal but an almost continuous, blocking oscillation probably from telemetry feed thru. Cancelled flight. Control a la Graves was very poor.

Responsibility for continued development is to be transferred to Sanctuary's group, after Sanctuary is 'convinced' that the computer works.

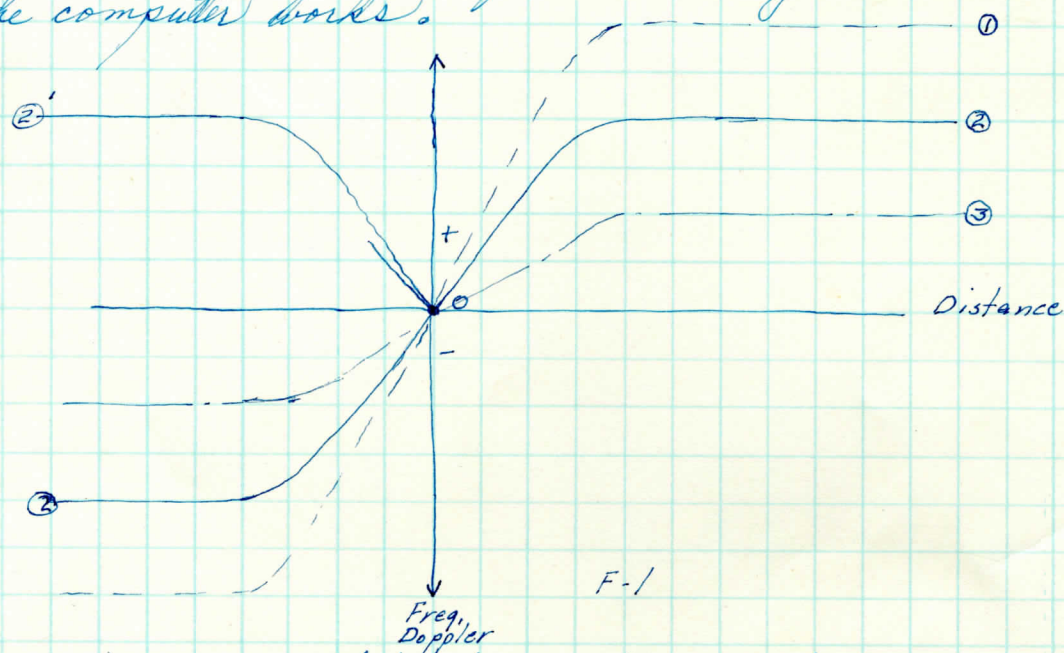
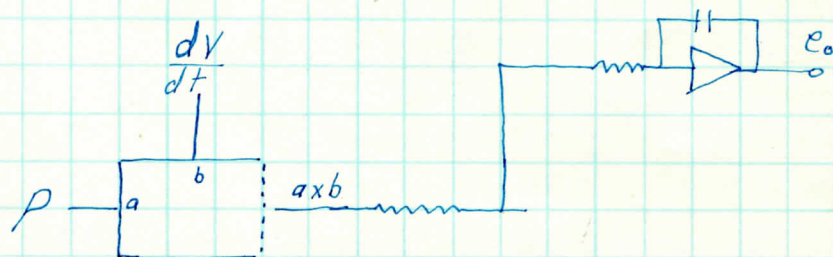


Fig. 1 is plot of doppler freq. from a constantly moving missile past a point $\wedge$. ~~at the same distance from the point.~~ 1, 2, and 3 are curves at different velocities. 2'-2 is the frequency from a typical doppler receiver which is not phase sensitive. Note that for a given 'miss' the shape of the curves are the same. Also see the scale drawn for graphic evidence of this

3-7-60

Check out of multiplier (Philbrick) for heart work

$$Work = \int \left(\rho \frac{dV}{dt} + \left(\frac{1}{2} m v^2 \right) \right) dt$$



-10-60

Doppler M.D.I. continued

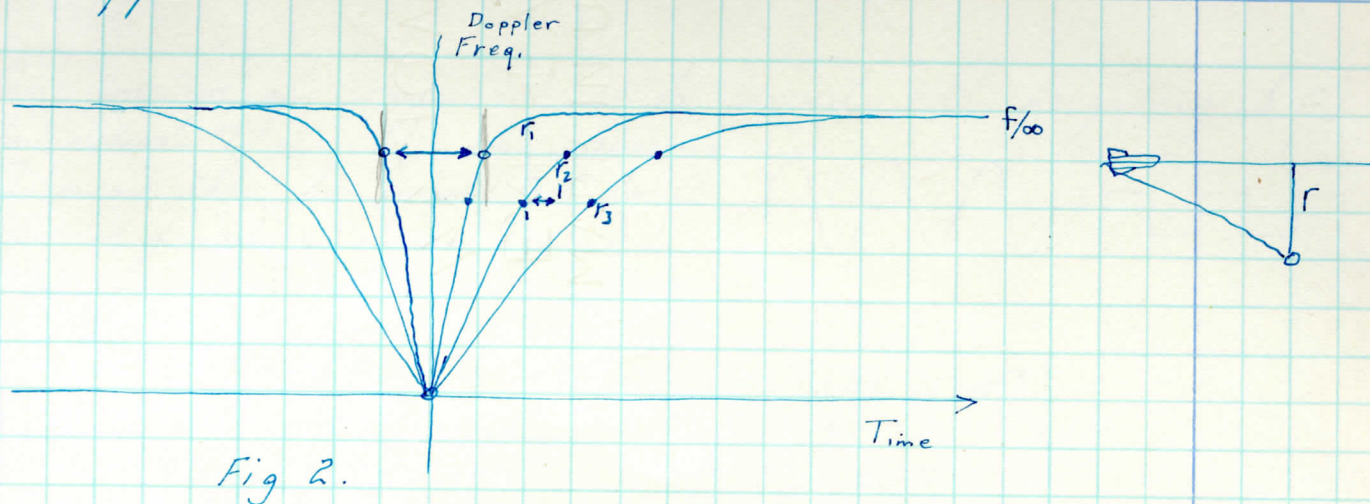


Fig 2.

The above graph represents a series of misses of different values distances at a common velocity. A variety of methods may be used to determine magnitude of miss (r). All are based in some measure on the rate of change of curve (slope).

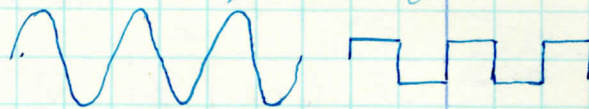
One of the simplest methods is to take some given point on the curves and measure the time required to pass twice thru this point. Here Miss Distance = $\sqrt{3/2} \cdot \lambda \cdot f_{\infty} (t_2 - t_1)$ if the point $f = \frac{f_{\infty}}{2}$.

Another approach is to take **two points** on the curve and measure the time required to pass thru these points. This time will then be a measure of miss distance.

In both cases some analog of frequency must be obtained. There are a variety of frequency to voltage converters available. For a number of reasons there ^{are} advantages to taking the analog of period Φ or $1/f$ frequency. A second problem is that of accurately determining the time of coincidence.

-10-60 Doppler M.R.D. continued.

One method of computing is to convert the frequency (F) to period T or $\frac{1}{F}$ by squaring. T may then be converted to some function of voltage. If this function is linear:



Ex-

$$\begin{aligned}
 F &= 3 \times 10^3 \text{ Hz} & T &= \frac{1}{F} = 0.333 \times 10^{-3} \\
 + 0.8 F &= 2.4 \times 10^3 & &= \frac{1}{2.4} = 0.417 \\
 0.6 F &= 1.8 \times 10^3 & &= \frac{1}{1.8} = 0.555
 \end{aligned}$$

For coincidence purposes:

$$\text{Voltage} = K \frac{1}{F}$$

and some fraction α is taken of this voltage such that $\frac{K}{F} = \alpha \frac{K}{F_2}$ or $F_2 = \alpha F_1$

$$\text{Or for } K \frac{1}{F_1} = K \frac{1}{\alpha F_2}$$

$$F_1 = \alpha F_2$$

Computer Scale Factors

Max. Multiplier Output - ± 50 Volts

$$\begin{array}{l} \bar{c} \text{ flow } \left(\frac{dv}{dt} \right) \text{ in } \text{cm}^3/\text{sec} \\ \cdot \text{ in Squarer } \quad K_1 \left(\frac{\text{cm}^3/\text{sec}}{\text{cm}^2} \right) \cdot \text{ out } \quad \frac{K_1^2 \left(\frac{\text{cm}^3/\text{sec}}{\text{cm}^2} \right)^2}{25} \end{array}$$

in Multiplier - mv^2

$$a = K_2 \frac{dv}{dt}$$

11-60

Heart Work Computer

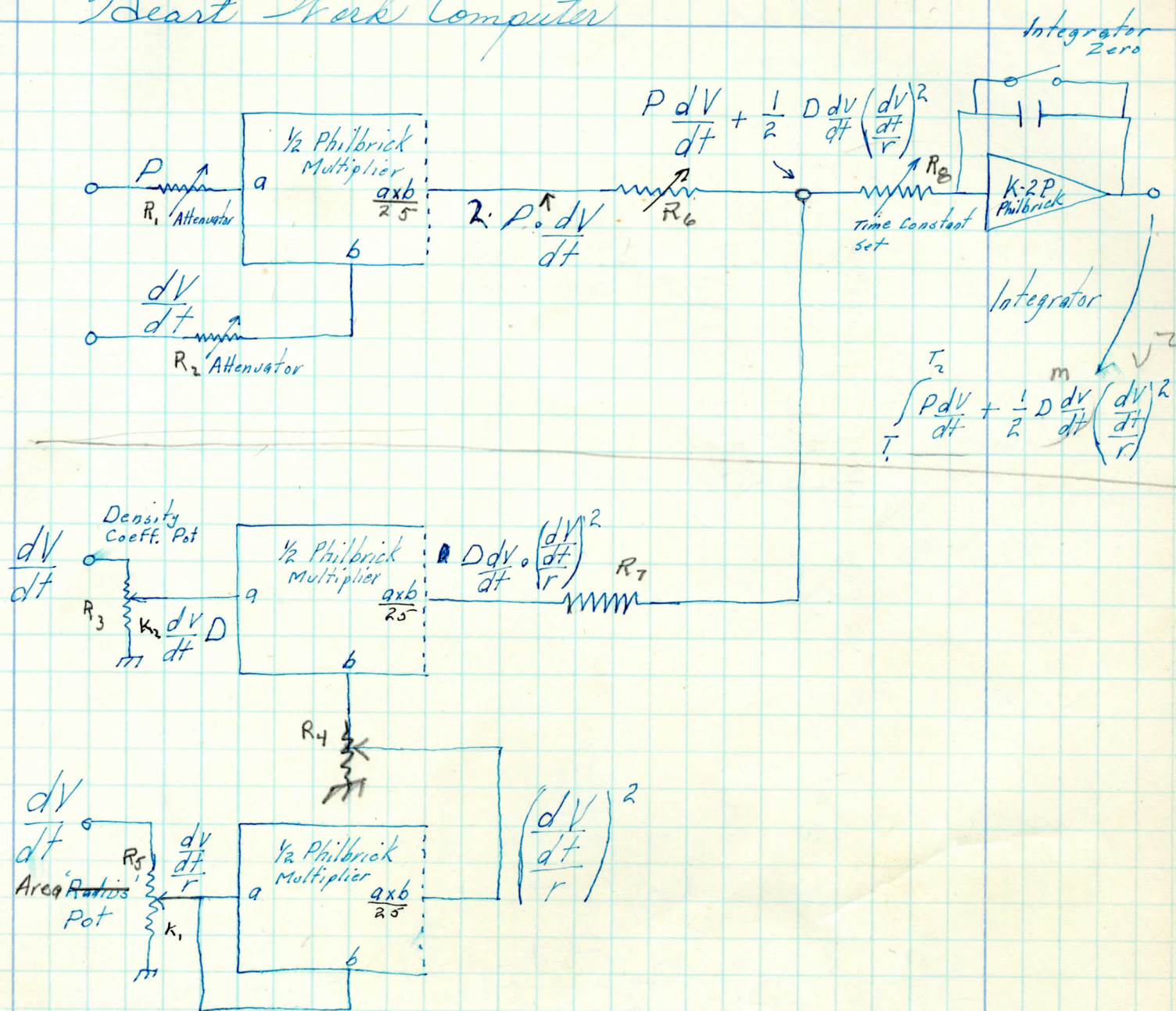


Fig -

A block diagram of the computer is shown here. This is symbolized without the detailed connections of power supplies, balance controls and other auxiliaries. These units are commercially available items with operating instructions supplied. The first computation

Hand-drawn circuit diagram of a three-stage RC network. The circuit consists of three identical stages connected in series. Each stage is composed of a resistor in series with a parallel combination of a resistor and a capacitor. The input is labeled "GR Plugs" and the output is labeled "Phone Jack".

- Stage 1:** A $5K$ resistor (R_1) is in series with a parallel combination of a $50K$ resistor and a $50pF$ capacitor.
- Stage 2:** A $5K$ resistor (R_2) is in series with a parallel combination of a $50K$ resistor and a $50pF$ capacitor.
- Stage 3:** A $5K$ resistor (R_3) is in series with a parallel combination of a $50K$ resistor and a $50pF$ capacitor.

As Above except $R_2 = 50 \text{ K}$

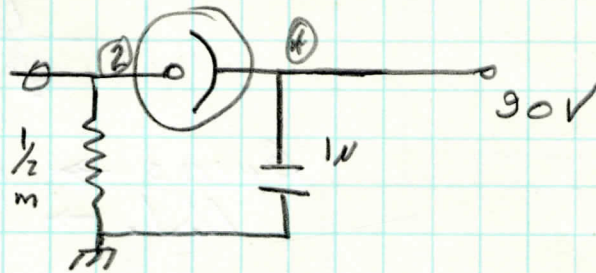
Only R_1 as above with 2 phone jacks in parallel

[illegible]

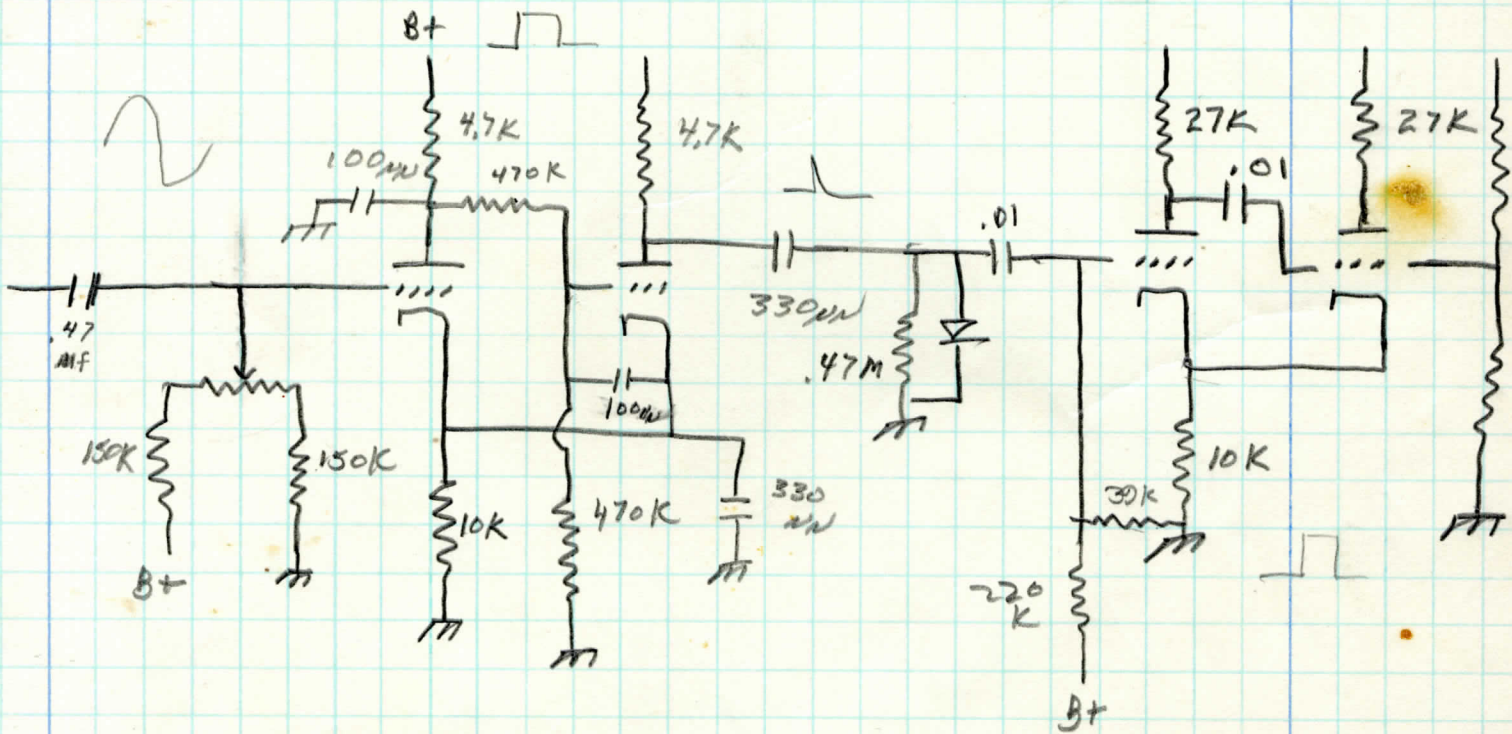
-15-60

Photoformer

918



Ckt. of Sub Carrier Demod P.W.



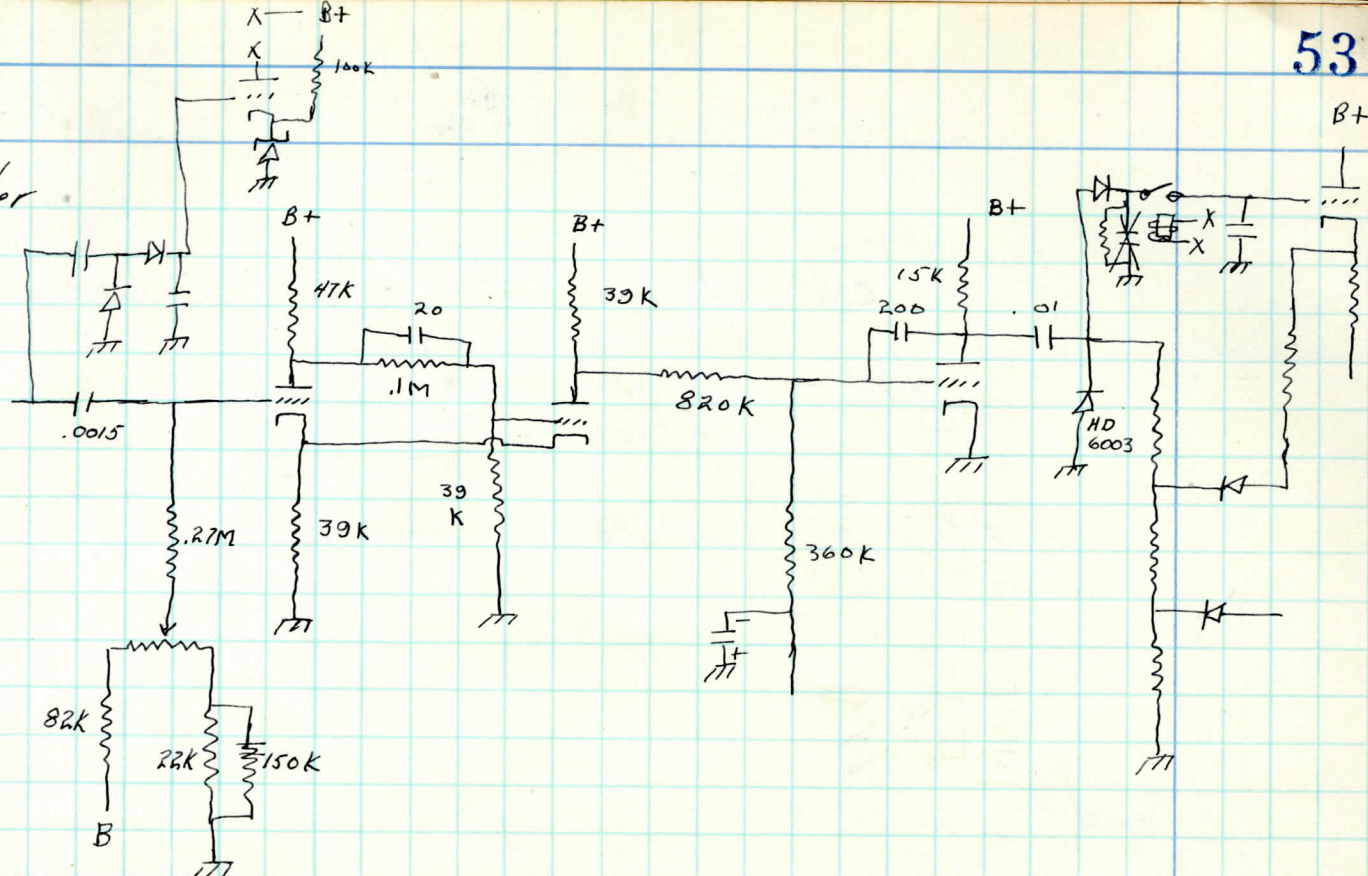
P R - 23 - 6 G - 1500^A

25 V -

125 - mv/300mm -
\$ 275. 3 wks -

Burns → 20 Stern Ave.
N.J. → Springfield.

8-15-60
2 pt computer



$$W = PV = F \times D$$

$$= \text{cm}^3 \cdot \text{dynes/cm}^2 = \text{dyne cm or ergs}$$

$$\dot{W} = \frac{dV}{dt(\text{sec})} \cdot P = \text{dyne cm/sec}$$

$$\text{Flow} = \text{cm}^3/\text{sec} \cdot \text{dyn pressure} (= \text{dyne/cm}^2)$$

$$\text{and } \frac{1}{2} m v^2 = \frac{\text{gm cm}^2}{\text{sec}^2}$$

$$\text{mass} = \text{Volume} \times \text{Density}.$$

8-16-60

Check of Mod. Metreflow

Integrator - Low

Gain -

Initially calibrated by measuring successive vols. in
1 L. graduate

# 1	575 ml
2	572 "
3	572 "
4	570 "
5	572 "
6	<u>575 "</u>

572 ml
<u>260 counts.</u>
34320
<u>1144</u>
148720 L

Final wt -

Initial wt - 484.50

Final wt -	160.25
	<u>323.25 #</u>
	454

129300

161575

129300

146750.50

Final -

Initial -

400.00

151.70

248.25

454

112705.50

475.

200

950.

Flowmeter Probes

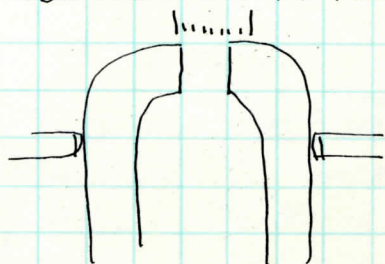
Core material - Grain Oriented Steel by
Carstedt - Research Inc.
2501 East 68th Street
Paramount, Calif.
Long Beach Calif.



#1, #2, & #3 mils - recommended 2 mil for 400N

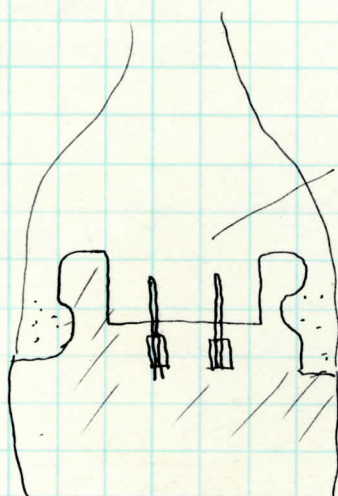
#18 Formvar - 50 T

Eurane 221 resin - D 40 activator



gap to be adj. c nylon screws thru mold

Connector detail



mating connector of Silastic RT
501

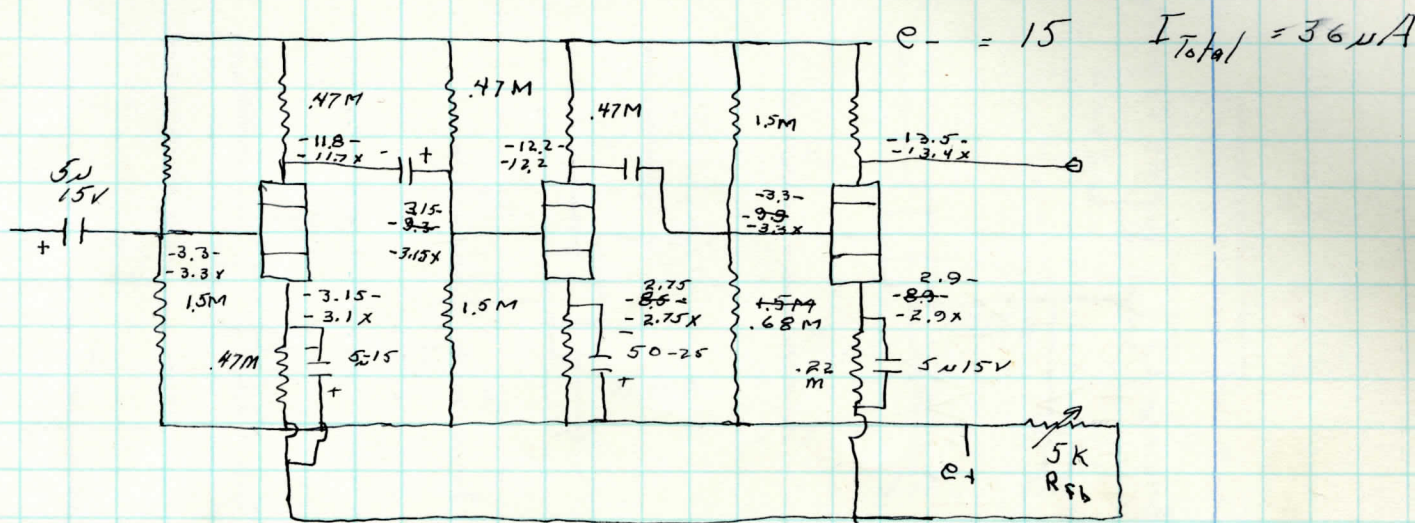
Electrodes -

Avionics
Talbot
Car
Singer

7
08
28)2.00
\$

Performance of Hi-Impedance Amp.

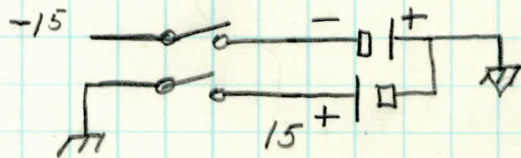
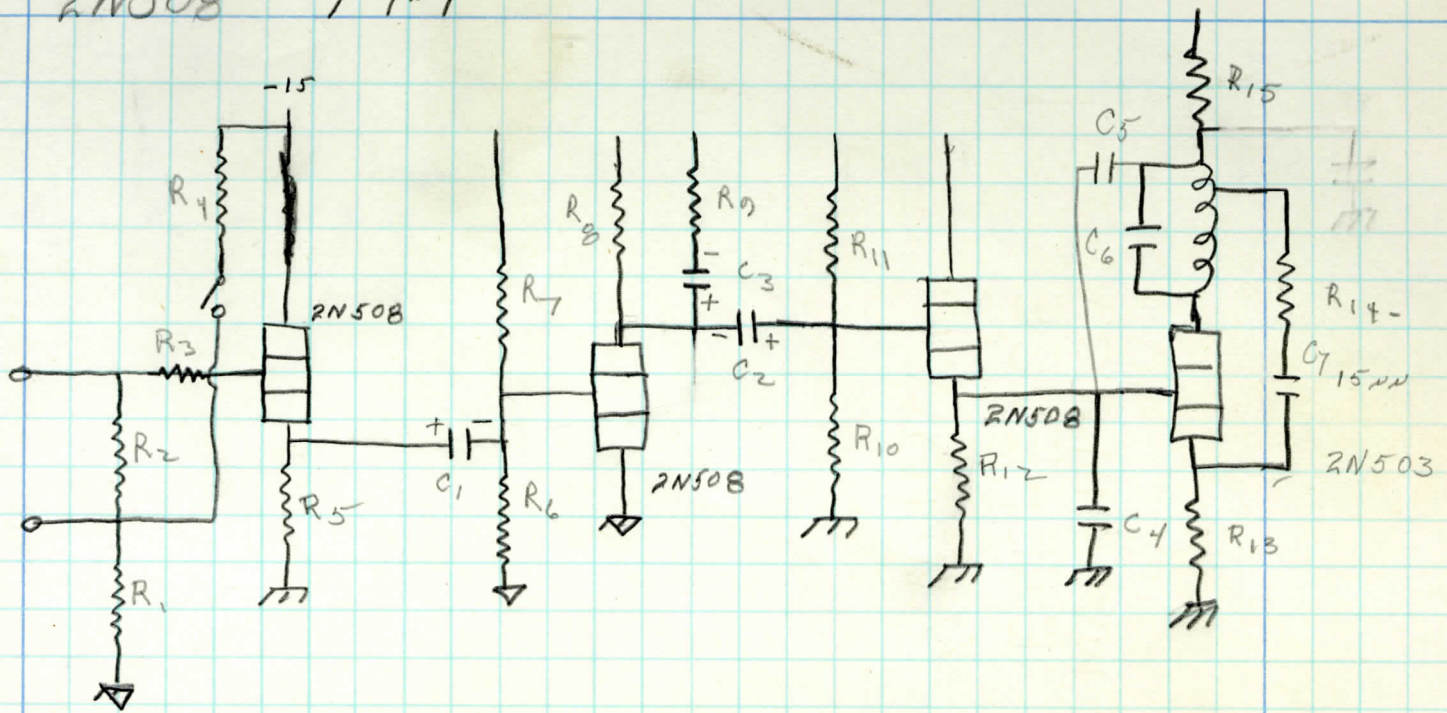
All transistors CK 942 - 6004 RAY



	E_{out} V.P.P.	E_{in} V.P.P.	G_{in} $\frac{7 \times 10^{-1}}{8.4 \times 10^{-3}}$	Z_{in}
$\bar{c} R_{fb}$ max -	10.5 7.003	2.8	$\approx 9 \times 10^2$	33 K
min x -	1	$0.208 \times 2.8 \times 10^2$		680K
$\bar{c} R_{fb}$ Max -	2×10^3	$1.08 \times 2.8 \times 10^{-3}$	$= 7 \times 10^3$	680K 33 K.

Input Imped - meas by inserting resistance in series $\bar{c}$ input until output was halved

2N508 T M-1



Batteries 2 ea Gulton 6VD-180 7.2V. - Newark 79F616

Switch, Pwr.

" , calib.

6 ea 2N508 Transistors -

1 ea 2N588 "

3 ea switch craft 39-1 spst N.O.

3 ea Cutlerhamner 8867 K1

4 ea 250V 12V capacitor

4 ea 300V 3V "

24F209

23FX331

18F832

18F547

R₁ - 100Ω 1/4W 5%

R₂ - 39X10⁶ " 20%

R₃ - 1KΩ " "

R₄ - 7.2X10⁵ " 5%

R₅ - 22K " 20%

R₆ - 47K " 10%

R₇ - 3.3M " 10%

R₈ - 15K " 20%

R₉ - 15K " 20%

R₁₀ - 68K " 5%

R₁₁ - 82K 5%

R₁₂ - 47K 20%

R₁₃ - 330Ω 10%

R₁₄ - 220Ω 10%

R₁₅ - 15K 20%

C₁ - 300V 3V Sprague

C₂ - 250V 12V "

C₃ - 250V 12V "

C₄ - 1001V

C₅ - 201V

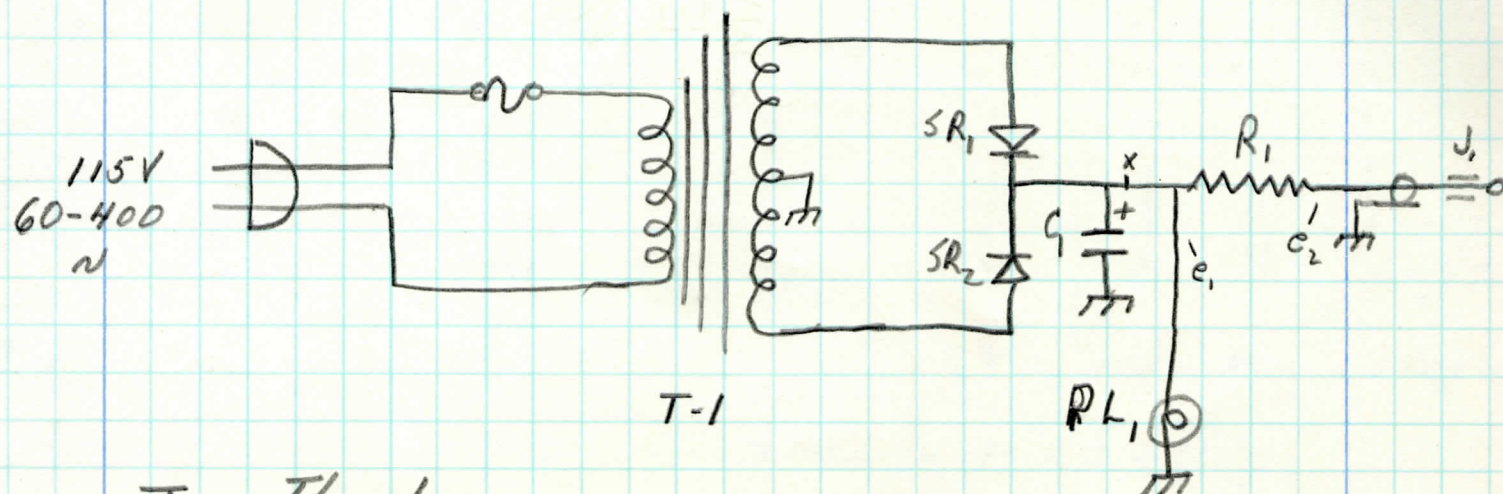
C₆ -

C₇ -

TM #1	Freq.	Current	Sens	Zin
	before transinst.	ma		
	112	5		30K -
	106			
	103			

It was acc. to change R₁₁ to 105Ω -

D.H.T.M. Supply



T₁ - Thorndarson
21F27 - 26.5V.C.T. 1A sec. 115V Pri.

SR_{1,2} - Sarkes Tarzian M-500 500 Ma 130 rect-

PL₁ - 1815

C₁ - 500 μ fd. 25V. cond.

R₁ - 1K Ω 1 watt

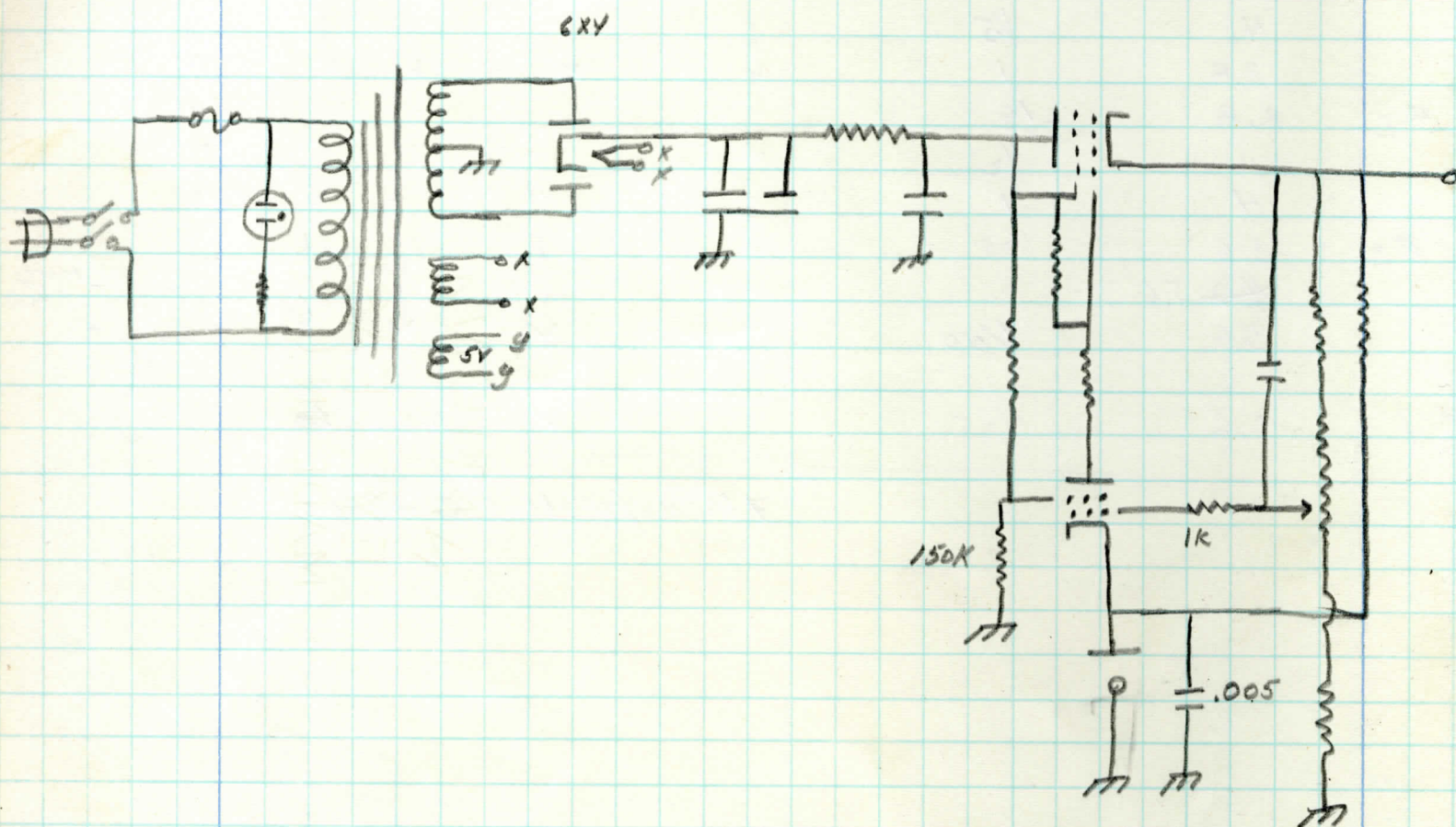
J₁ - Min. Phone Jack

e₁ - +15.7 Volts

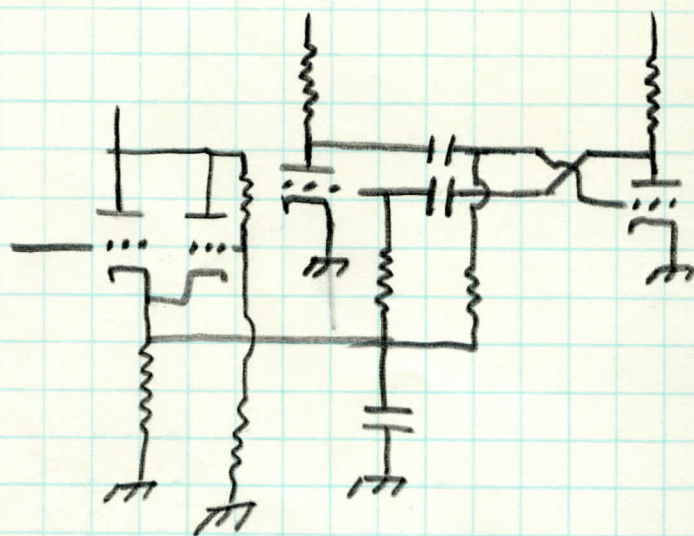
e₂ - +14.4 "

#	F	sec	Scale	Sens -	H	L	O-Flow
#1	4.	$\frac{1}{2}$	Full	100 μ V/cm	10K, 8	330 CPS	O-Flow
	4.	$\frac{1}{5}$	↓	↓	↓	↓	↓
	2.8	1	↓	↓	↓	↓	↓
#2	2.8	$\frac{1}{2}$	"	"	"	"	"
	"	$\frac{1}{2}$	"	"	"	"	"
	4	1	"	"	"	"	"
#3	5.6	$\frac{1}{25}$	"	↓	↓	↓	"
	4.0 5.6	"	"	↓	↓	↓	small - "
	5.6	$\frac{1}{50}$	"	↓	↓	↓	large
#1	5.6	$\frac{1}{25}$	"	↓	10K 60	to	large

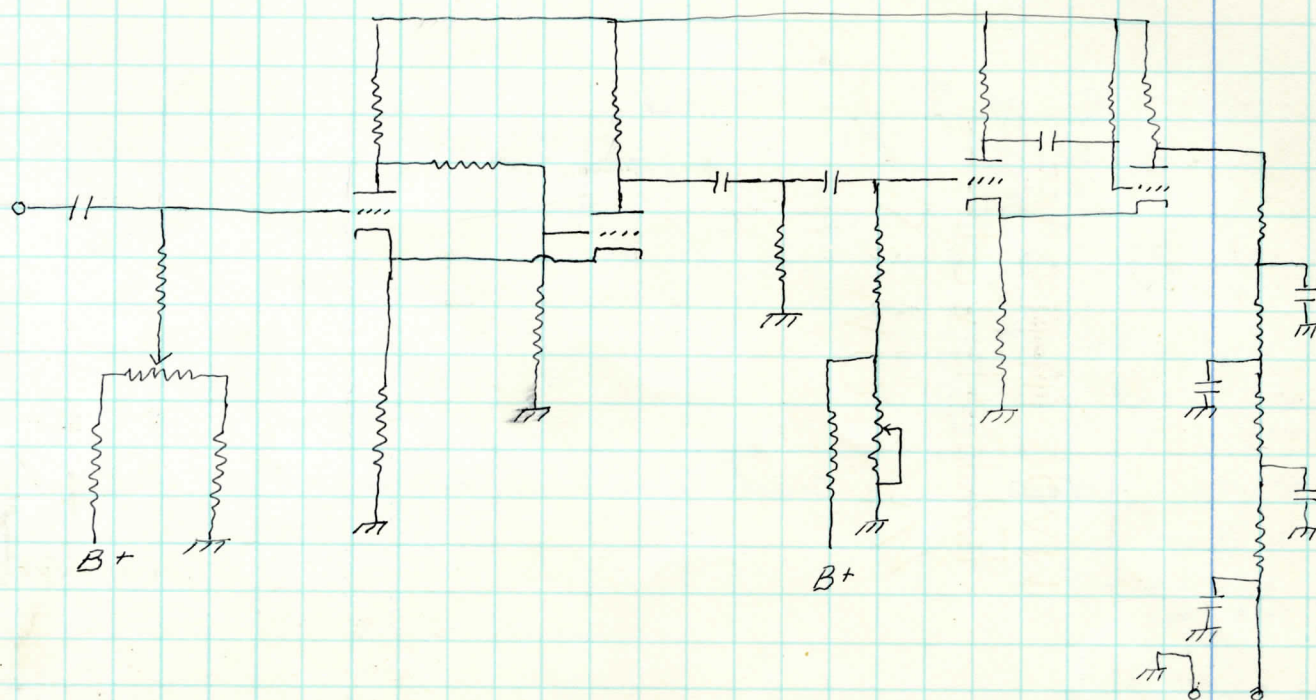
7100 μ V/cm 10 KC + 8 CPS



S.C.O.

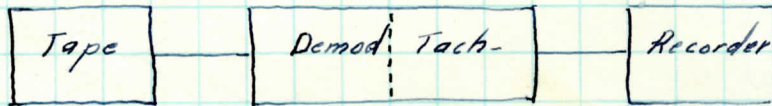
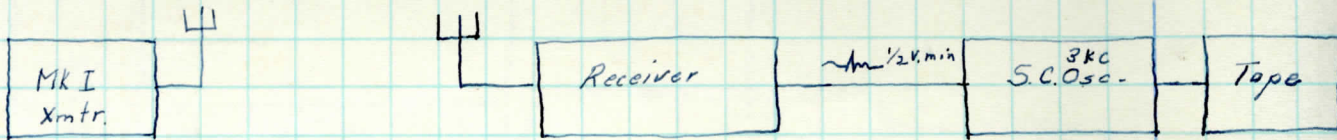


Sub Carrier Demodulator

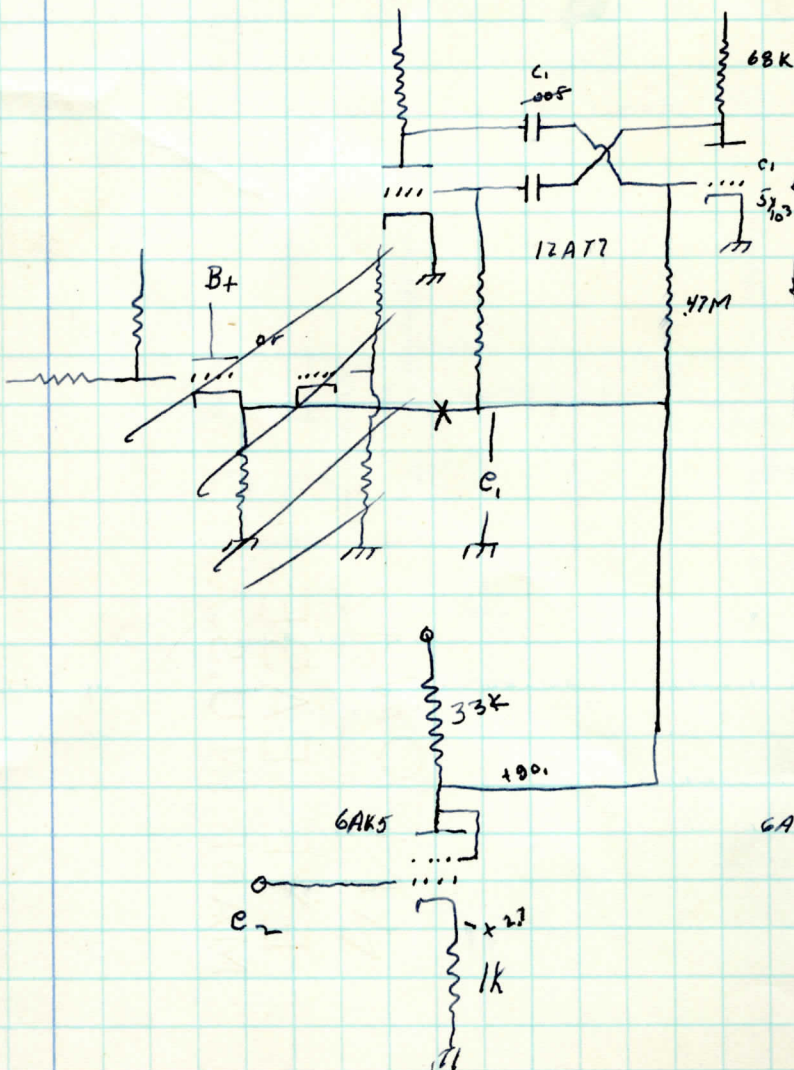


A cardiostachometer will be constructed to satisfy Dr. Craig's requirement for a preliminary study on tachycardias. The 'Older period' tachometer ($V_{out} = \frac{1}{4}$) had no smoothing. This resulted in a 'dirty' record.

Pulse count system

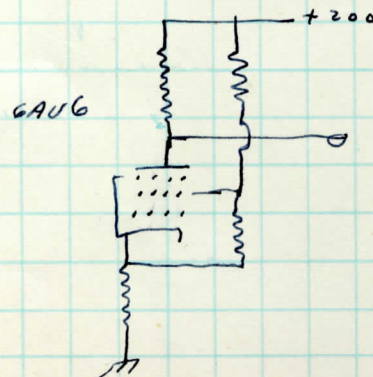


S.C. Osc.

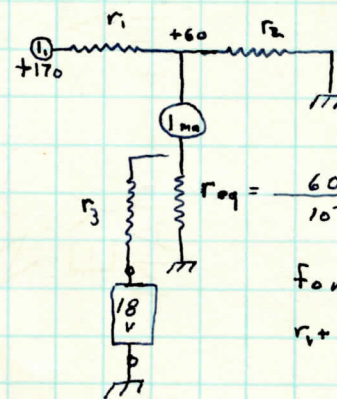
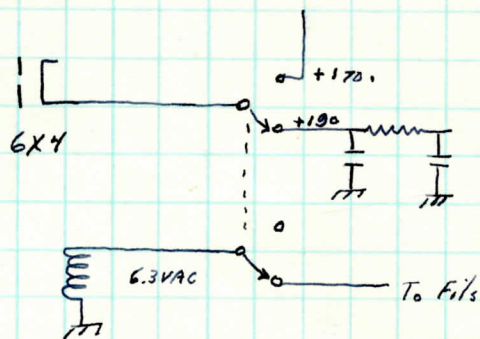


C_m	$\tau \times 10^{-3}$	E_1	$C_0 / 2 \text{ ms/cm}$	E_2
7.5	16	0	2 ms/cm	V
6.2	10.4	+20.0	↓	
4.0	8.0	+41.0	↓	
5.0	10.6		↓	
7.4	3.7	+162.0	.5	
8.4	4.2	+125.0	↓	
9.4	4.7	100.0	↓	
5.3	5.3	75.0	↓	
7.0	7.0	50.0	↓	
7.4	.74		0.1	0
7.68	.768		↓	+ .5
8.0	.80		↓	+ 1.0
8.28	.828		↓	+ 1.5
8.8			↓	+ 2.0
9.2			↓	2.5

Insufficient Gain - Try this



Mod. to Eico HFT-90 for charging batteries



$$\text{for } I_1 = 5 \text{ mA}$$

$$r_1 + r_2 = \frac{170}{5 \times 10^{-3}} = 34 \times 10^3$$

$$P_{r_1 + r_2} = \frac{34 \times 10^3 \times 5 \times 10^{-3}}{2} = \frac{1}{2} \text{ W}$$

$$r_1 = \frac{170 - 60}{5 \times 10^{-3}} = \frac{110}{5 \times 10^{-3}} = 22 \times 10^3$$

$$r_2 = \frac{60}{4 \times 10^{-3}} = 15 \times 10^3$$

$$r_3 = \frac{60 - 18}{10^{-3}} = 42 \times 10^3$$

Defl. Cal Period Ein
cm. $0.1 \times 10^{-3} \text{ cm} \times 10^{-3} \text{ sec.}$

$r_k = 3-1 \text{ K in II}$
6AK5

7.0		.7	0
7.1		.71 + .01	
7.2		.72	.02
7.4		.74	.03
7.5		.75	.04
7.7		.77	.05
7.9		.77	.06
8.0		.80	.07
8.2		.90	.08
8.4			.09
8.6			.10
8.8			.11
9.1			.12
9.3			.13
6.7		-.2	
6.5		-.24	
6.3		-.06	
8.2		.0	
8.4 8.5		+ .01	
8.6 8.75		.02	
9.0			
9.3		.4	
9.6		.05	
10.		.6	

$r_k = 300 \Omega \text{ II K}$
↓

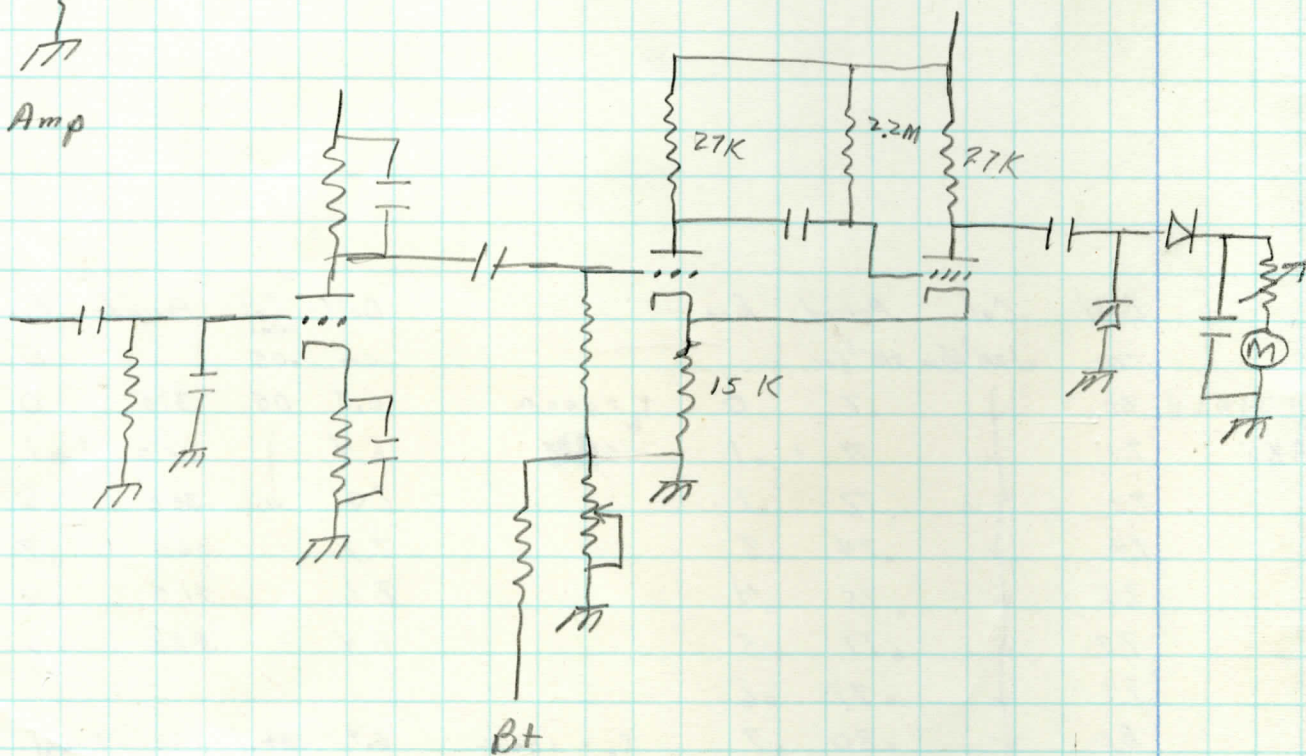
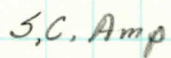
$r_k = 300 \Omega$
6AU6

$r_k = 150 \Omega$
6AU6

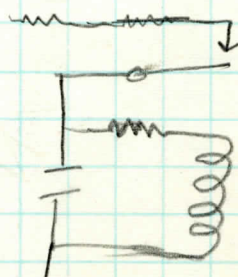
Defl. Cal Period Ein
cm. 0.05

6.3	.05	.315	0
6.4		.320	+ .1
7.0	↓	.350	.6
7.2		.360	.7
8.2		.410	.12
8.4		.420	.13
6.7	.1	.67	+ .11
6.4	.1	.64	.12
5.0	↓		.7
4.8	↓		.6
4.1	↓		.5
3.9	↓		

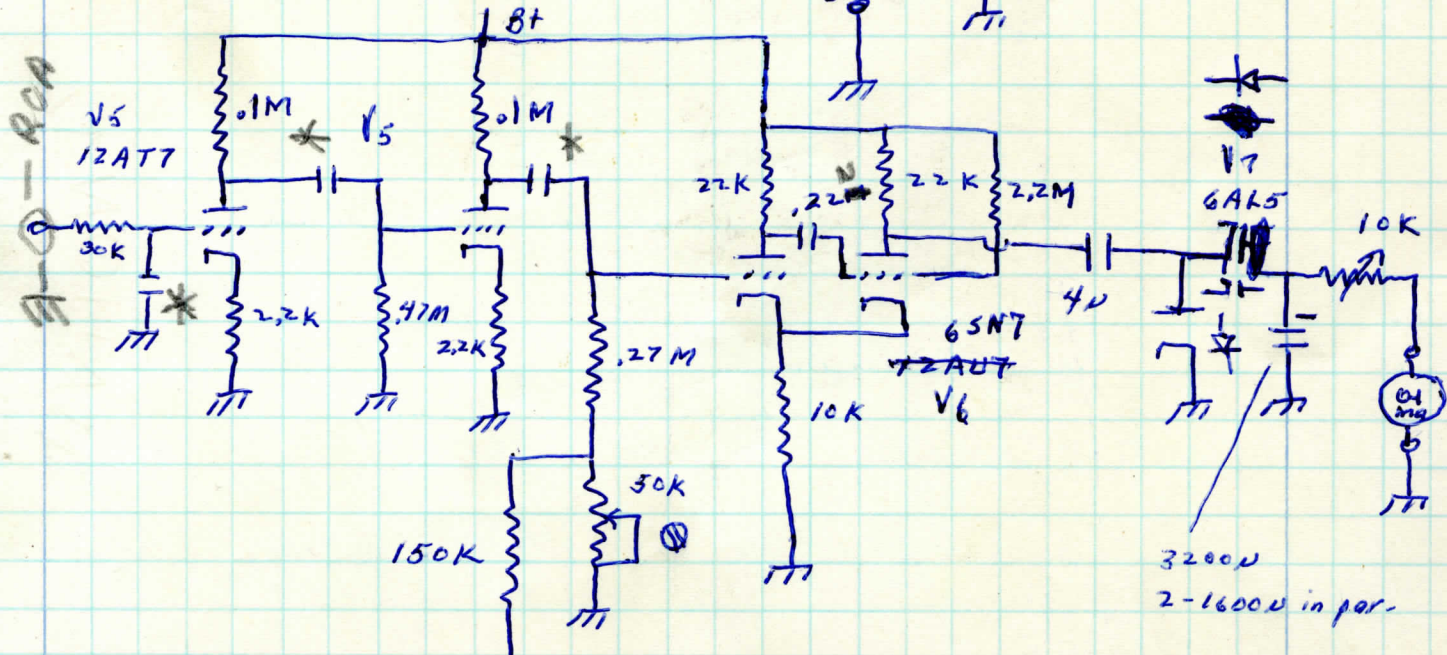
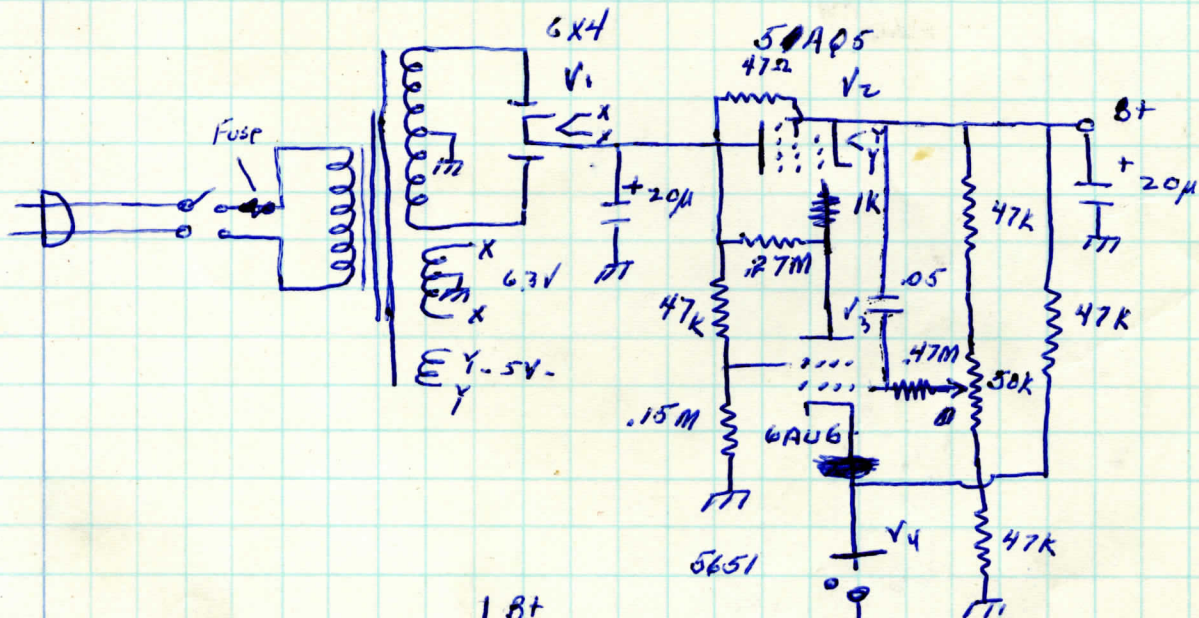
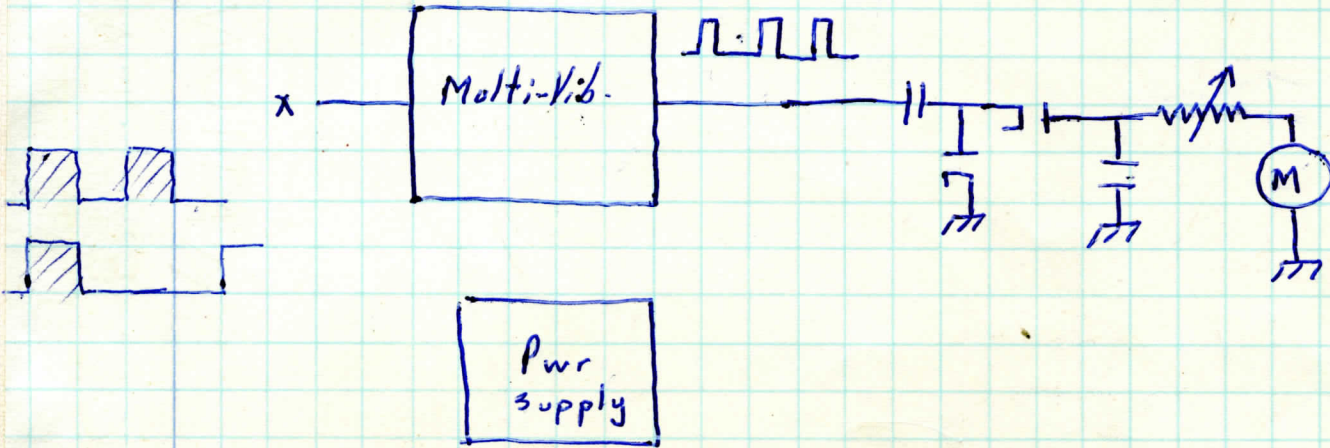
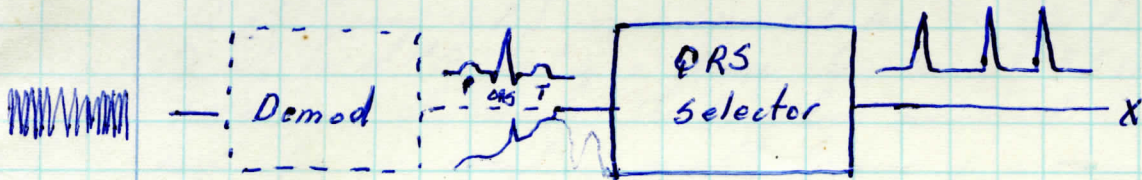
1



PGME - Cardio Tach - O.Z. Reg P-48



Cardio tech Prototype

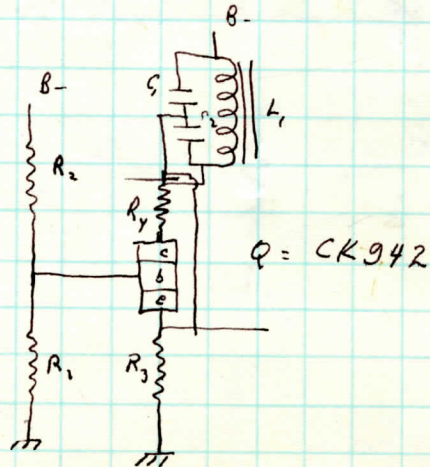


12-27-60

A pt. (Young-6E) was recorded for $\approx 1 \frac{3}{4}$ hrs. in the MKT
X mt + S.C.O. feeding a Quercus recorder at 3.5 I.P.S. A Heath
FM-4 was the receiver. The base line wandered excessively during deep
respiration + coughing possibly because of proximity.

Amplitude modulated S.C.O.

Use Bearden & Dunn's ckt. in P.G.M.E.-12, Dec '58 & silicon trans-
 c transformer coupling to recorder - Osc Freq = 1.5 - 3.5 K.C. (F_o)
 c 1.4 H_y choke available & $F_o = 2$ KC



$$\begin{aligned} R_1 &= 10K & C_1 &= .005 \\ R_2 &= 30K & C_2 &= .01 \\ R_3 &= 10K \\ R_4 &= 10K \end{aligned}$$

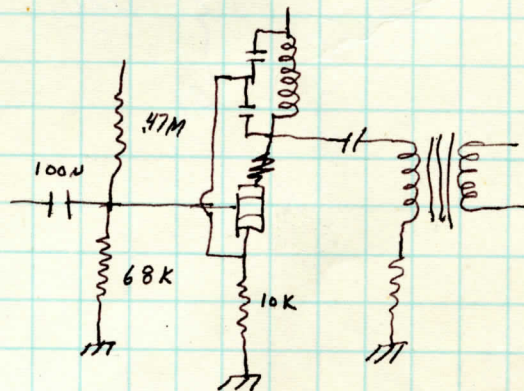
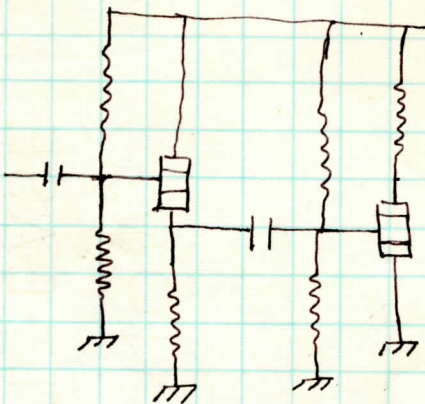
c the following values the Osc could be mod. by 2

50 mV RMS - $F_o = 3$ KC

$R_1 = 6.5K$ $R_3 = 10K$ $C_1 \approx 800\mu$ $L_1 = UTC Mk 4 1.4H$

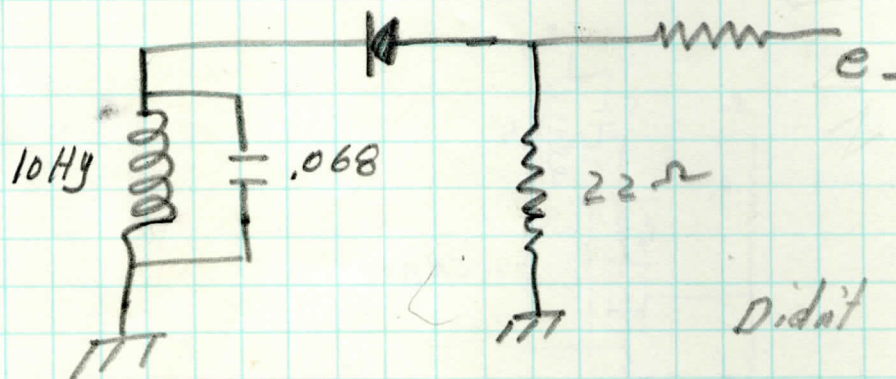
$R_2 = 30K$ $R_4 = 30K$ $C_2 = .15\mu$

Try This -



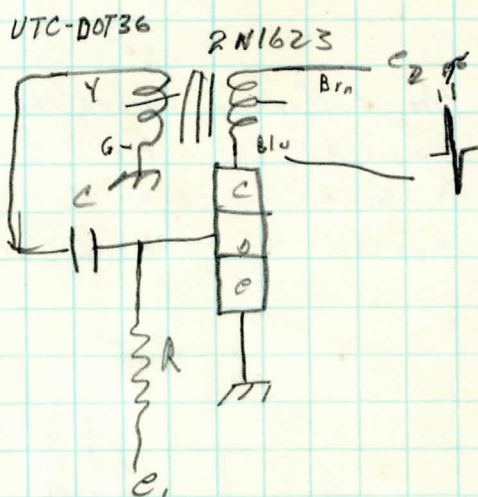
Freq. Mod. SCA Tunnel Diode

GE 2N491



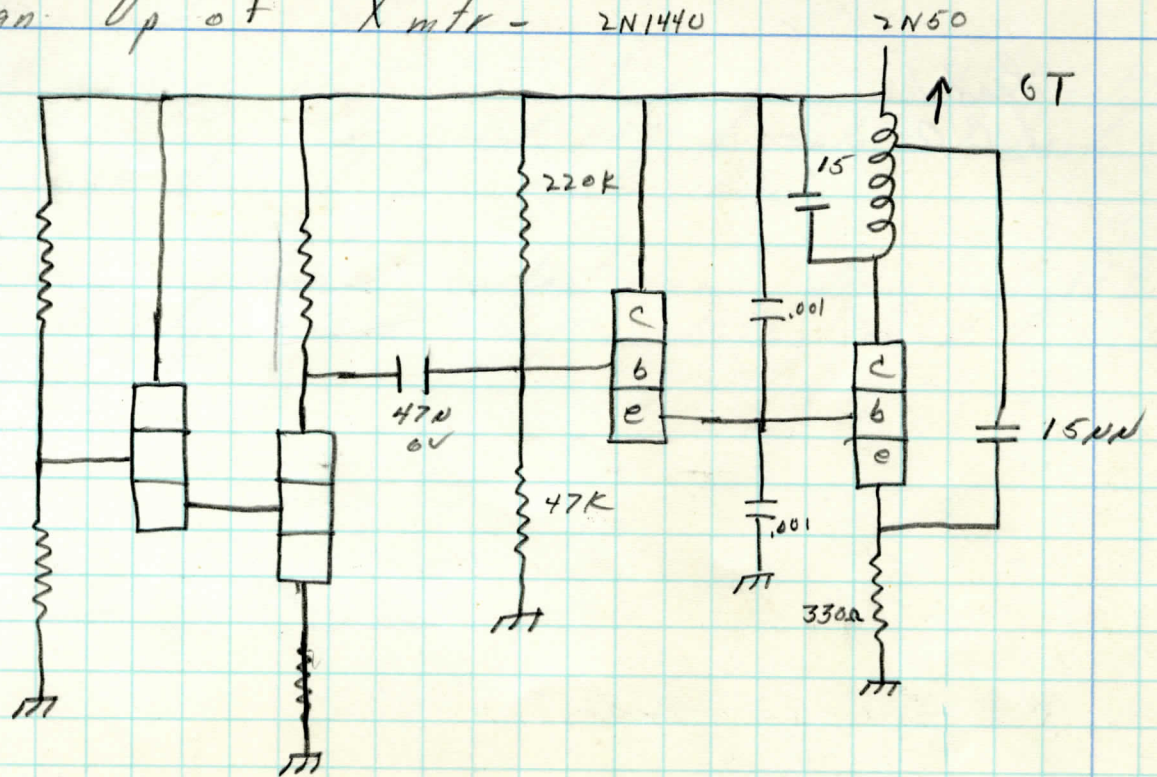
Didn't Work

c Silicon Transistor



e_1	e_2	R_e	C	F_o	γ
-1.3	-1.3	47M	.005	5000	.06ms
"	"	33M	.005	7500	"
"	"	.1	.15	100	.1
"	"	.068	"	150	1
"	"	"	"	200	"

Clean Up of X mtr - 2N1440



8-27-61 Improved Electrodes -

Attempt to produce electrodes which are motion artefact free for use in telemetry and wired EKG signals which are simple and reliable enough for routine use.

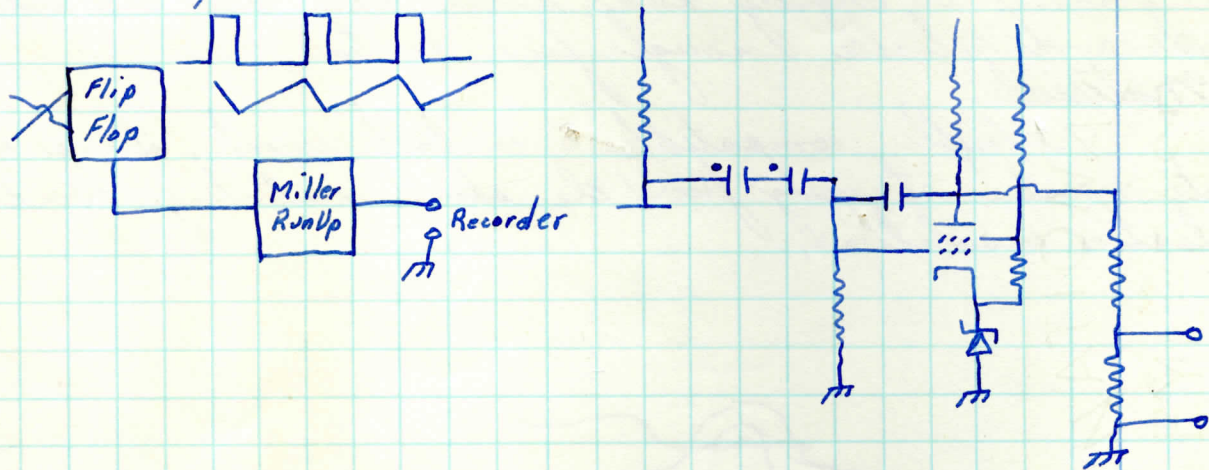
Material -

Flexible, compatible contact cement, strong enough to resist repeated stripping from the skin, insulating, bond to leads in plastic insulation,

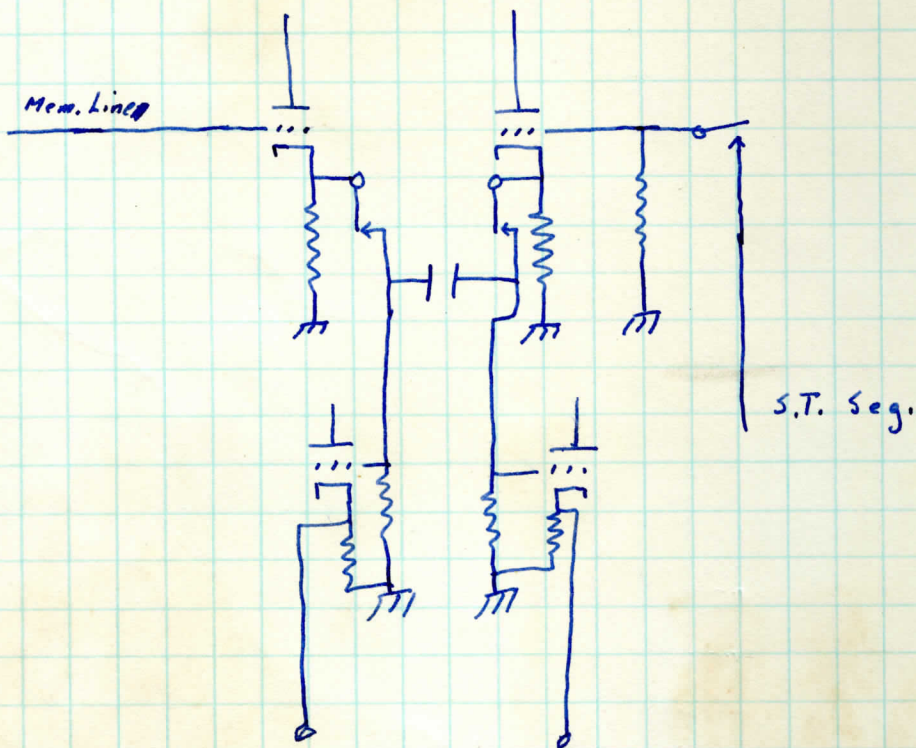


Rhythm computer

QRS
Trigger

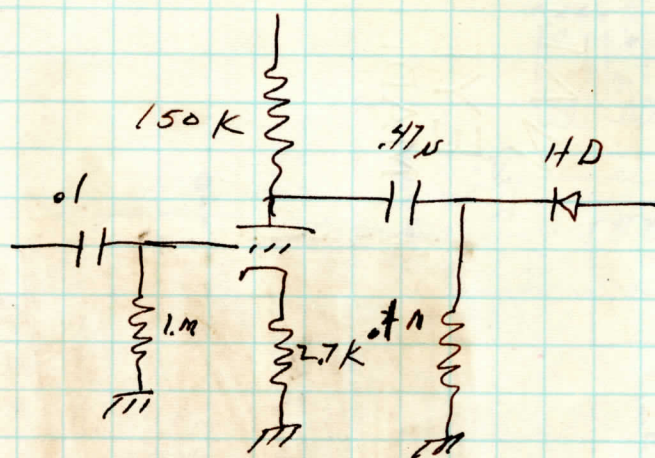
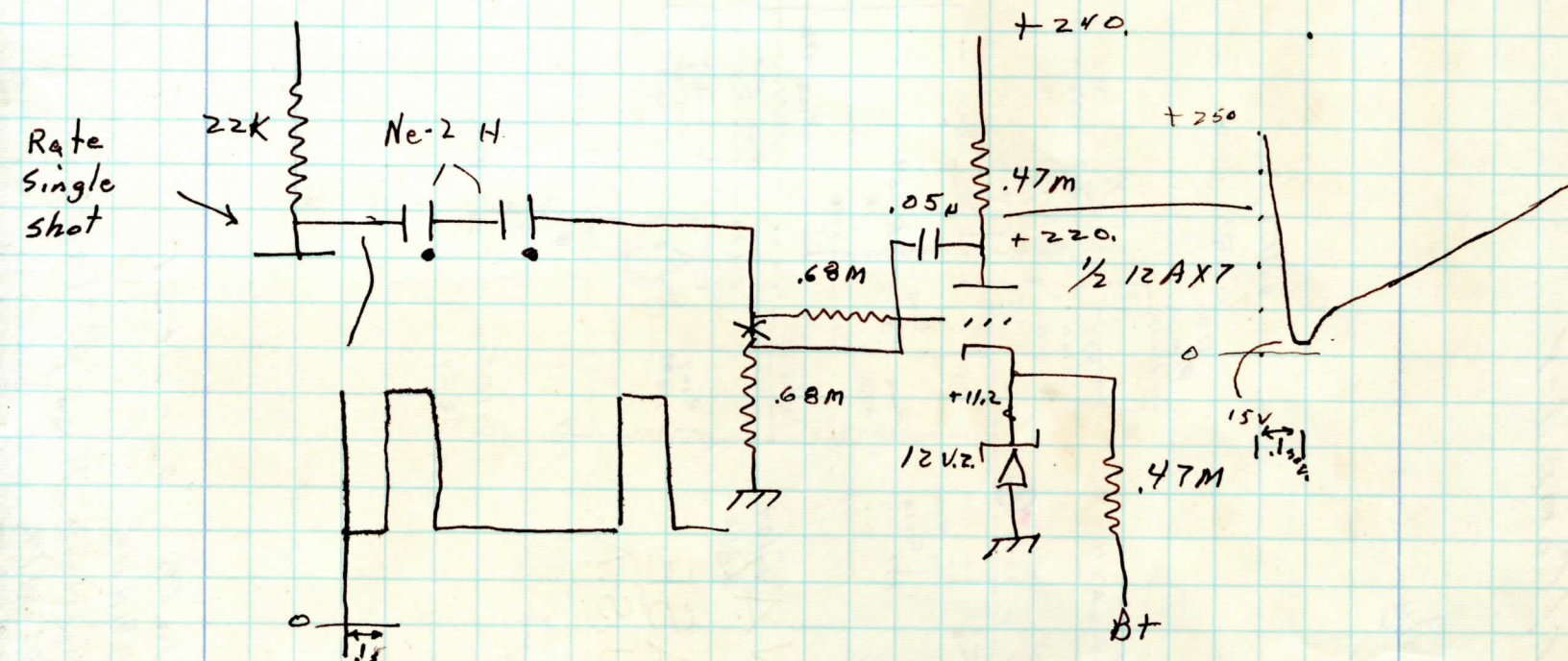


Seg. Comp.



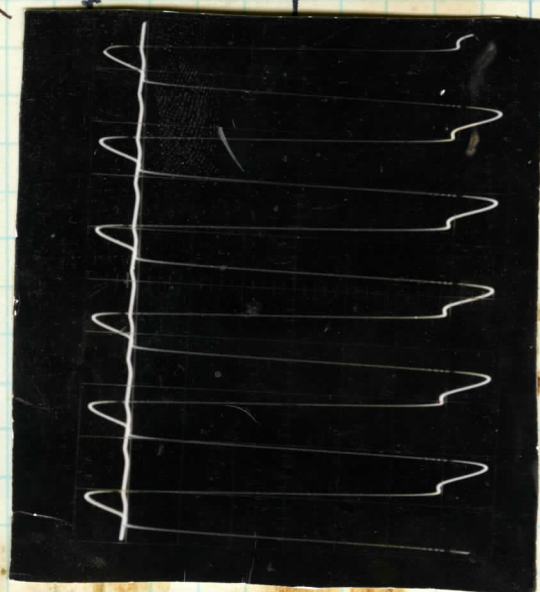
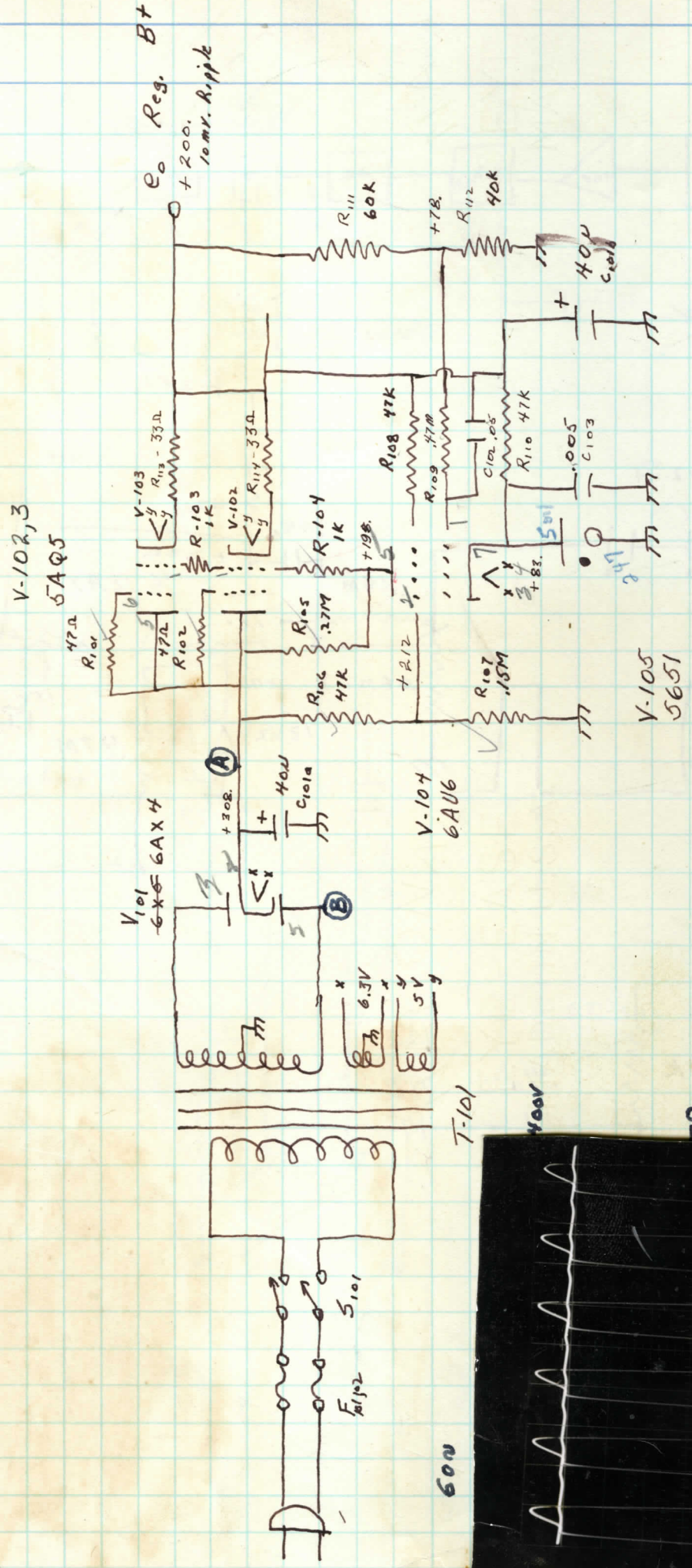


Rhythm



MK II Recorder/Computer

Power Supply

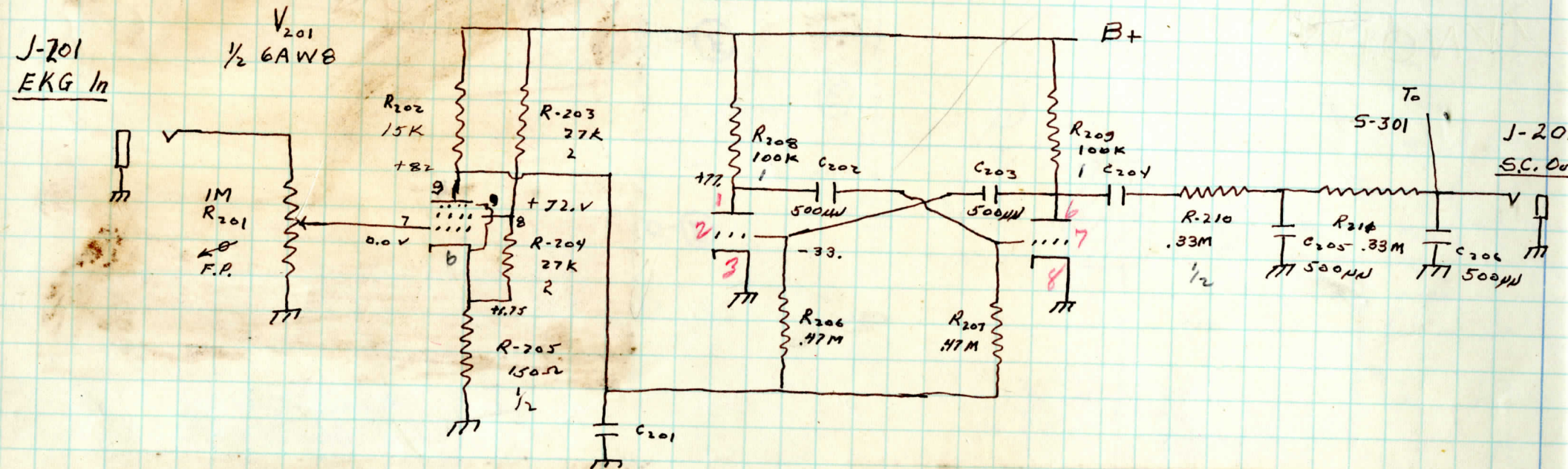


- 1 A. 5 1/2 B16
- 40-40u 450 V
- .05u 200V
- R_{101,2} - 47k 1/2W 20%
- R_{103,4} - 1k 1/2W 20%
- R₁₀₅ - 27M 1W 10%
- R₁₀₈ - 47k 1W 5%
- R₁₀₉ - 47M 1/2W 20%
- R₁₁₀ - 47k 2W 5%
- R_{113,4} - 33k 1W 20%
- S₁₀₁ - DPST
- T₁ - 300V A.T. 120Ma
- 6.3V 5A
- 5V - 3A

MK II Recorder Computer

Sub Carrier Osc.

V_{202a,b} 12AU7



R-201 1M 2W AB.

R-202

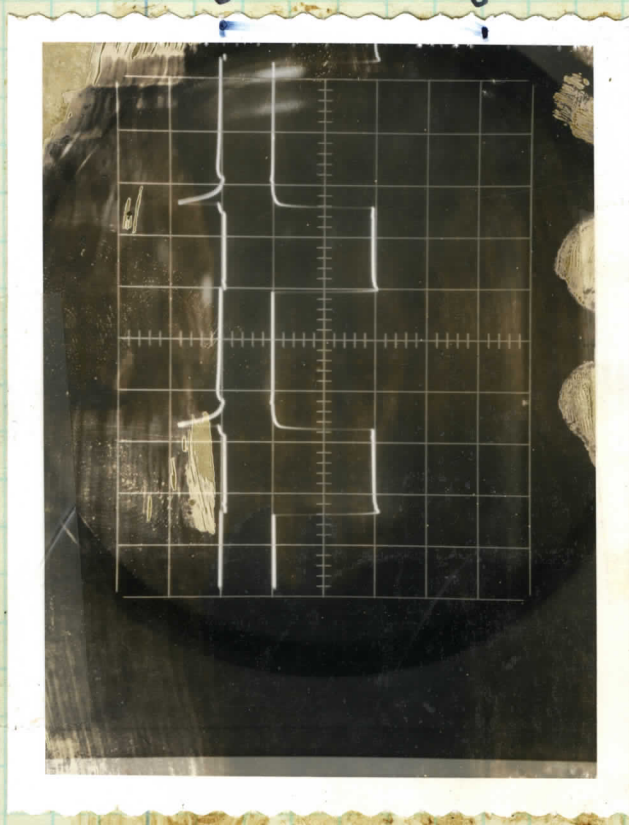
C₂₀₁ .001

.02

V-50V/cm
H-1ms/cm

0-C

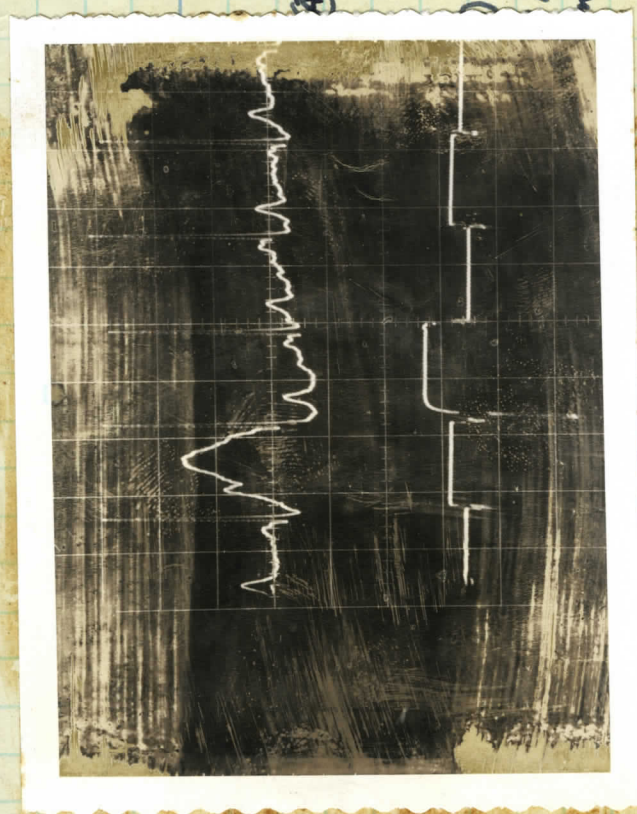
0-D



5V/cm

50V/cm
m/s

0-A



0-B

0-E



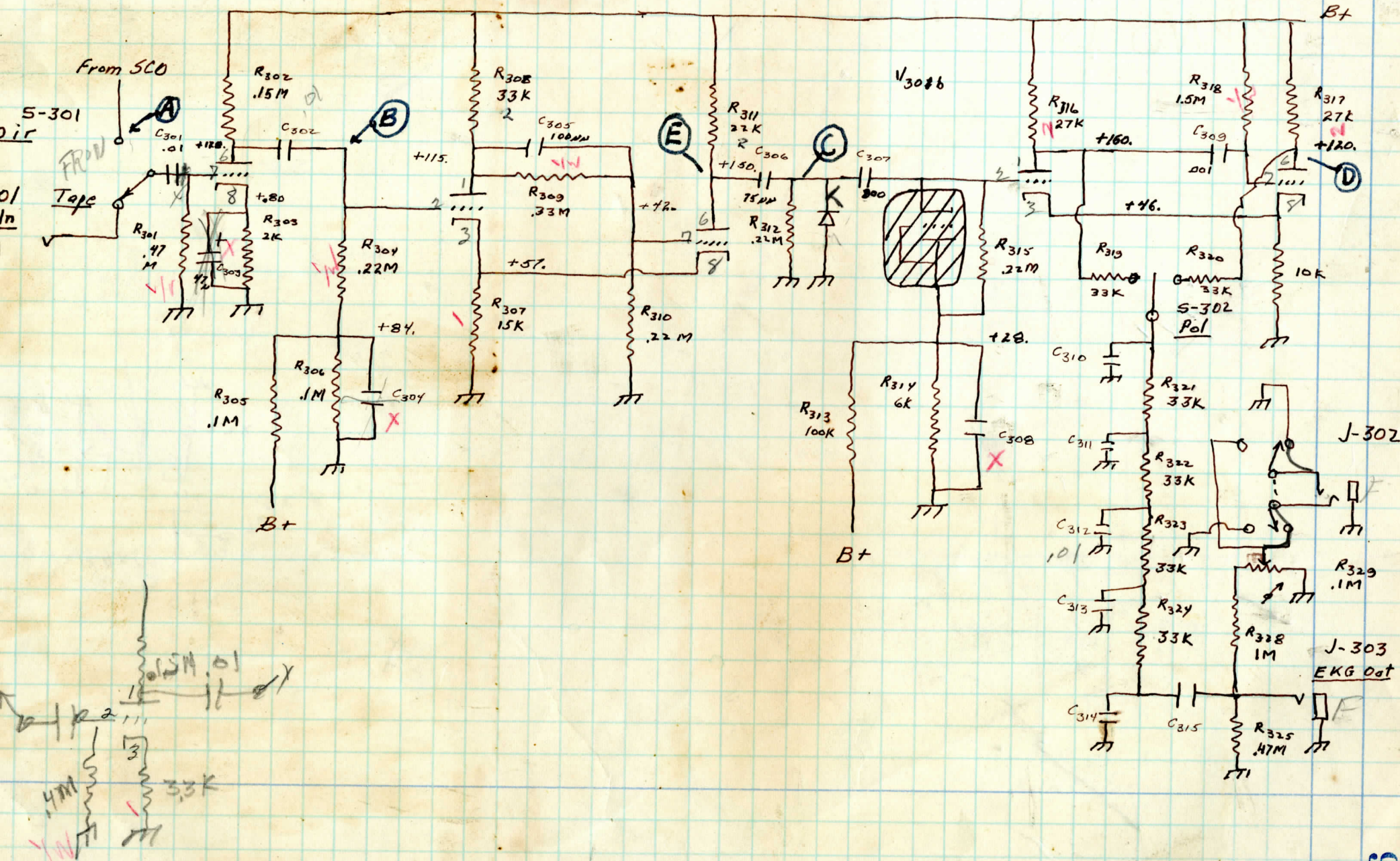
MK II Recorder Computer

S.C. Demodulator

V-301, 12AX7

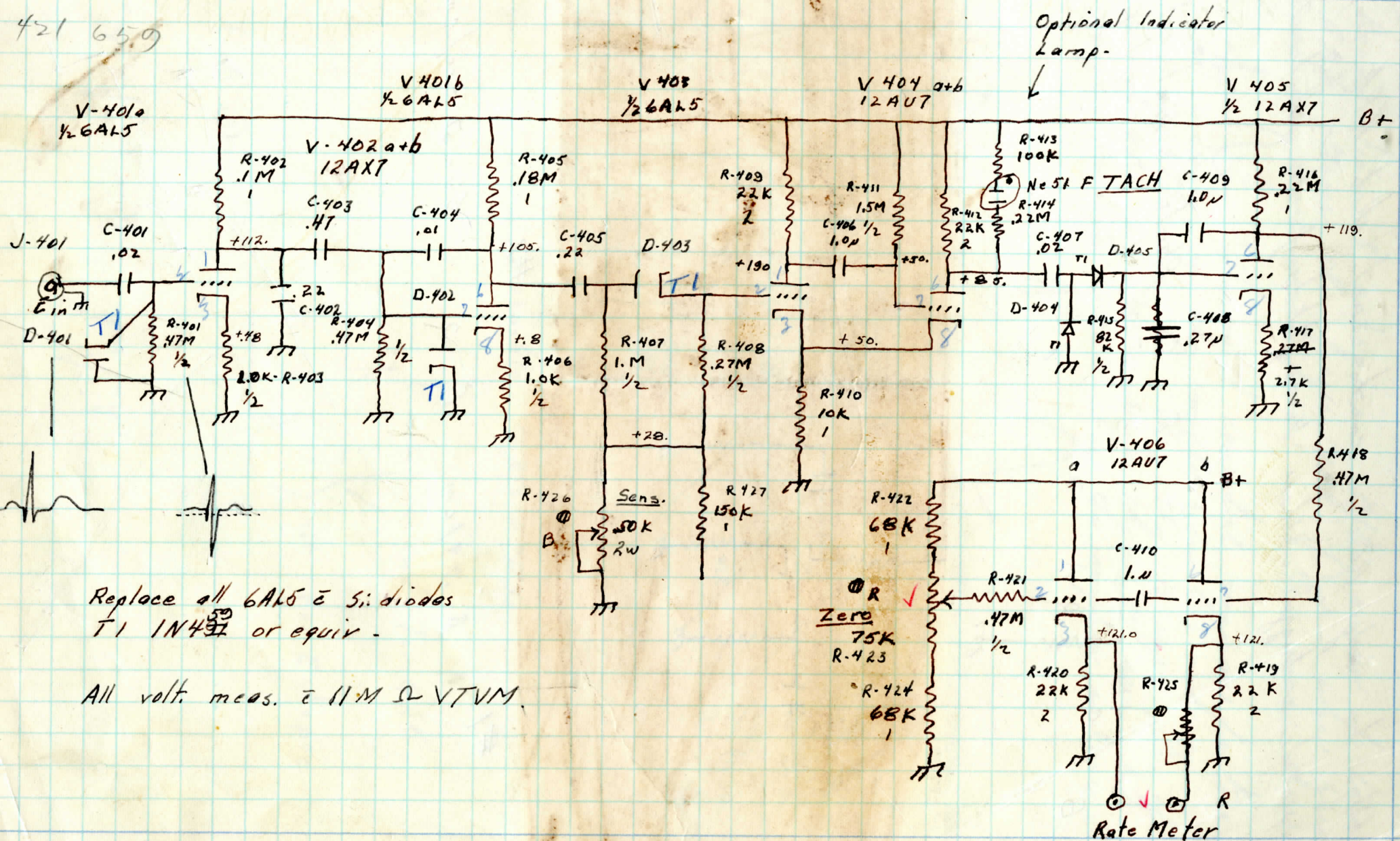
V-302 12AU7

V-303 12AU7

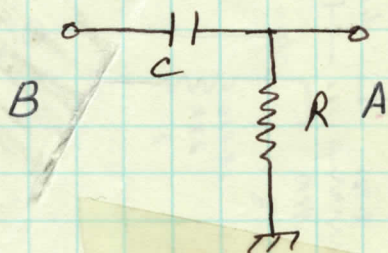


MK II Recorder/Computer Cardio-Tach.

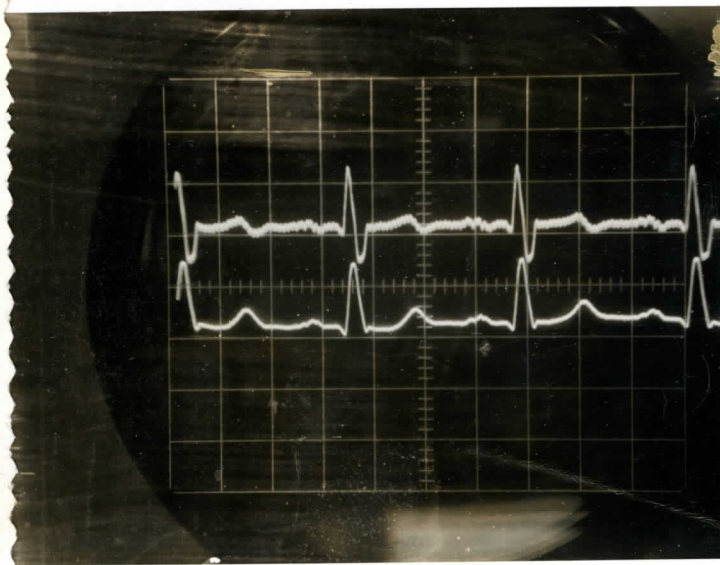
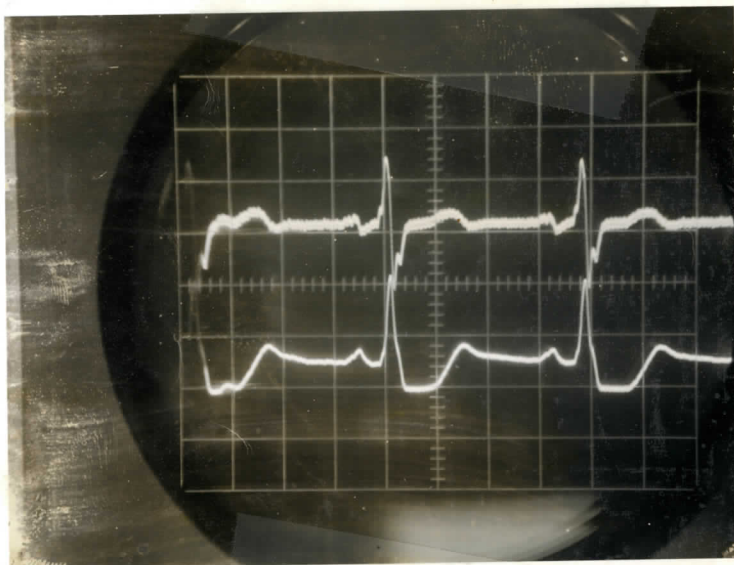
421 659



Obj. to adj. R.C. time const. such that QRS complexes provide a trigger within $\frac{1}{2}$ amplitude of its' initial stroke



R	C	Photo	Material
.03	.33M	1	Seg Dep
"	"	2	" "



#1

A - .2V/cm

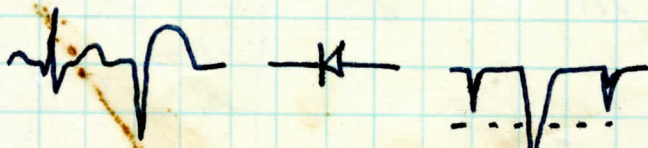
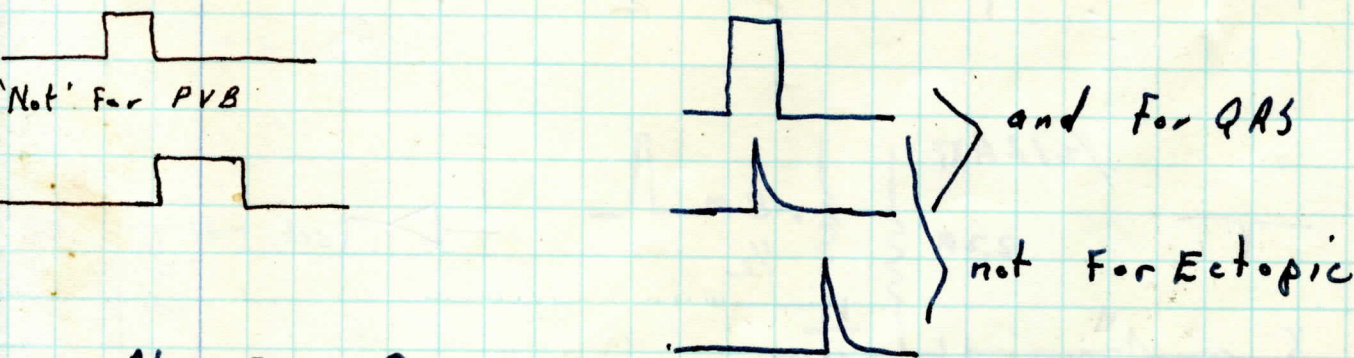
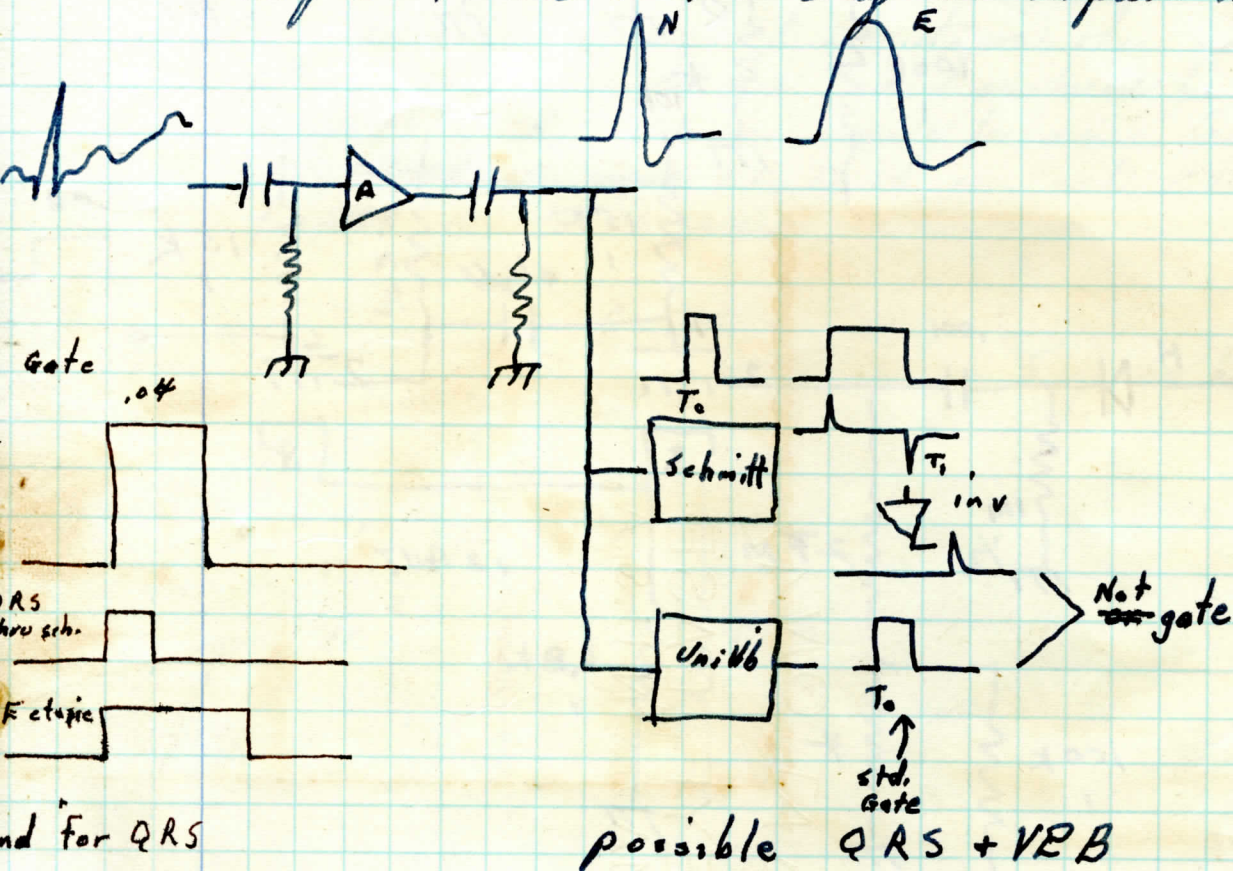
B - .05

#2

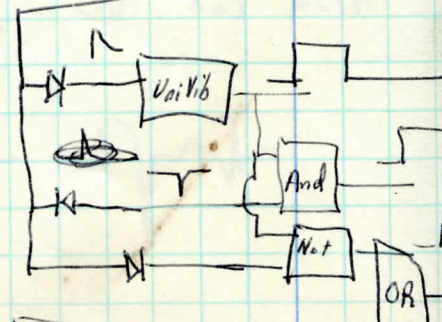
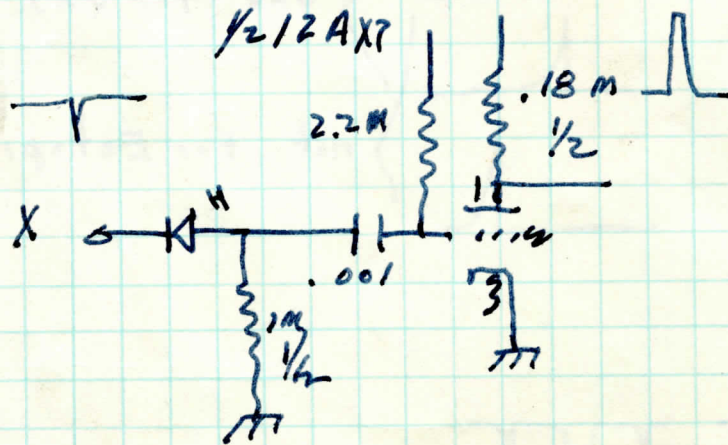
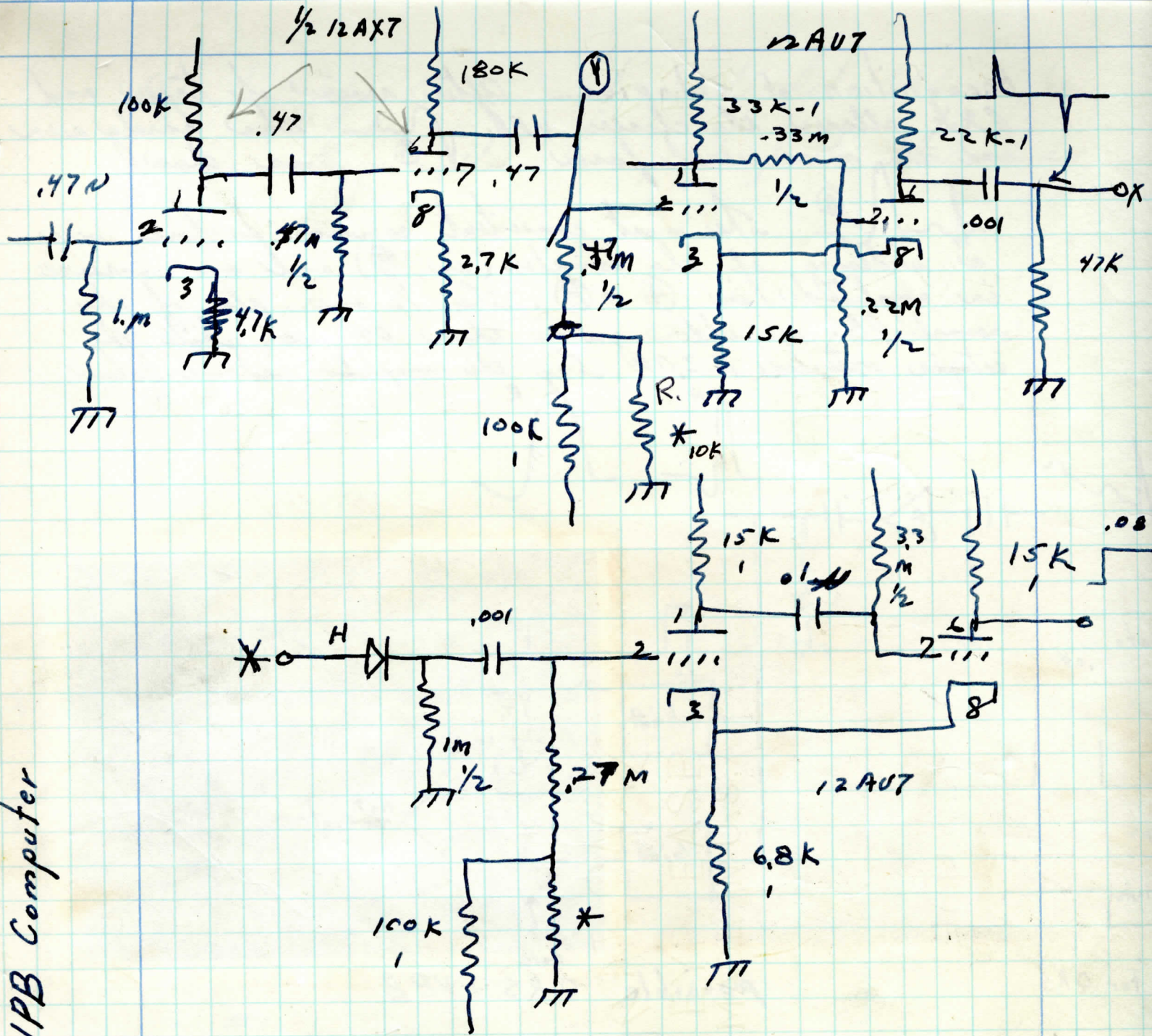
Sw - .02 sec/cm -

Recognition of ectopics - After review of tapes and C.R.G. atlases the classic V.P.B. form was hardly seen and the more usual form (A) was thus

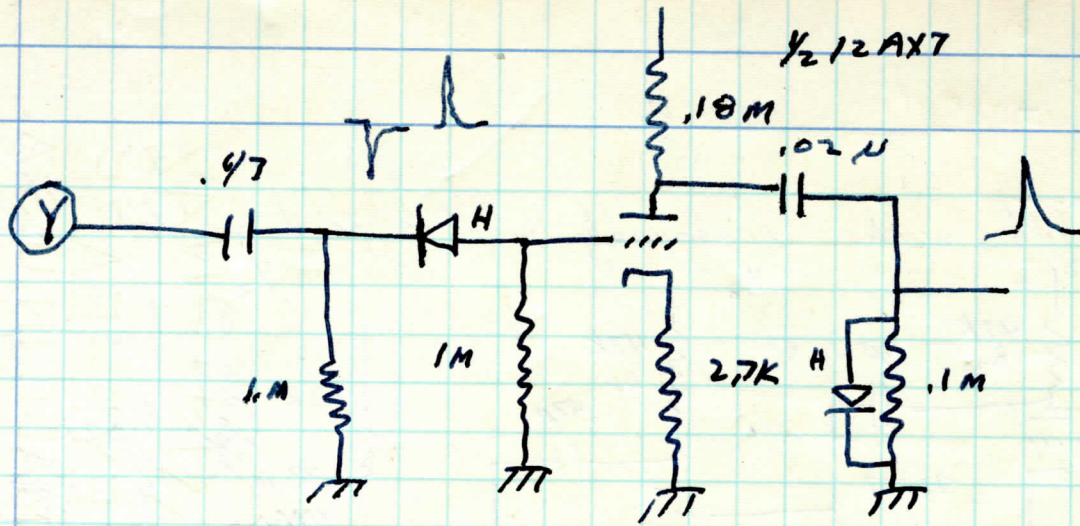
(B) The most consistent common factors were a widening of the complex (in B) and an increase in amplitude in A + B. The $\frac{1}{2}$ amp. pts. of the normal QRS is seldom greater than .04 sec. while the ectopics extended to 3.08 Try the amplifier scheme below.



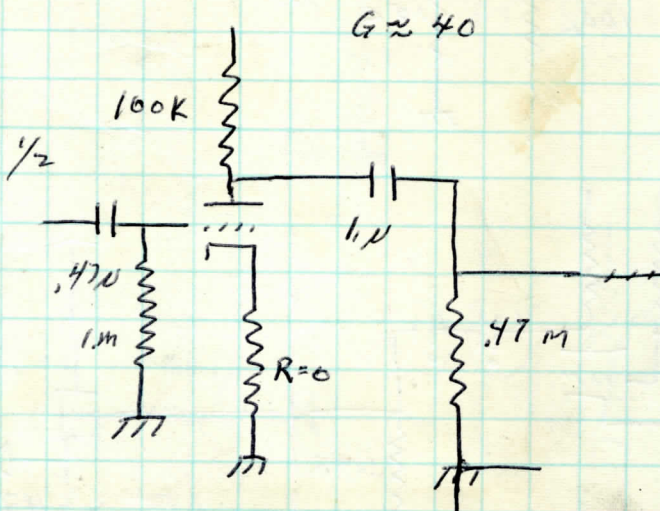
VPB Computer



* To be added at test



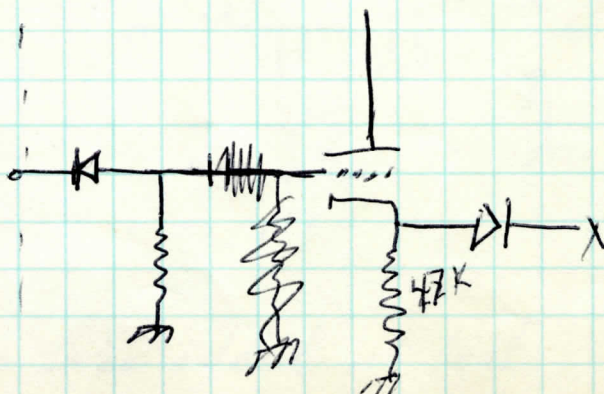
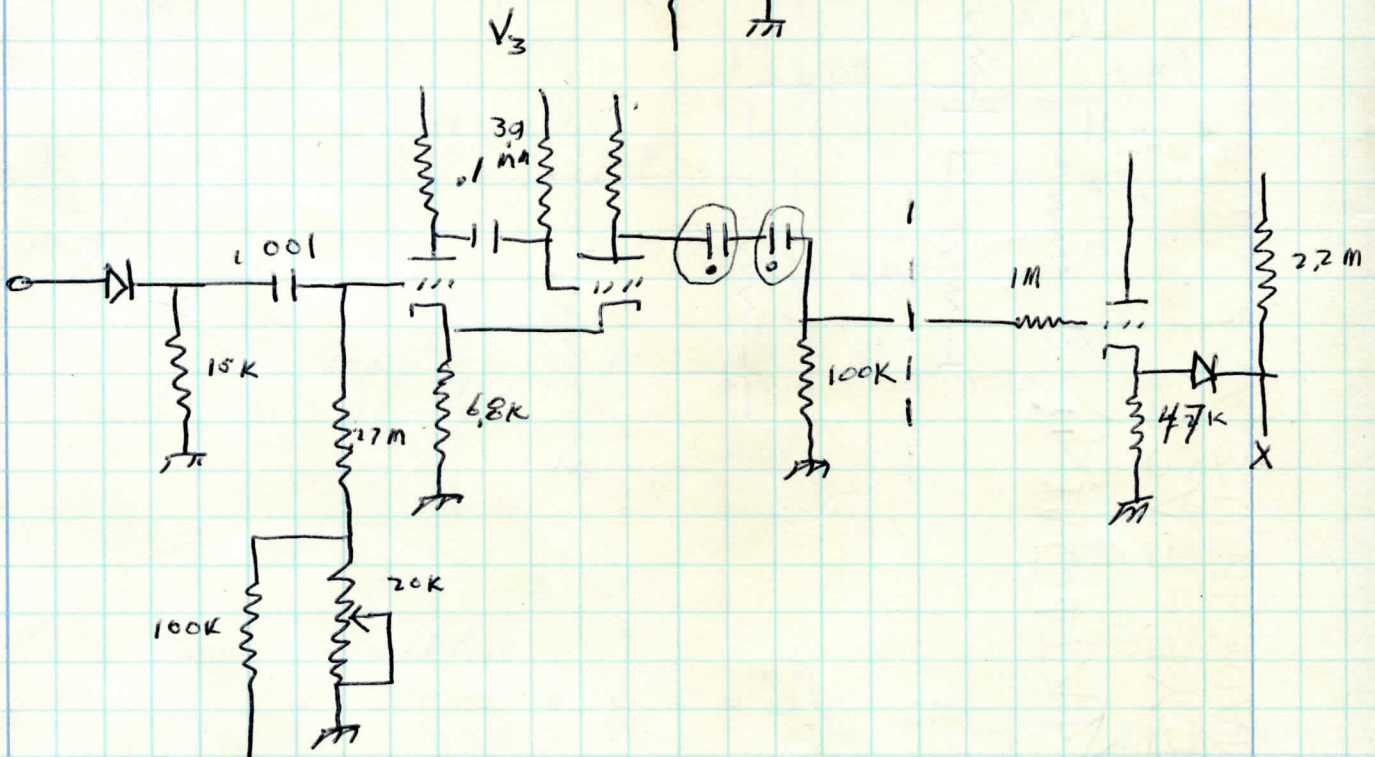
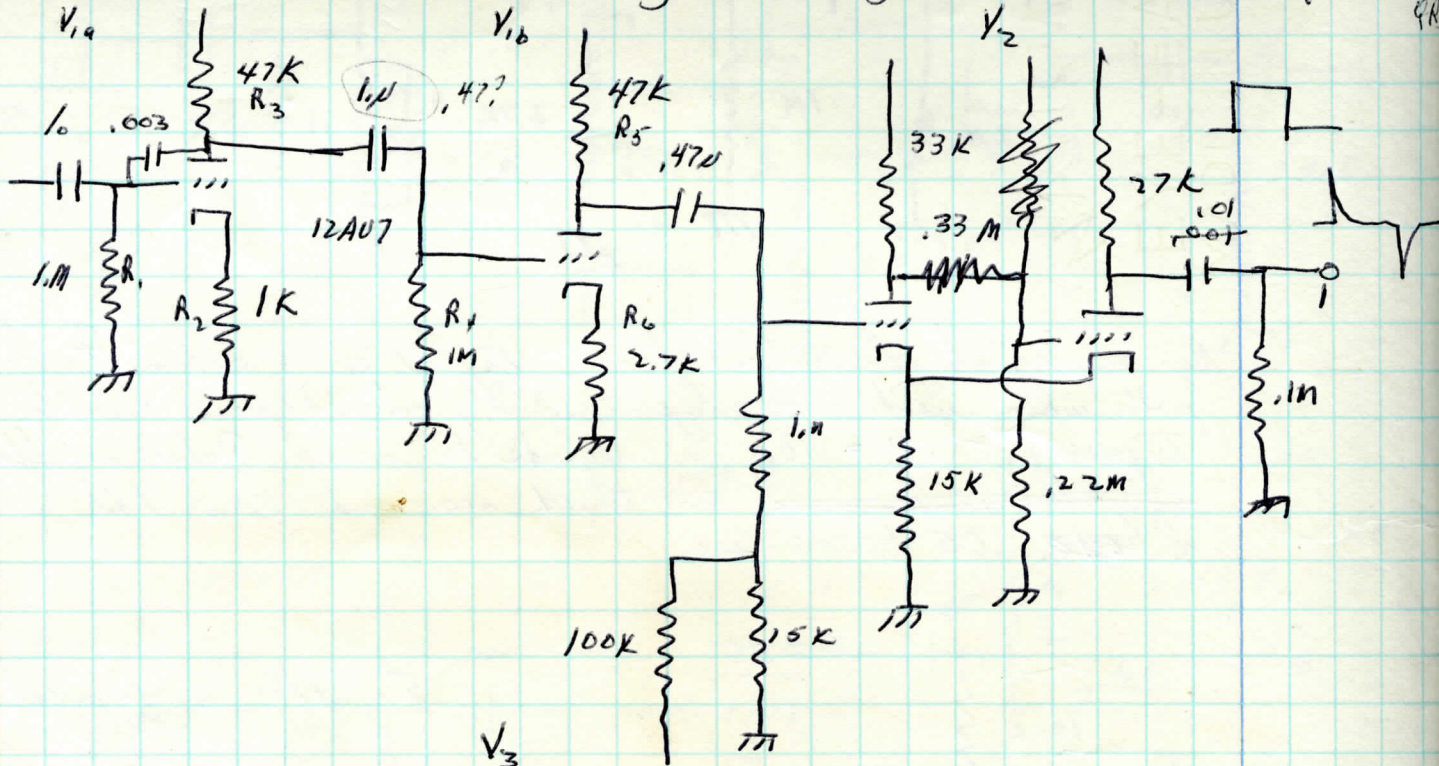
By empirical observation from tapes the schmitt trigger on p 96 when used in the amp. below produced fair results on triggering $\bar{c}$ $R_i = 10K$ as regards to noise. Pulse width was ~~only .04 to .05 sec.~~ .02 to .04 sec. and P.V.B. had a width of ~~.05 to .06 sec.~~ .05 to .06 sec.



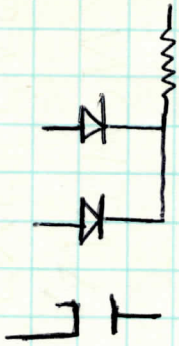
Try the arrangement below.

PVC -

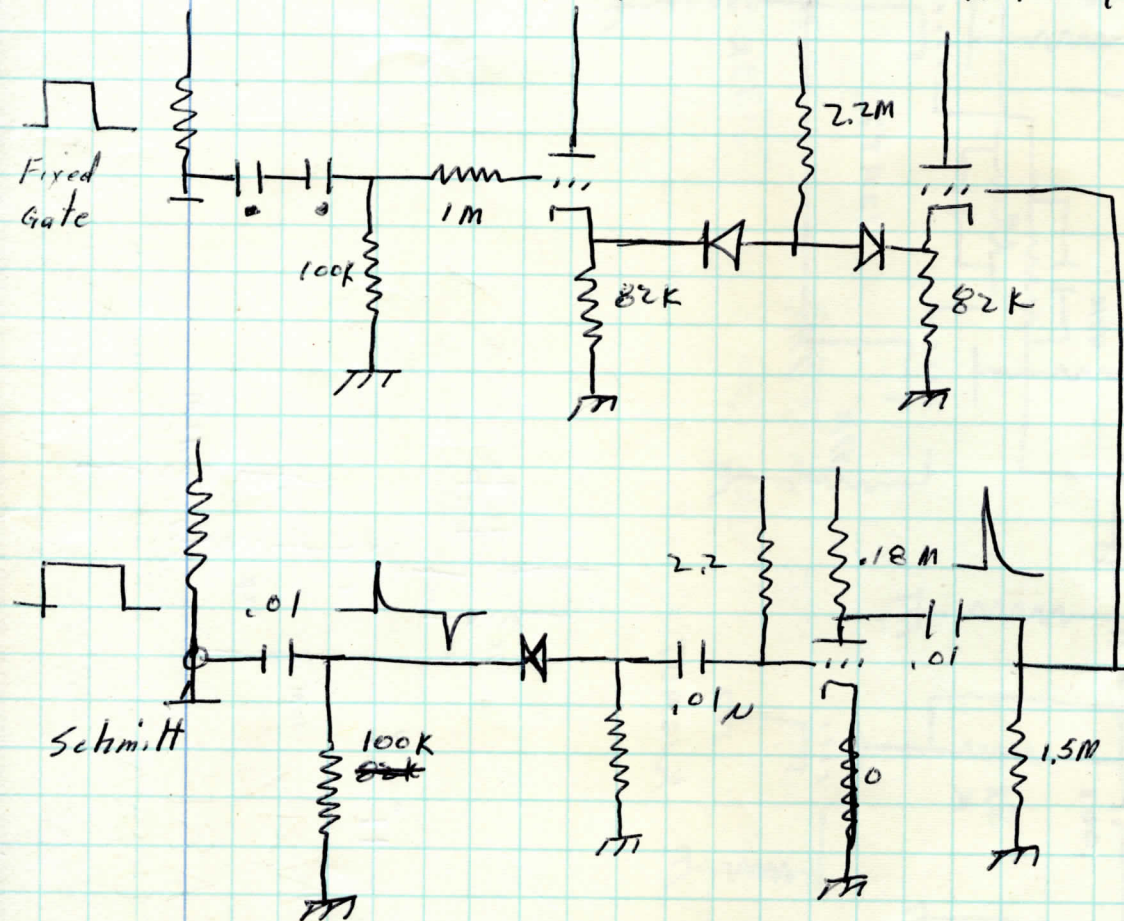
Ckt, which works reasonably well & good width ratios (VPB: Norm 9R)



'And' + 'not' ckt.

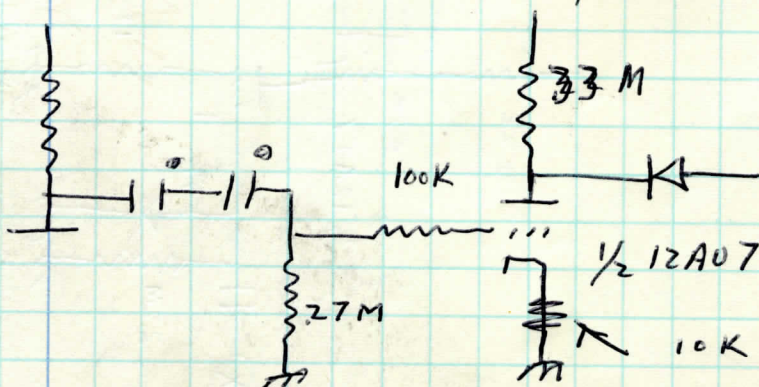


'And' ckt. For Norm QRS



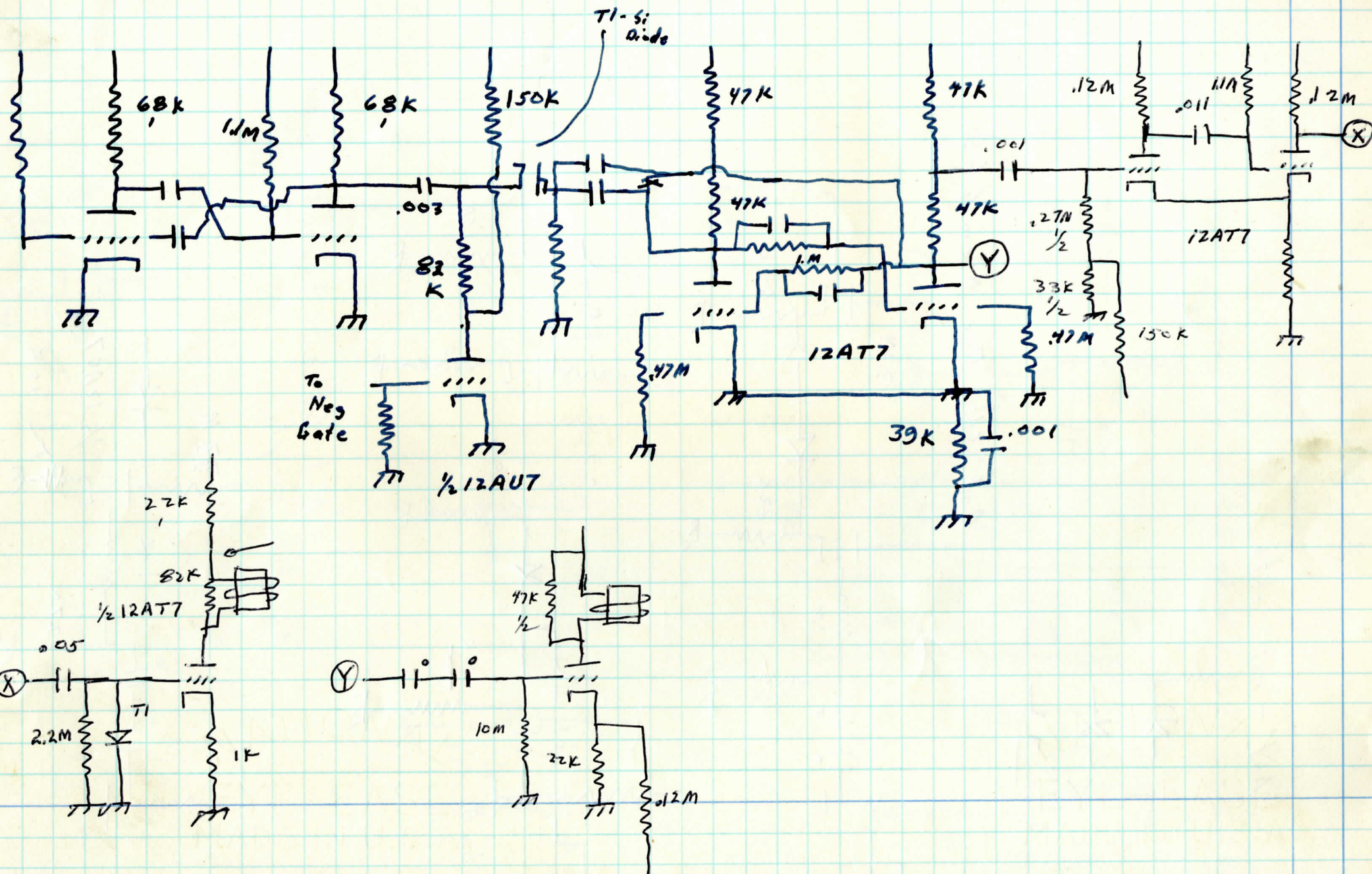
'Not' Gate For ectopics

As above except:



Segment Computer Breadboard

V_i - 12AT7



MK II Computer - Front Panel



Sens.



Recorder Gain
EKG Record



Normal
QRS



1



2



$\frac{1}{4}$



Reset
Zero



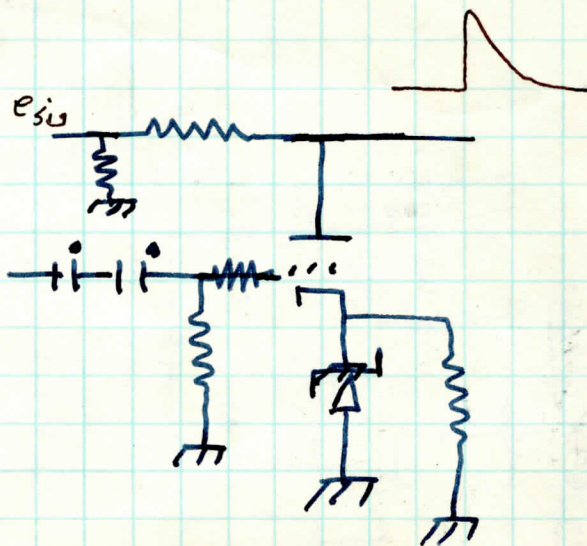
Dir Type Polarity

Op.

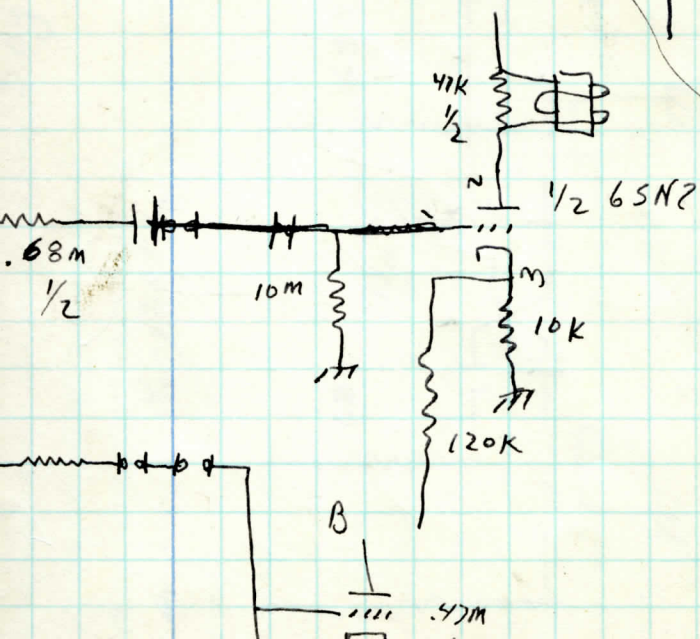
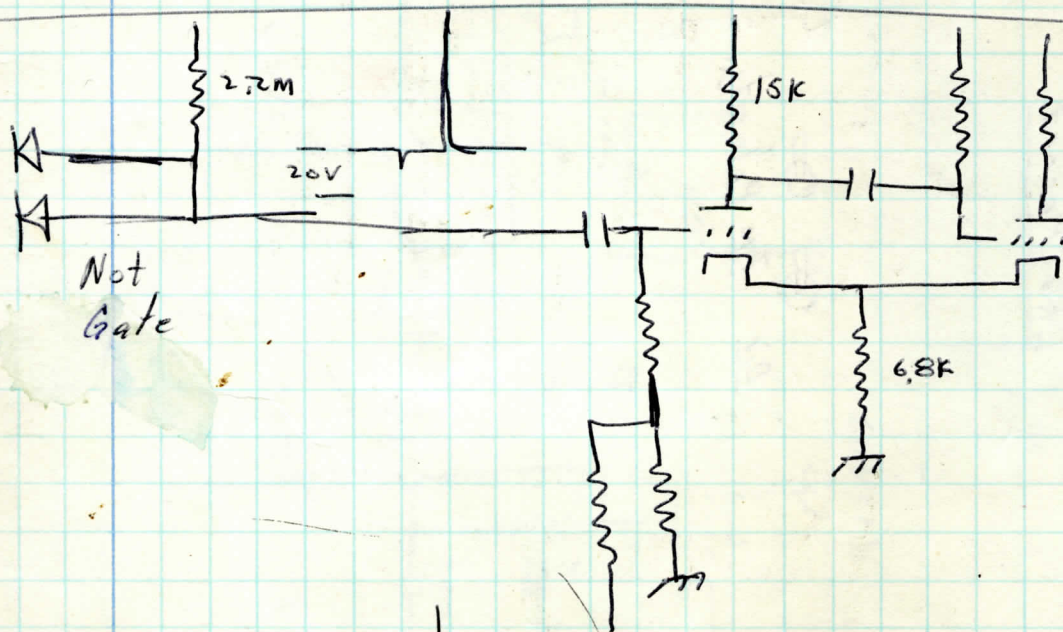


Cal.

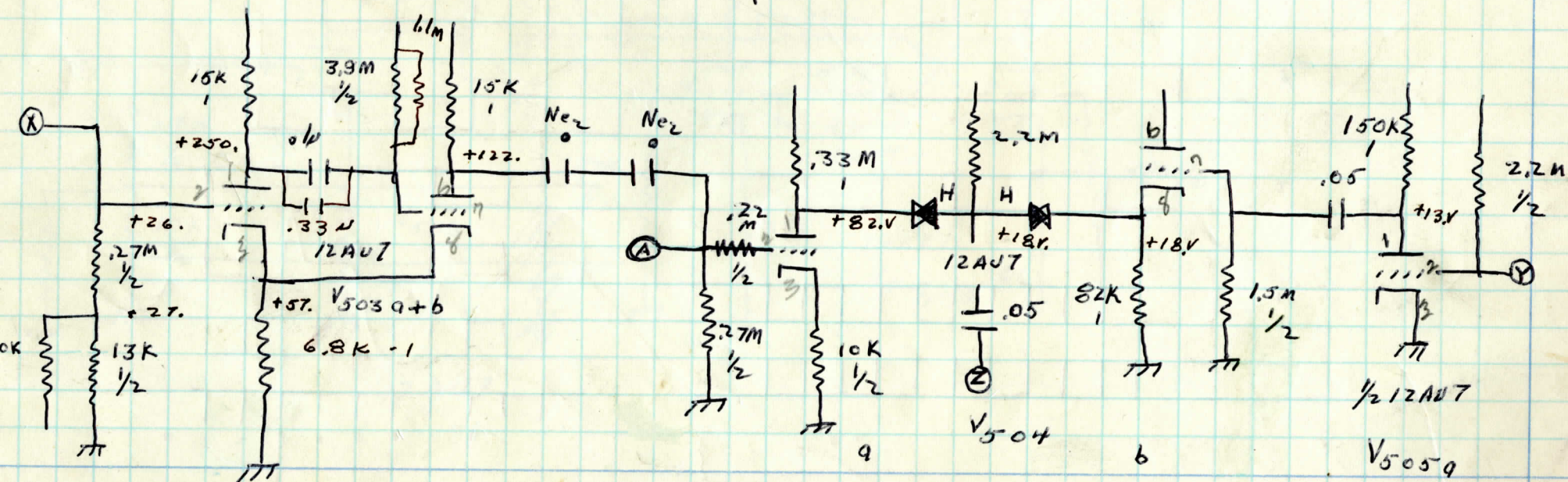
Test of a 'not' circuit -



This ckt. left a fast spike on the leading edges.
Try diode ckt's -

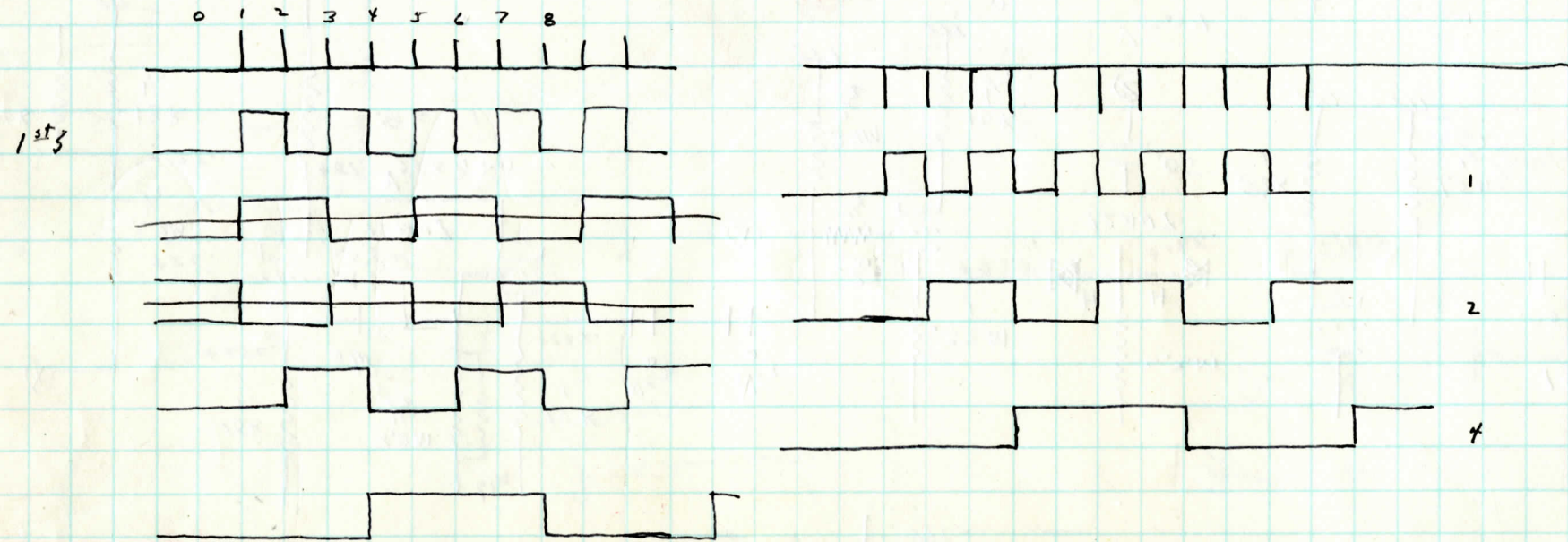


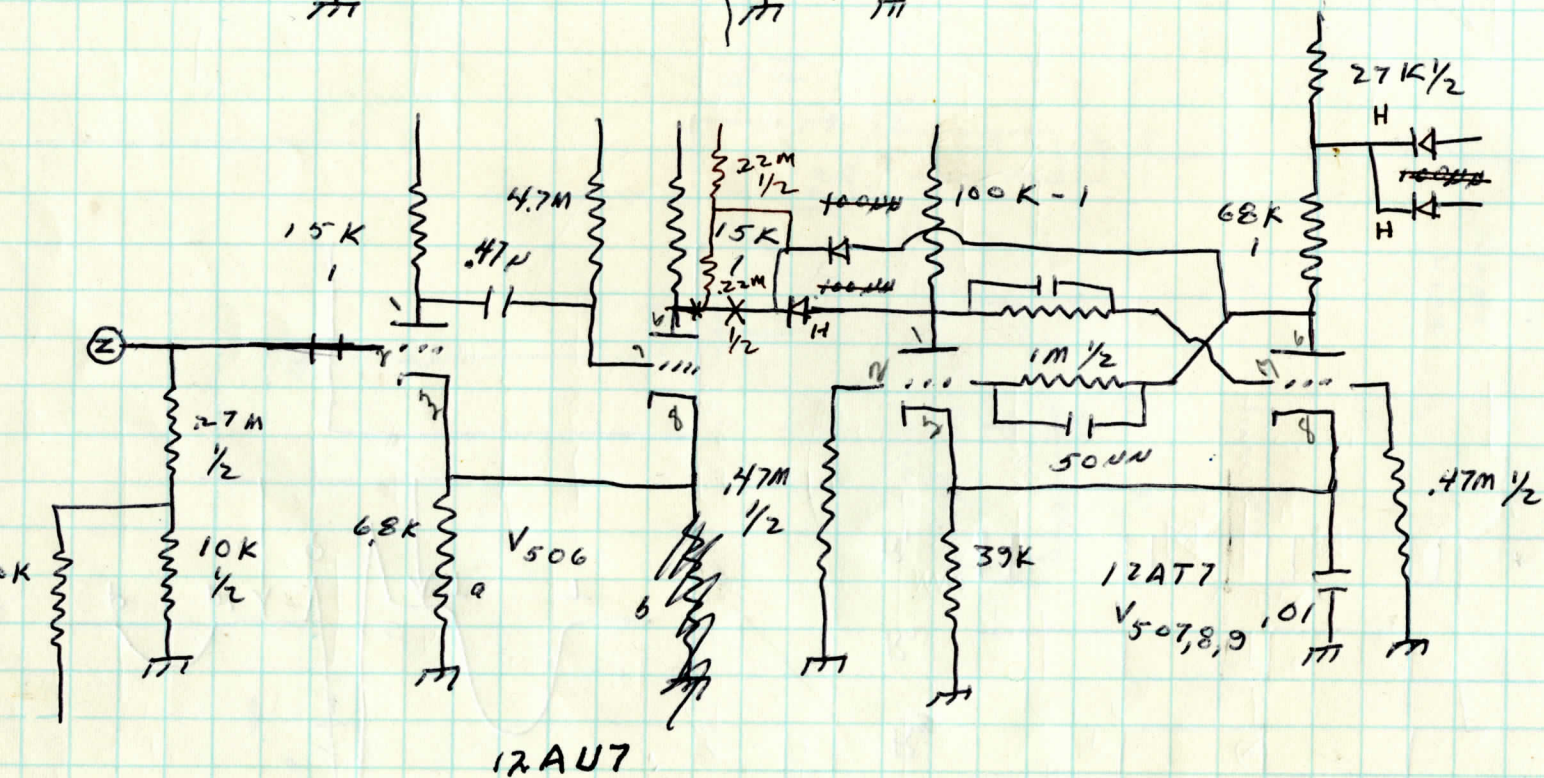
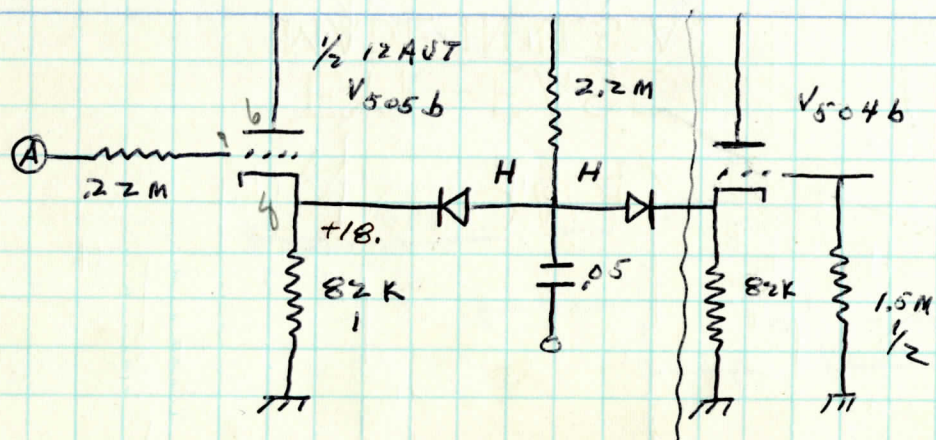
103



$H = 1N463$

P.V.B Counter

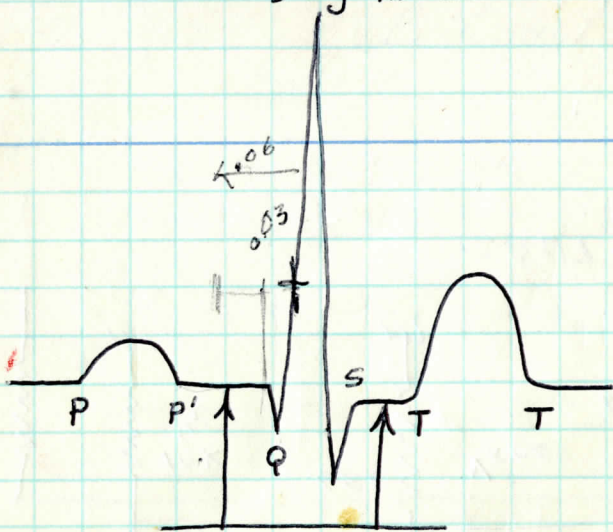




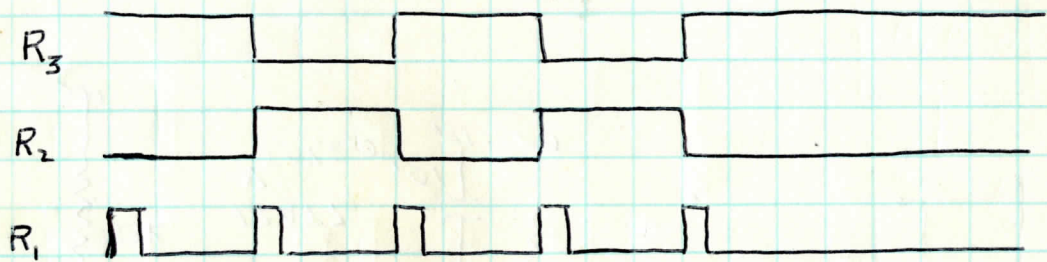
Segment Computer MK I

106

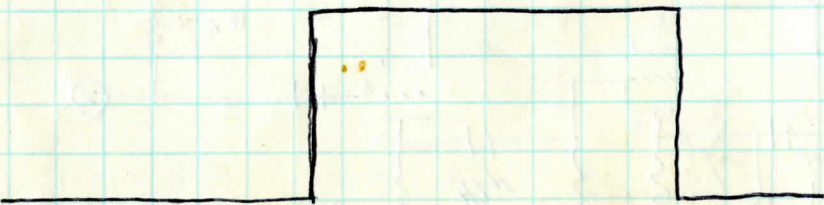
0.06
0.03



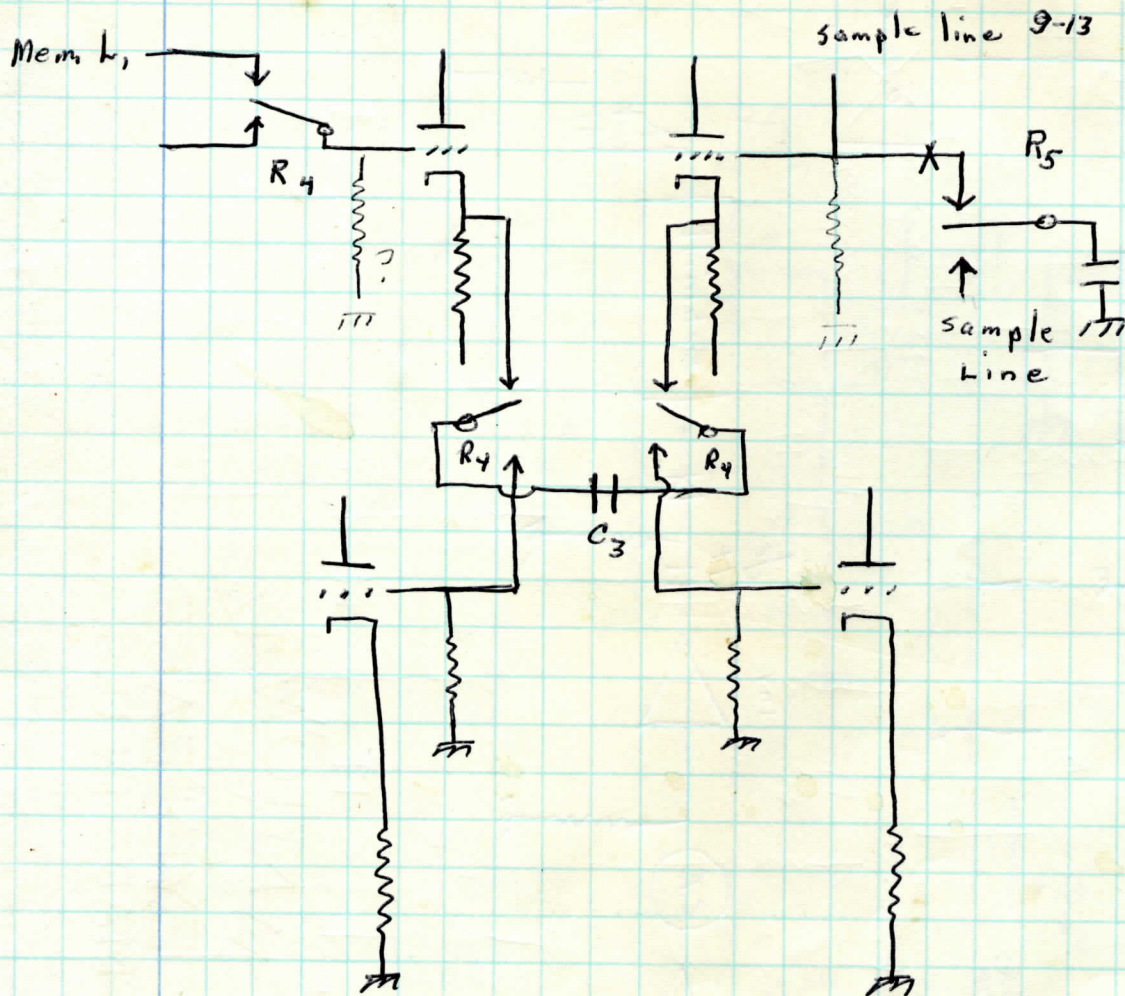
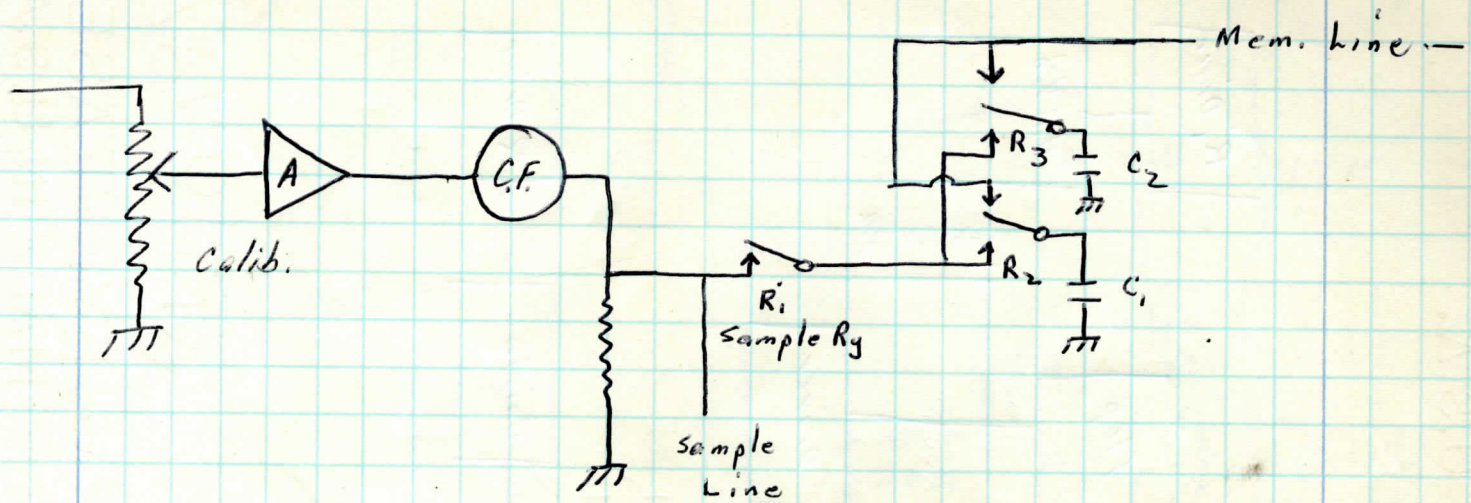
Method. Compare amplitudes of $P'Q' + ST$.



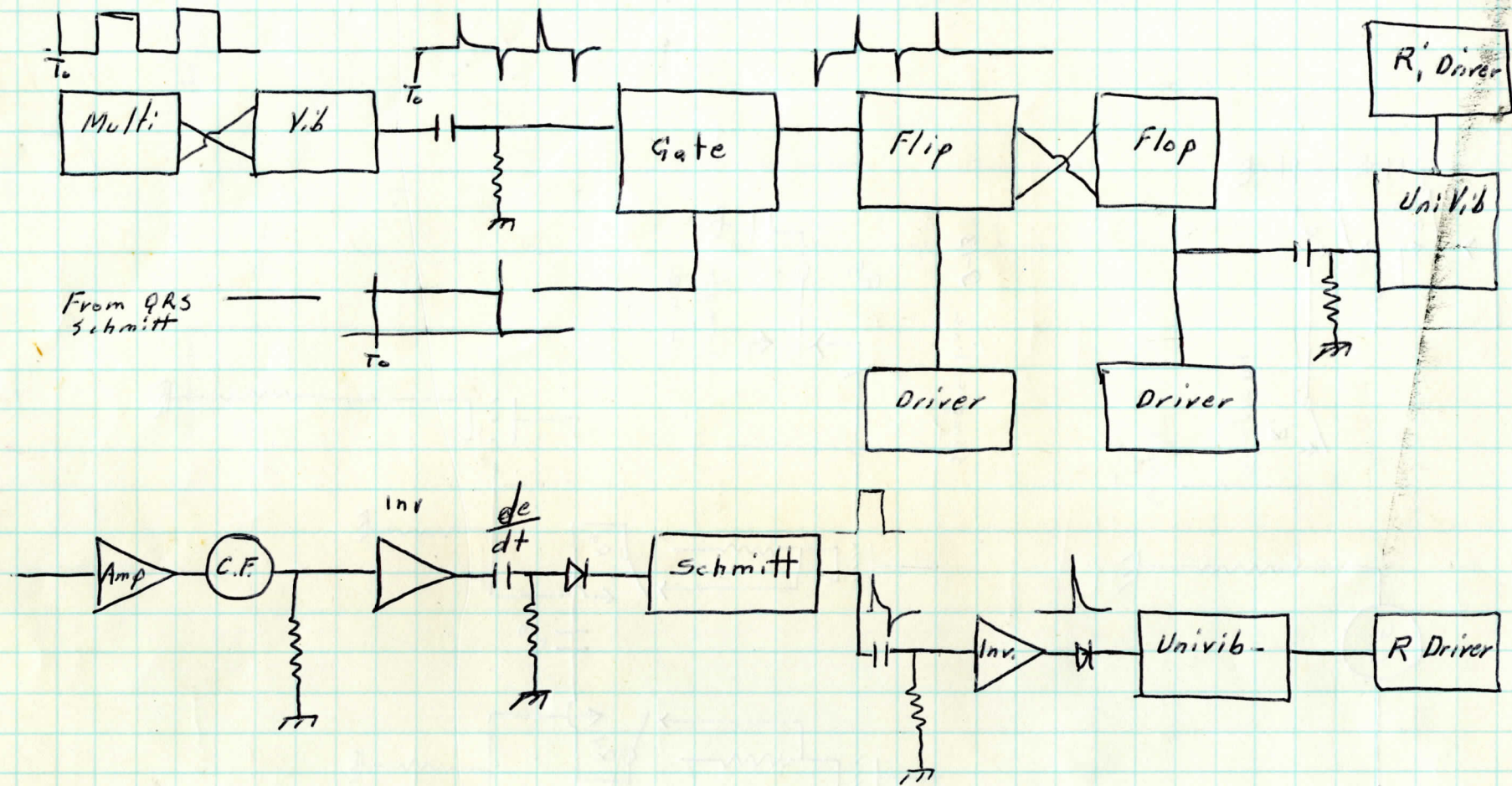
↑ on line
↓ sample

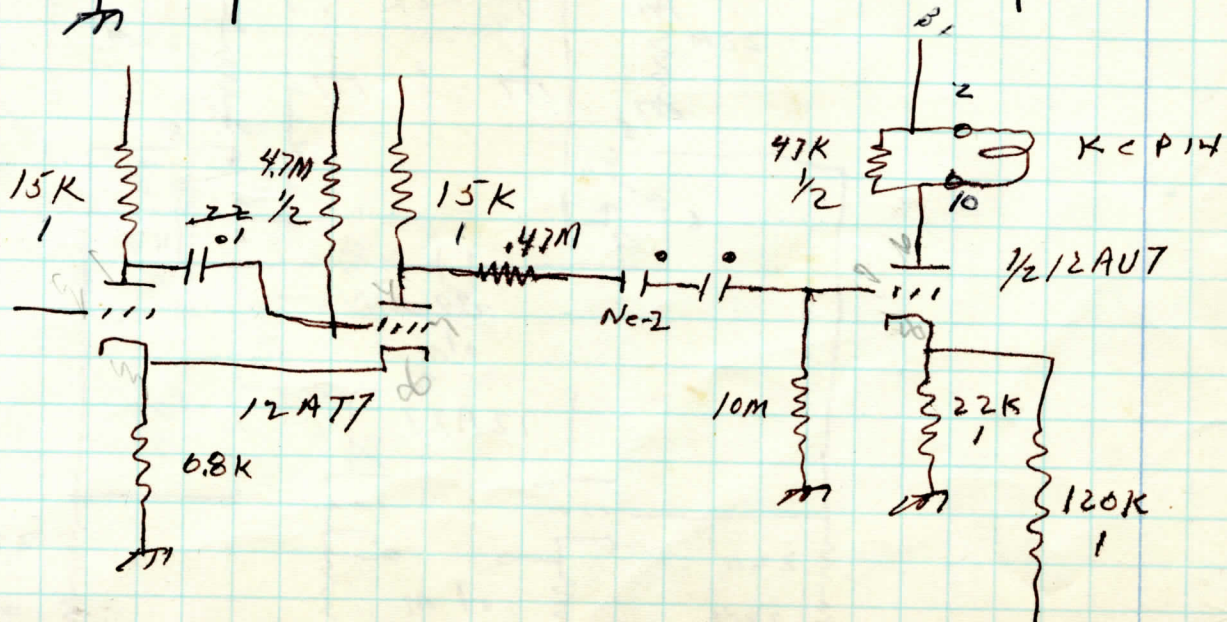
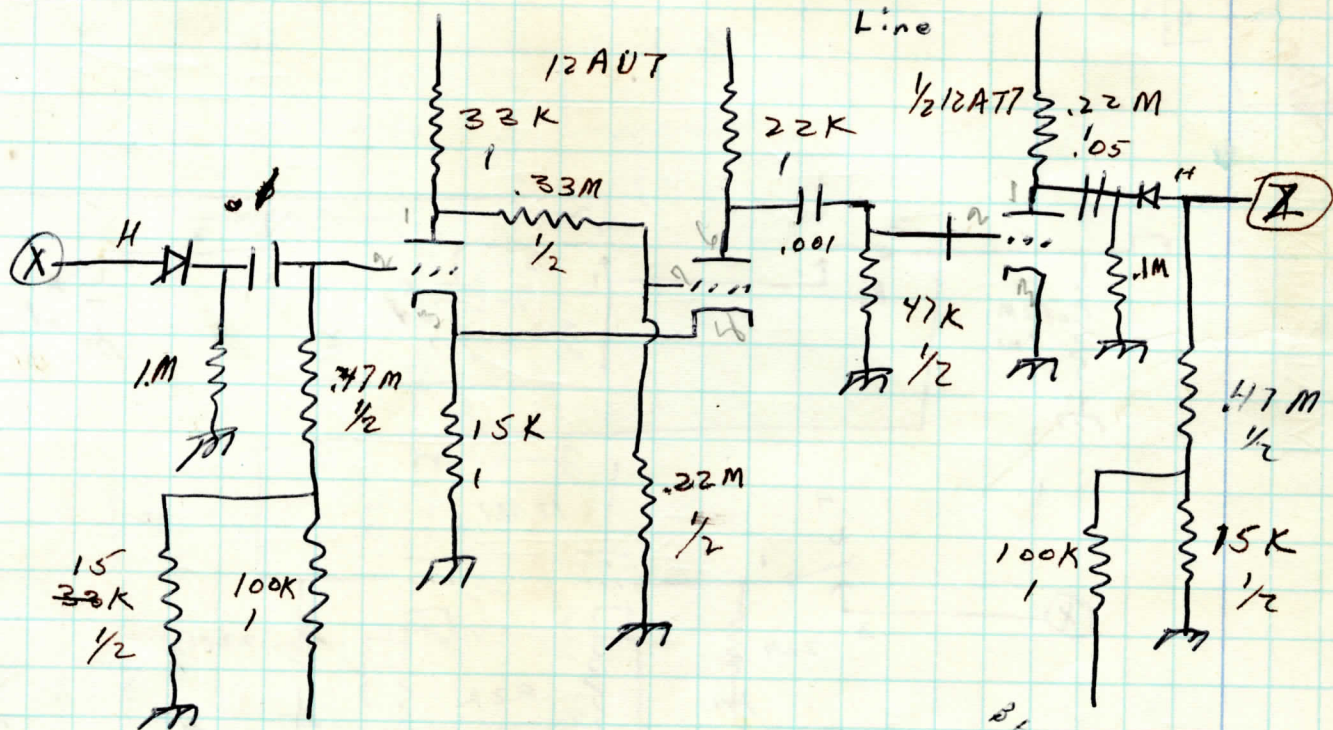
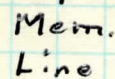


MK I S.T. Comp.



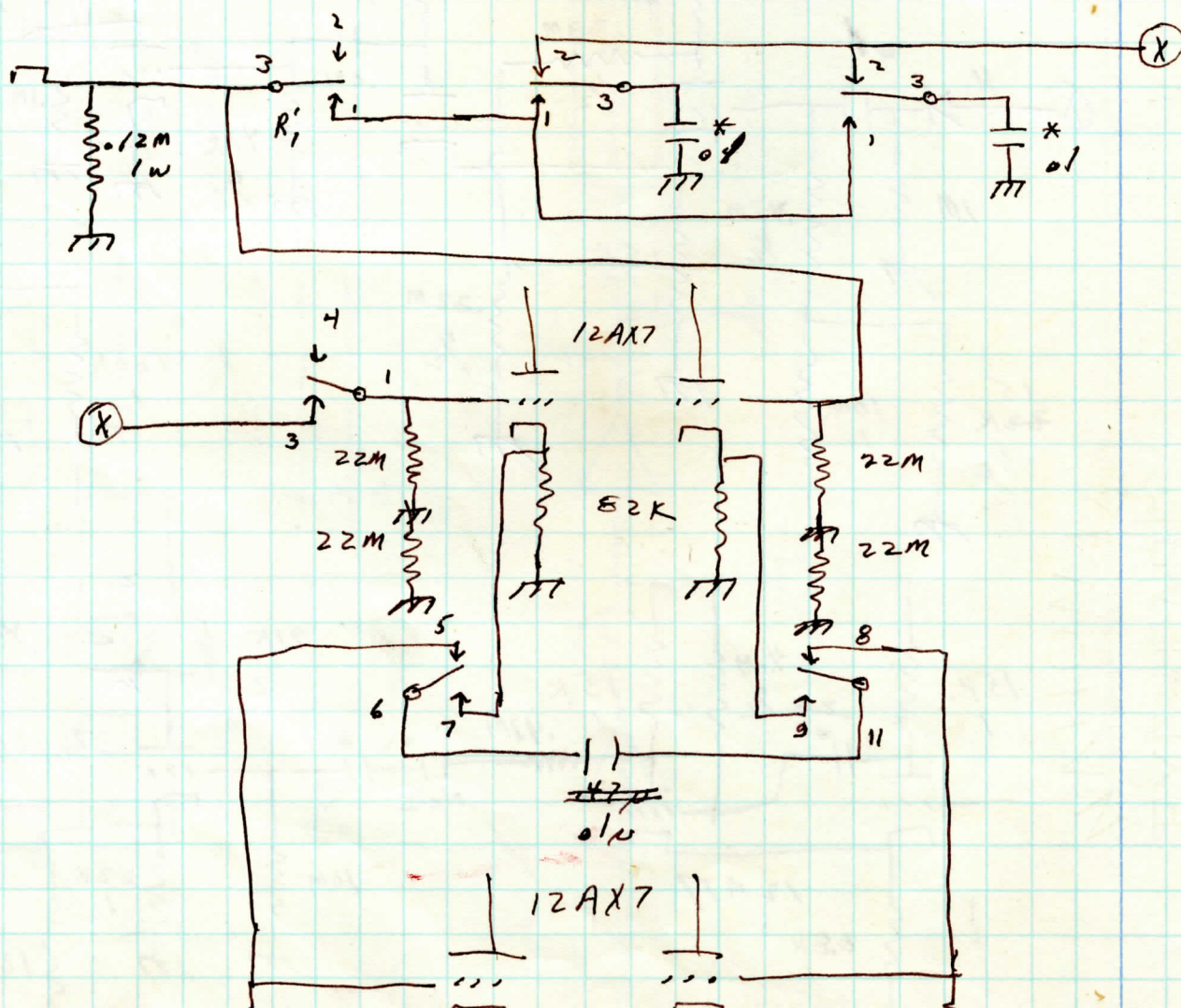
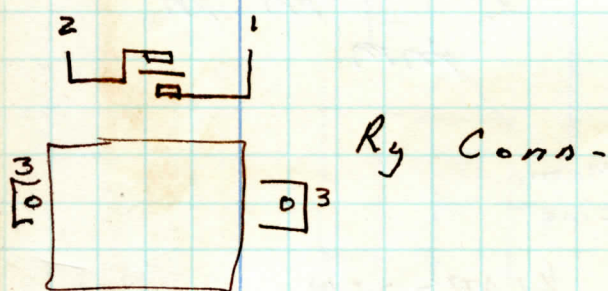
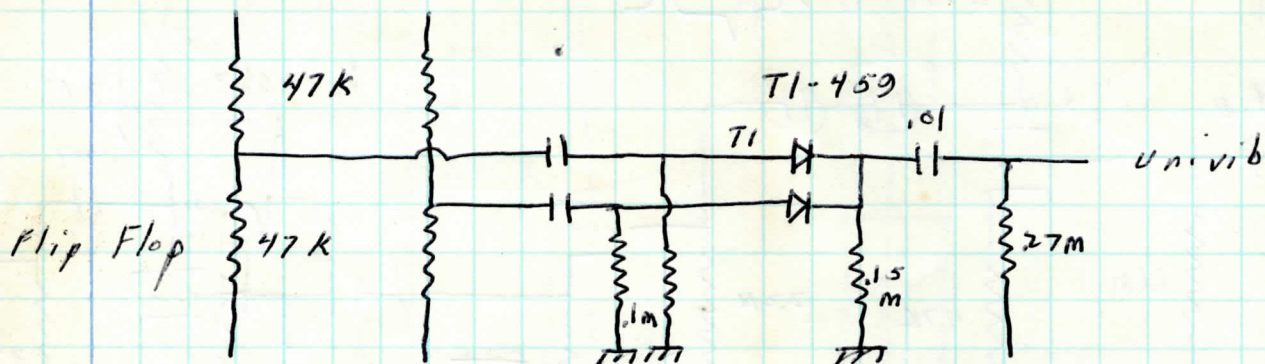
MKI Seq. Comp.





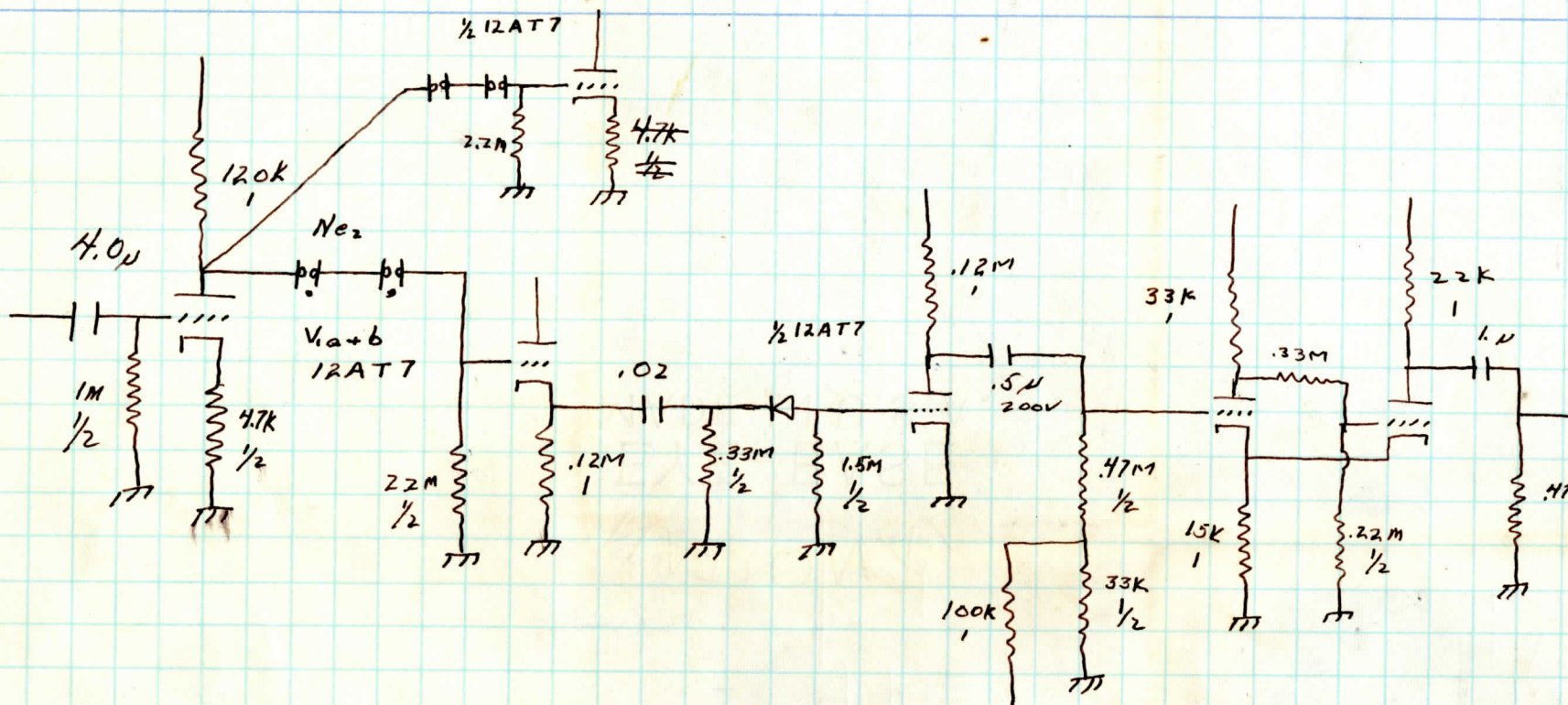
Seq. Computer

Detail of sample R_y (R_i') trigger

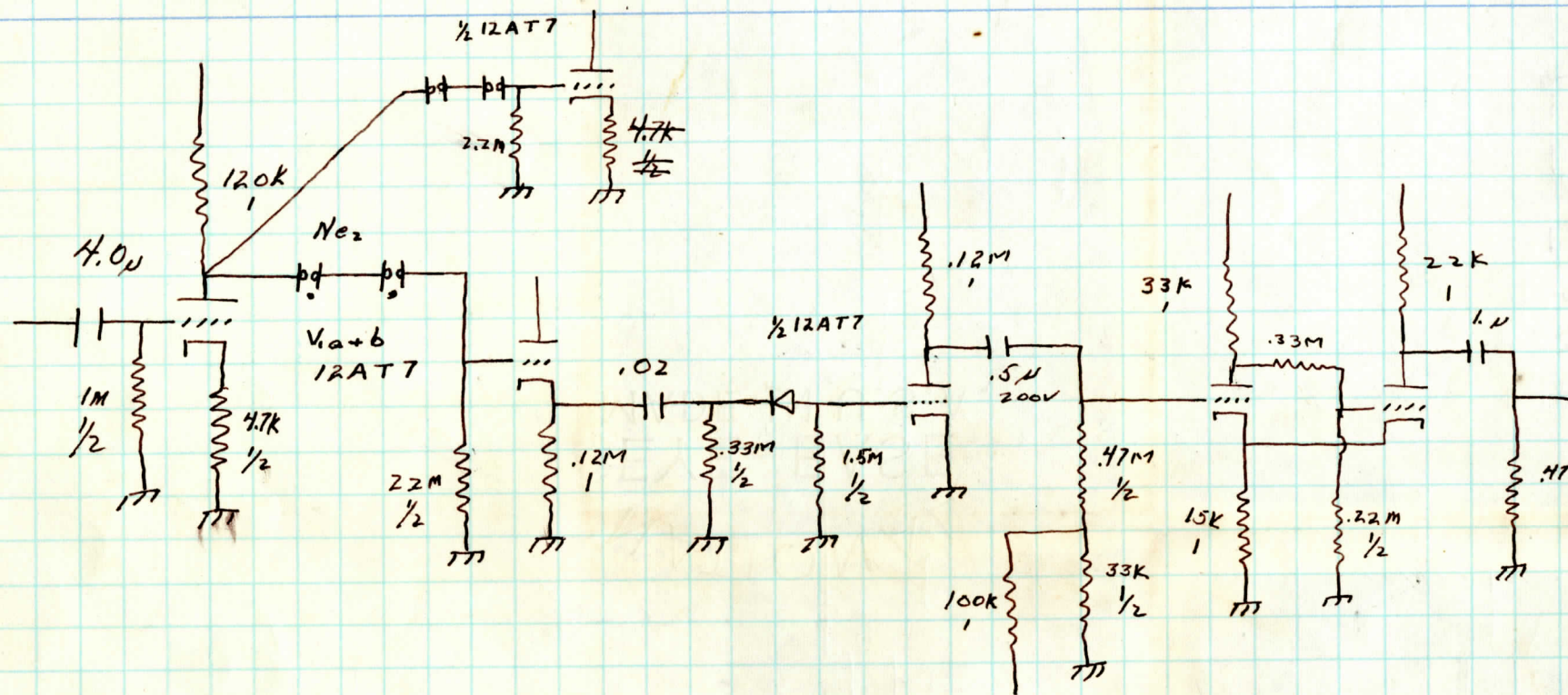


eg. Computer

Tested J point sampler



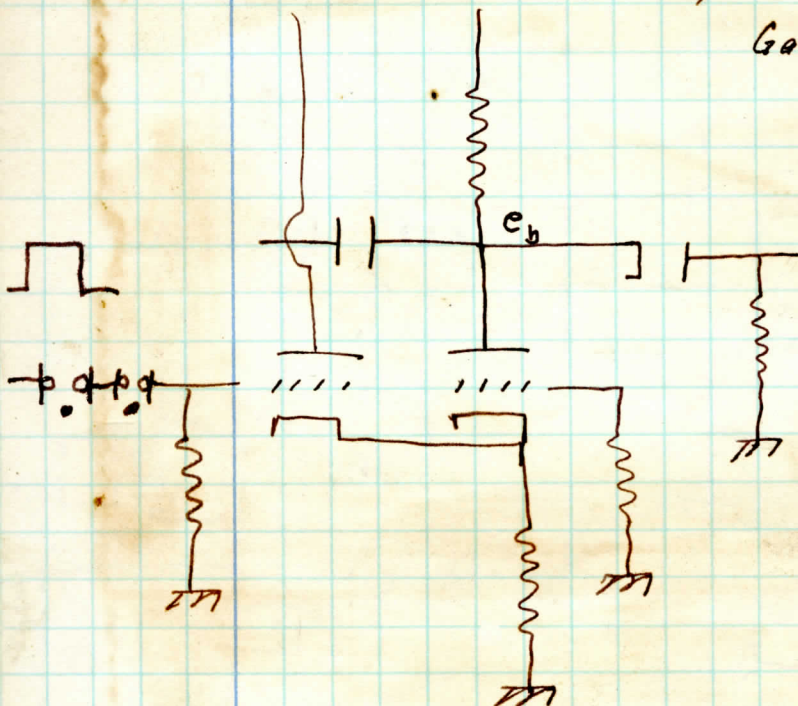
Seq. Computer Tested 1 point sampler



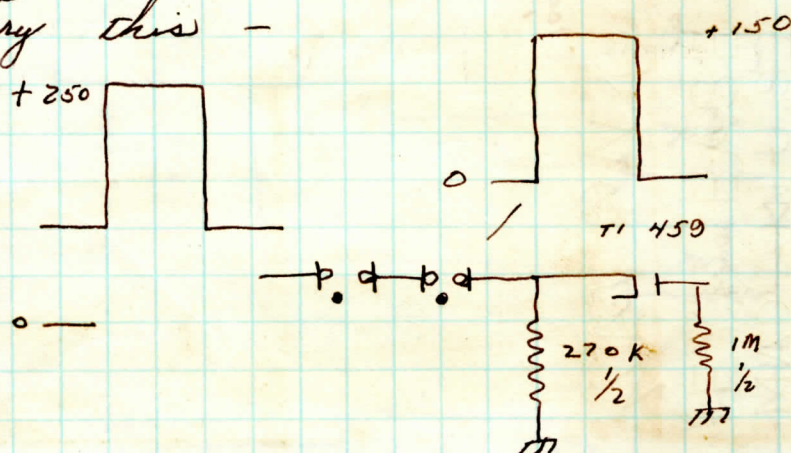
Seg Computer

Modified 'not' gate for neg pulses

Gate open $\bar{c}$ $e_b = +130$
 closed $\bar{c}$ $e_b = +150$
 12AT7

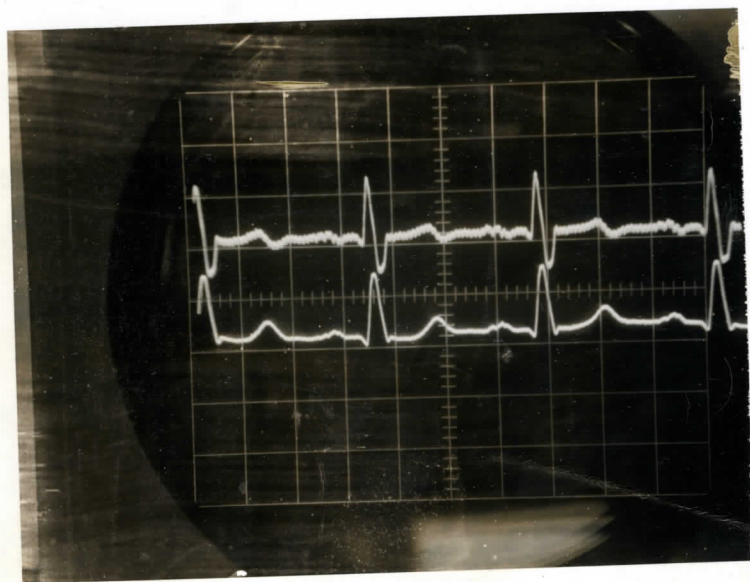
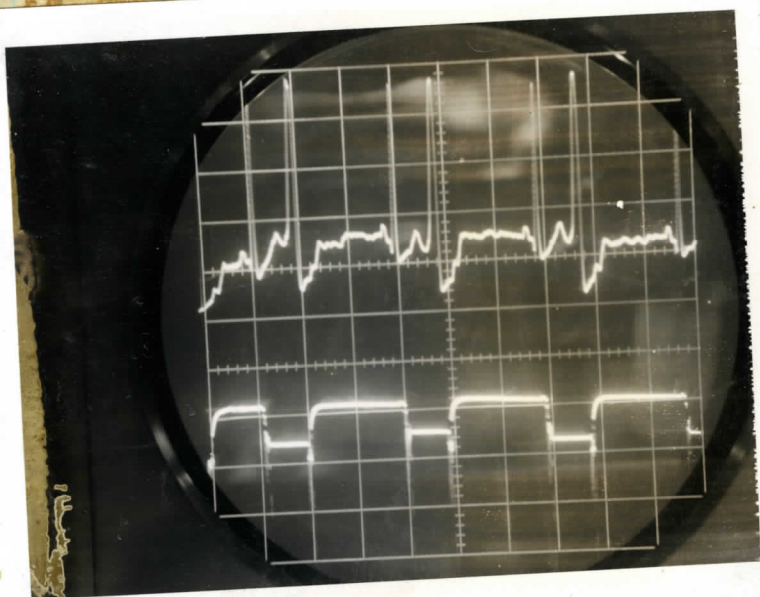
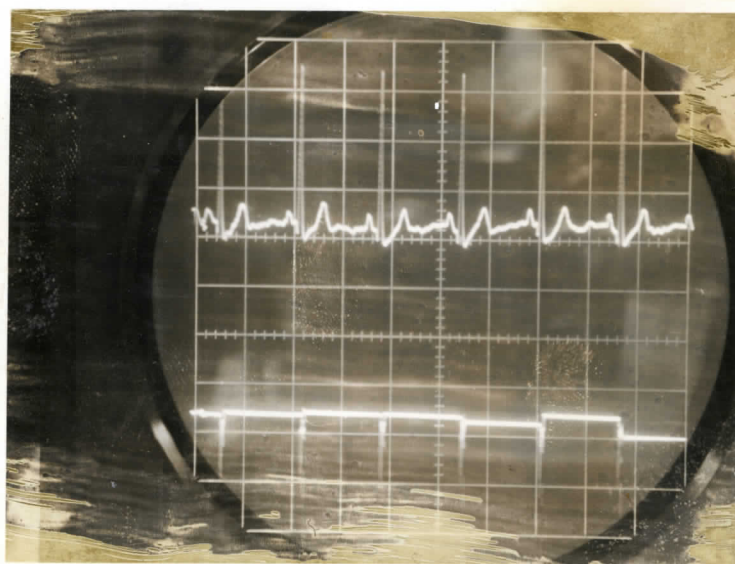


Try this -



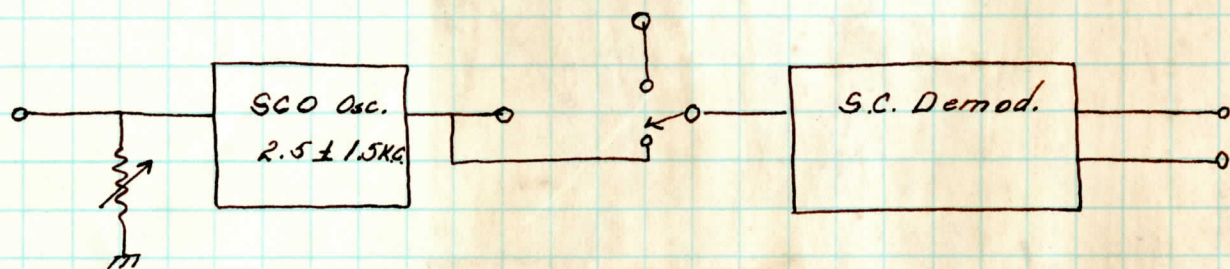
Works well $\bar{c}$ feedback
 to source.

Segment Computer

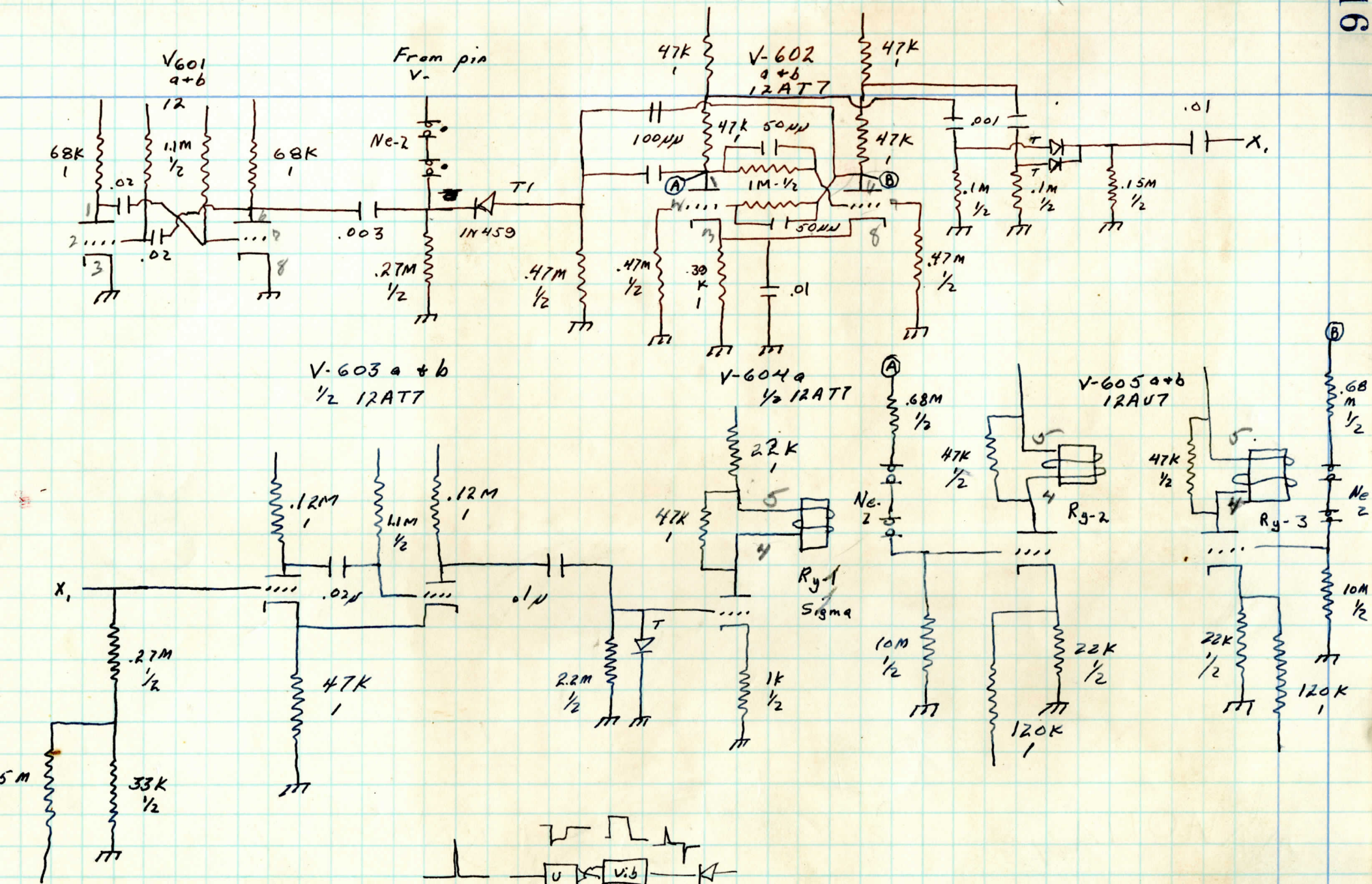


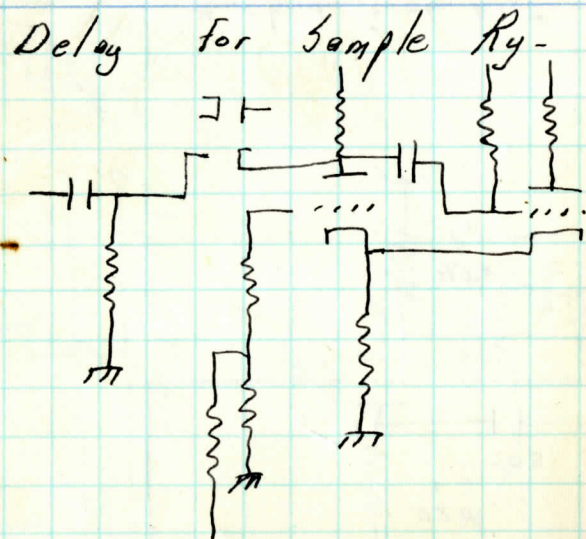
A → R2
← 4

Complete Block of EKG Computer

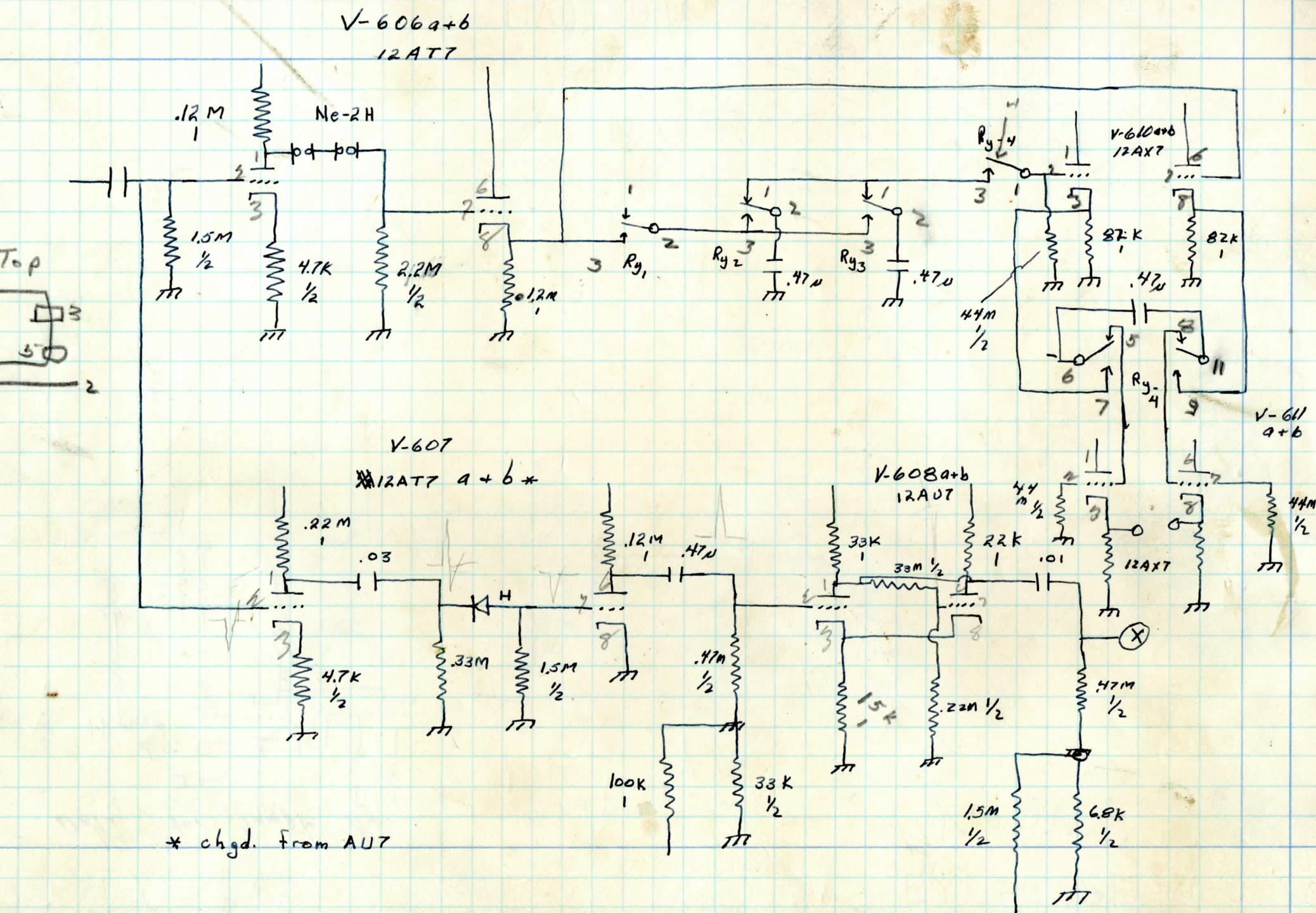


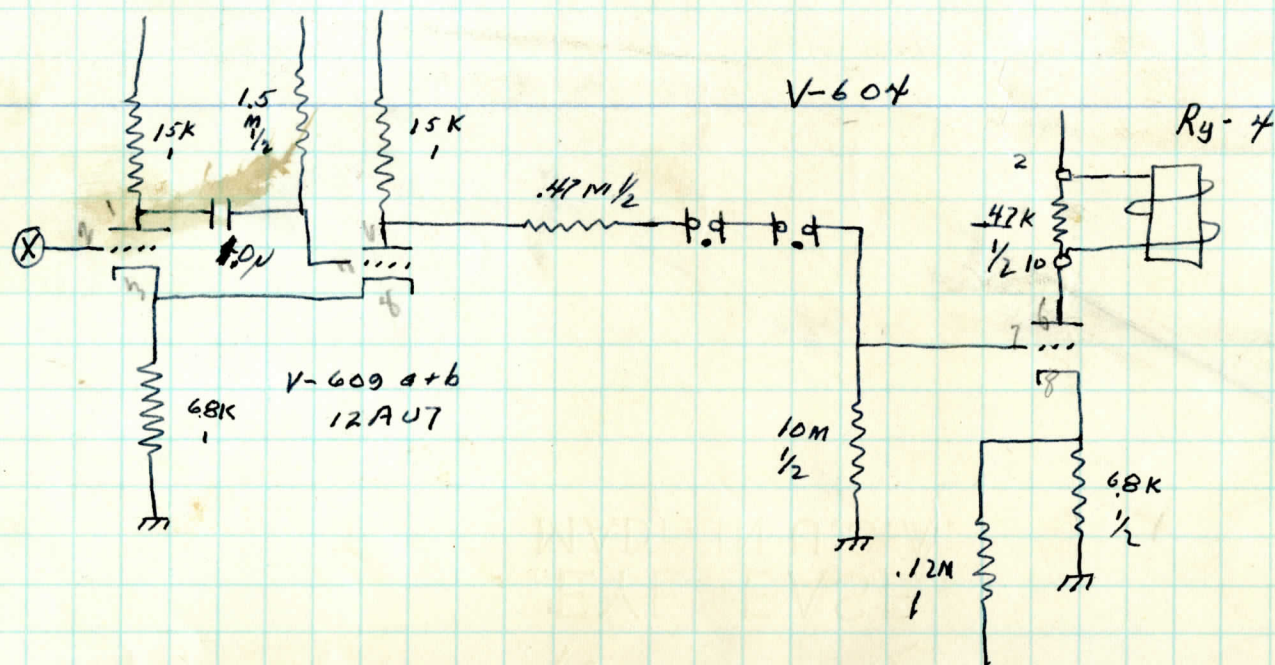
Segment Computer - Schematic ~~VPB selector & ORS Gate~~



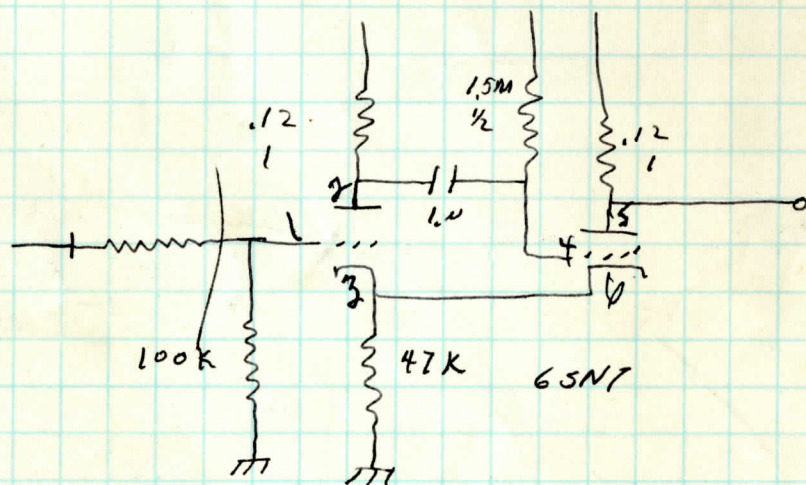


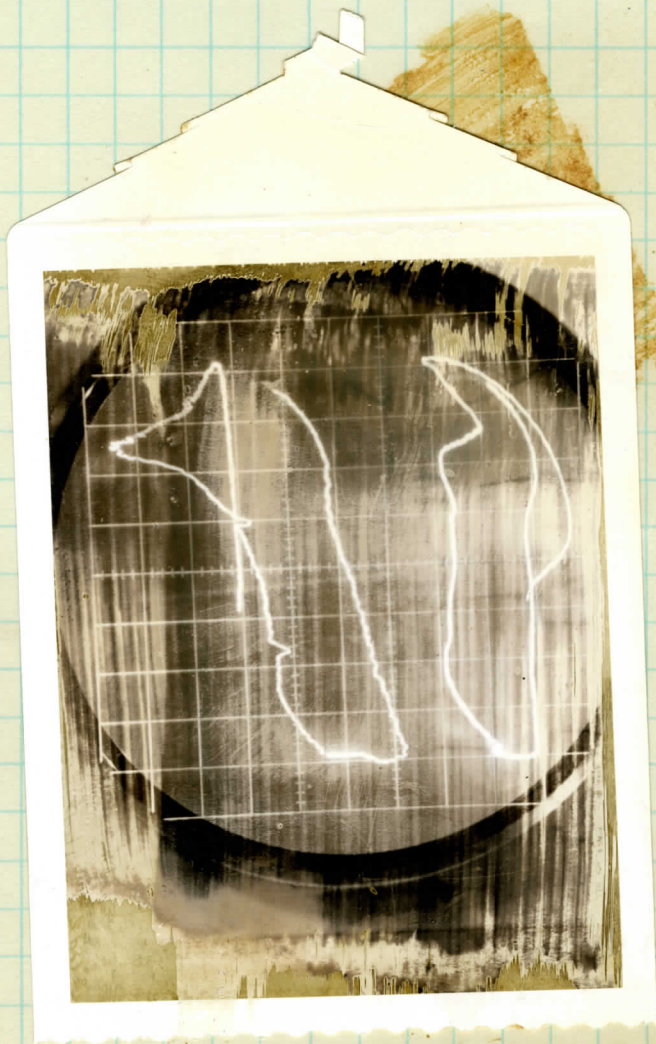
MKI Segment Computer - Schematic





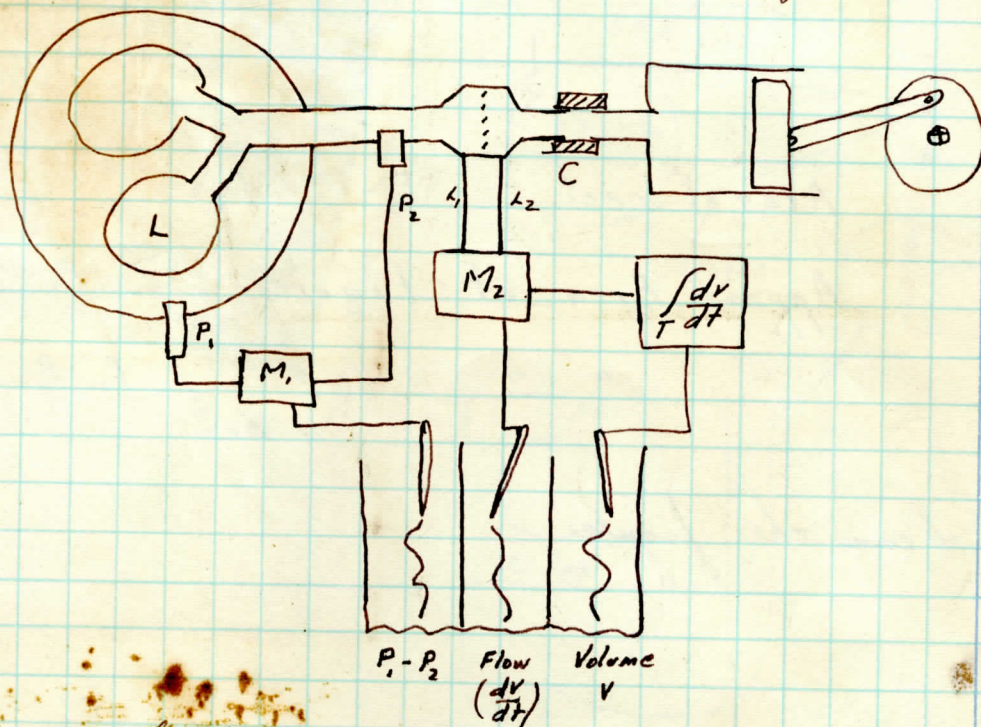
Seq. Comp. QRS 'OFF' Gate





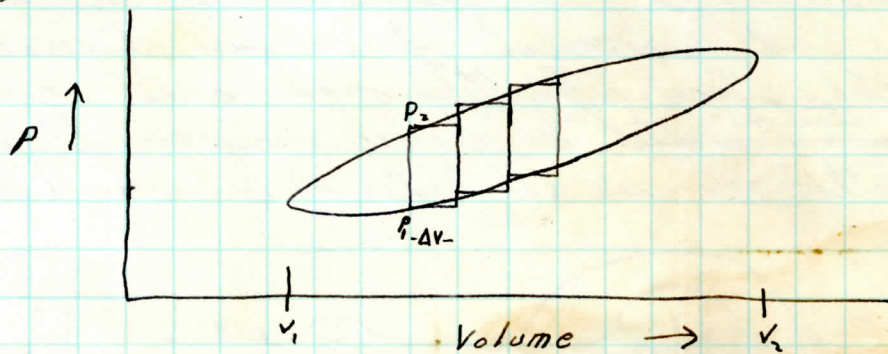
Respiratory work computer

Dr. Richard Peters described the difficulties of data reduction and assessment of various respiratory quantities on 9-12-61. These difficulties make wider application of these ^{studies} measurements to clinical measurement impractical. The method in use is shown below in diagrammatic fashion.



L represents the lungs surrounded by a cyclically varying pressure P_1 within the thoracic cage. This pressure is obtained by an esophageal catheter and closely approximates intrapleural pressure. The catheter is connected to one side of a differential pressure monometer M_1 (Statham 0-2 PSI). The other arm is connected by way of a catheter to the mouth of the animal where pressure P_2 is obtained. This is recorded as $P_1 - P_2$.

Thoughts on Area computer.

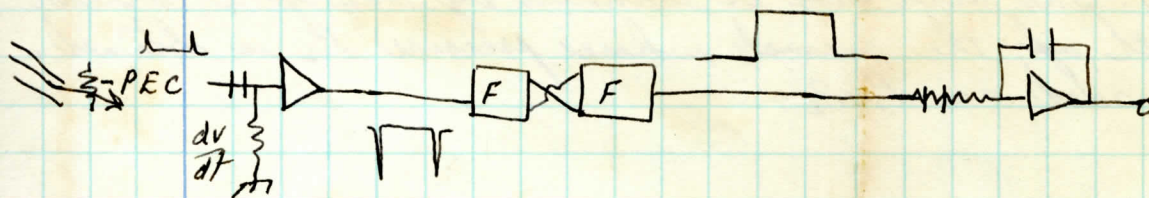


Area of rect. = $P_2 - P_1 \times \Delta V$

Approx Area of figure = $\sum (P_2 - P_1) \Delta V$

" " " $\int_{V_1}^{V_2} P_2 - P_1 dV$
 $\Delta V \rightarrow 0$

Scan the figure



Check of P.F.C. output for work computer. Two narrow strips of scotch #33 tape were placed on the graticule of a Tek 502 scope as seen in photo #1. The arrangement in F-1 was used and photos #2 + 3 are from scope #1.

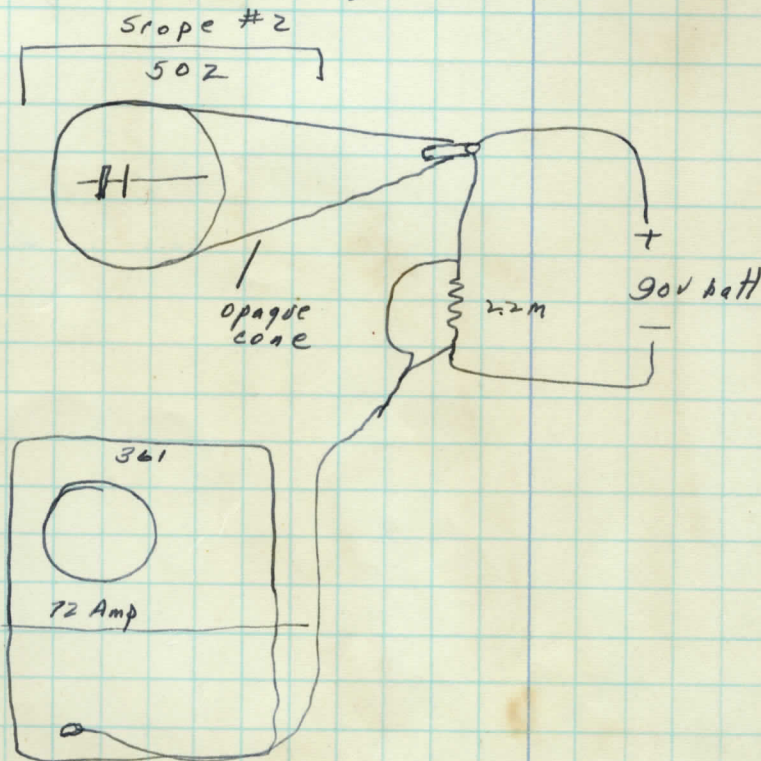
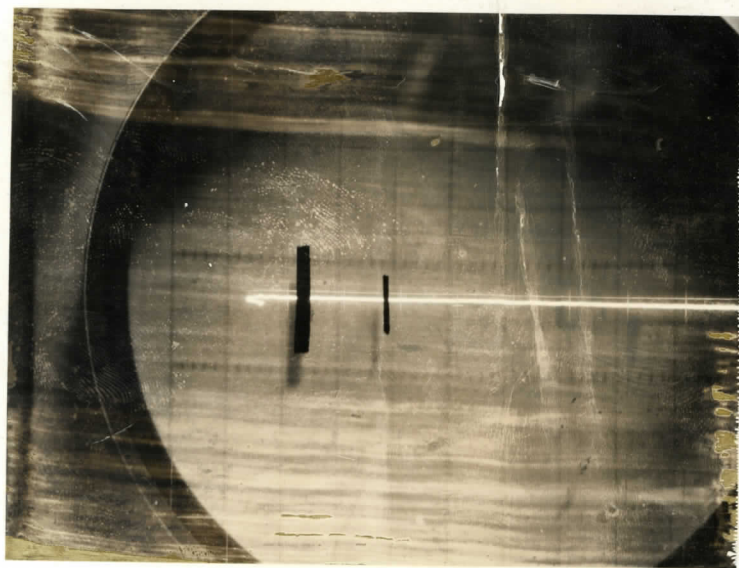
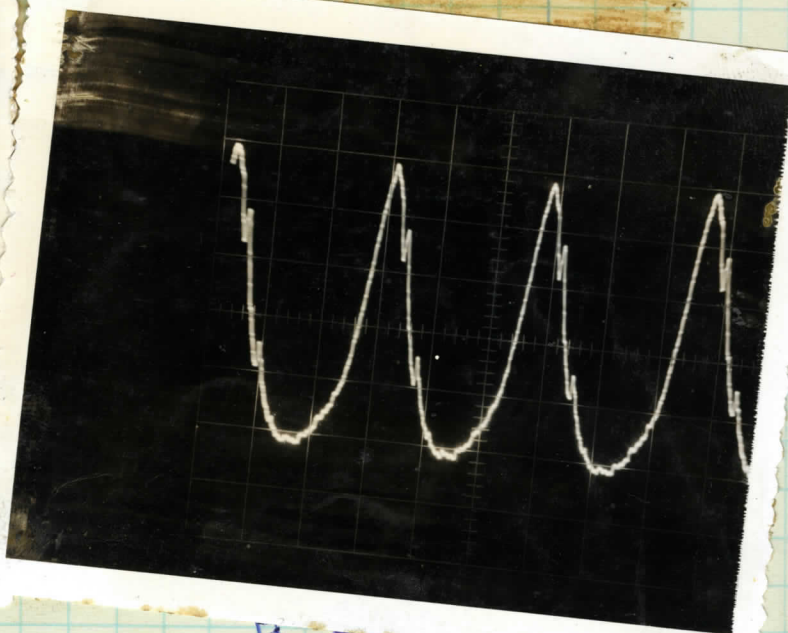
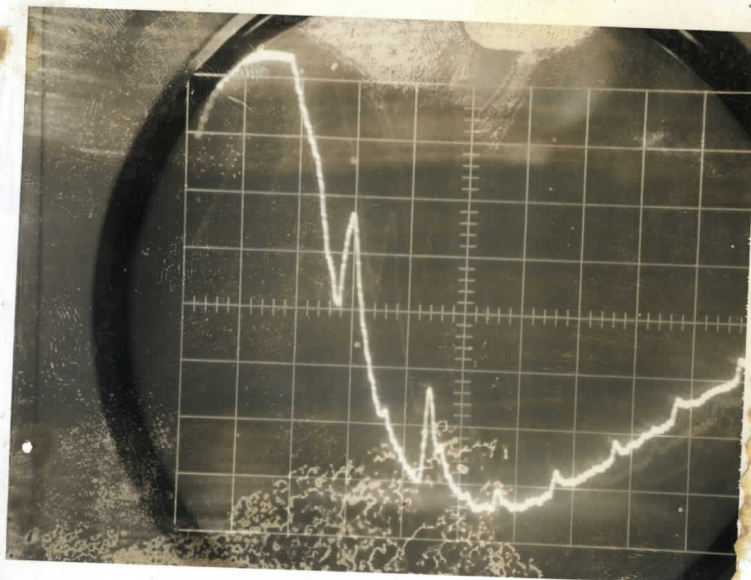


Fig 1-



.2 cm/sec 0.5V cm



26000

2φ

21200

21505

(3)

21245

(2)

21200

↑
↑

45 s. epoch

0 2 5 9 8 2

0 2 6 0 2 9

0 2 5 9 8 1

0 2 5 9 6 5

0 2 6 0 1 8

0 2 1 1 8 4

0 2 1 2 2 2

0 2 1 5 0 0

0 2 1 5 2 0

0 2 1 5 0 3

0 2 1 2 5 9

0 2 1 2 3 3

0 2 1 1 5 8

0 2 1 1 3 4

0 2 1 1 7 4

0 2 1 1 6 1

0 2 1 2 1 3

0 2 1 2 1 3

0 2 1 1 7 0

0 2 1 2 0 0

0 2 1 1 9 1

0 2 1 2 0 1

0 2 1 2 0 8

0 2 1 2 0 1

0 1 1 8 3 3

0 1 1 8 4 3

0 1 1 8 5 0

0 1 1 8 4 6

2φ 3.3K 85700

24

2φ 1.7K 22 69235

2φ 6.2 63220

2φ 7.2 48140

2φ 8.5 1460

0 2 1 7 7 0

0 2 1 7 2 7

0 2 1 7 5 3

0 2 1 7 3 6

0 8 5 7 6 2

0 8 5 7 0 8

0 8 5 6 7 5

0 8 5 7 0 9

0 8 5 6 6 6

0 6 9 2 8 5

0 6 9 1 7 6

0 5 2 3 5 3

0 4 0 5 8 4

0 5 3 2 4 0

0 5 3 1 9 7

0 3 5 5 9 3

0 3 5 5 6 6

0 4 8 7 1 4

0 4 8 7 6 8

0 3 3 8 5 3

0 3 3 8 0 2

0 4 4 5 9 5

0 4 4 6 0 1

0 3 2 0 7 4

15

0 3 2 1 0 5

0 4 2 0 2 4

0 4 2 0 5 2

0 0 3 0 9 5

0 3 1 0 7 5

0 3 1 0 8 6

0 3 9 0 3 3

0 3 9 0 1 6

0 2 9 8 5 5

0 2 9 8 7 4

0 3 5 0 9 5

0 3 5 1 1 8

0 2 8 0 7 6

0 2 8 1 0 9

0 2 1 7 3 0

0 2 1 7 4 4

0 2 5 5 1 9

0 2 5 5 3 8

0 2 5 7 1 6

0 2 5 7 0 5

0 2 9 8 1 3

0 2 9 7 8 4

0 2 9 8 2 9

0 2 9 7 6 9

0 2 9 8 2 5

0 2 9 8 0 2

0 2 9 8 1 5

9.4 2φ 42030

14

13

12

(11)

(10)

(9)

(8)

(7)

(6)

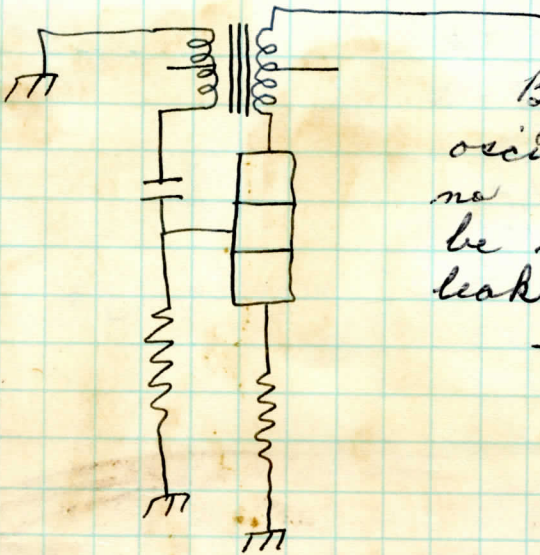
↑

2φ-16.2

2980

(5)

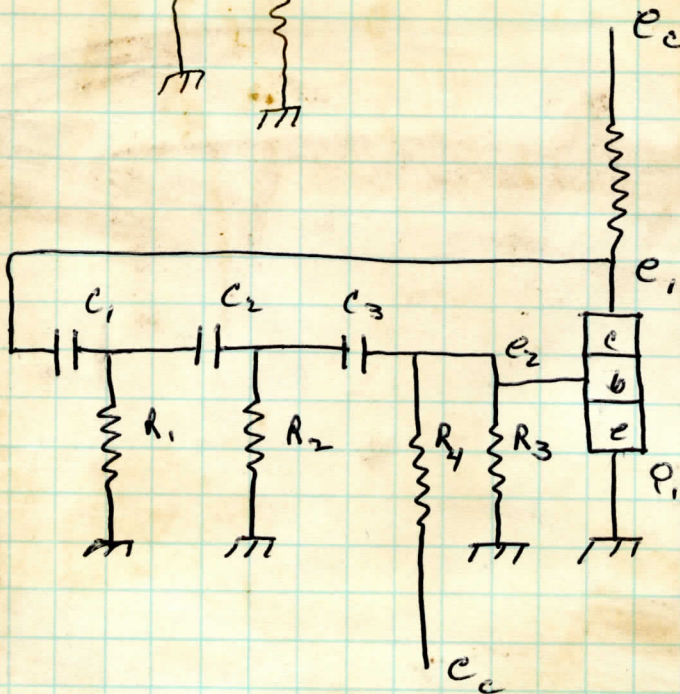
I.M. S.C.O.



By using a variety of quenched oscillators & available transformers no satisfactory arrangement could be made using a varying grid leak.

Try the ckt. below -

Wouldn't osc. w/ ϕ , a 1N623 - By going to a 2N508 the results below were obtained -



$C_{1,2,3}$ μFd	R_1 K	R_2 K	R_3 K	R_4 K	e_1 Volts D.C. Δ	e_2 Volts D.C. Δ	e_c -V.O.C.	Freq.
.005	28.	28.	22.	3.3			22.5	①
							-16.0V	②
								③
								④
								⑤
								⑥
								⑦
								⑧
								⑨
								⑩
								⑪
								⑫
								⑬
								⑭

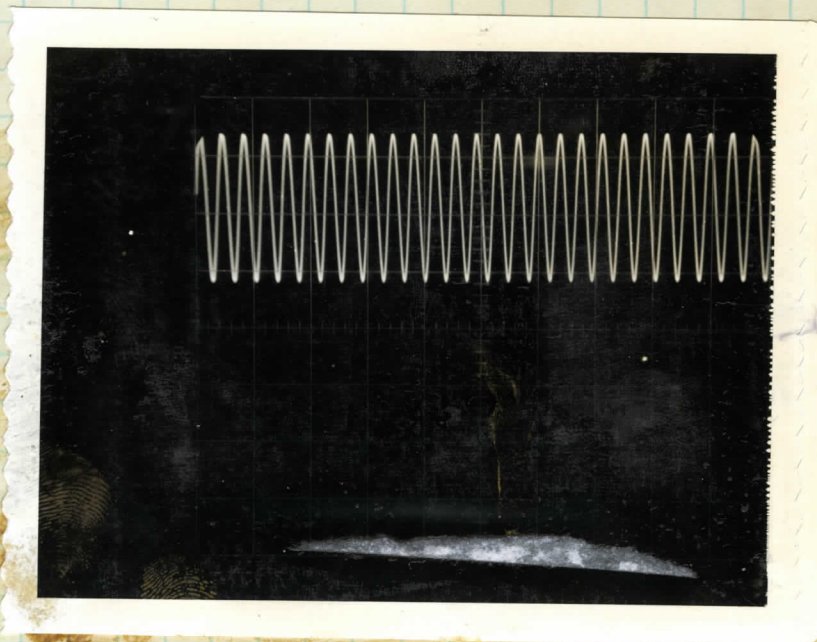
A.A. $\hat{z}$ trans at body temp
~~at~~ same as ①

↓

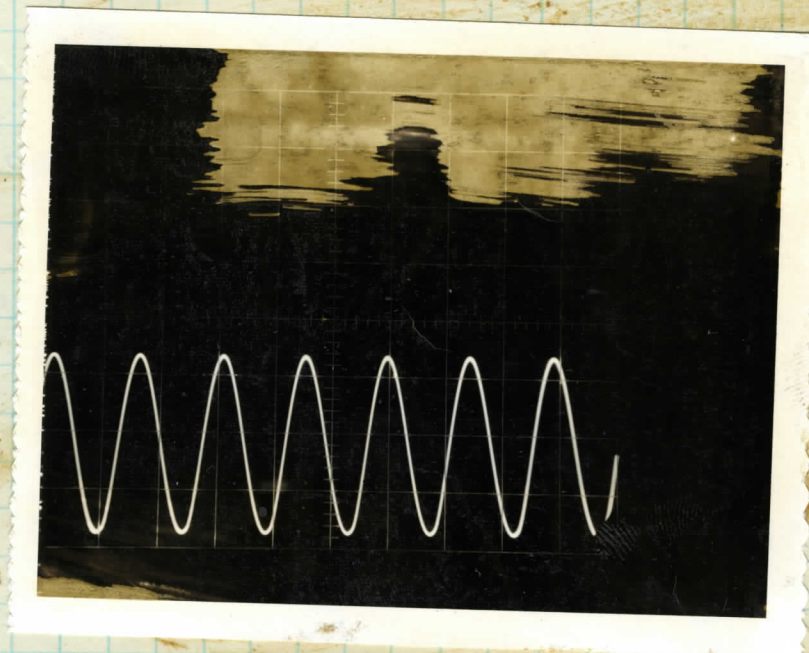
$7.2 K$
 $28 \text{ } 6.2 K$
 6.2
 ~~28~~ 28
 4.7
 28
 3.3

$7.2 K$
 $6.2 K$
 6.2
 4.7
 4.7
 3.3
 3.3

wouldn't go

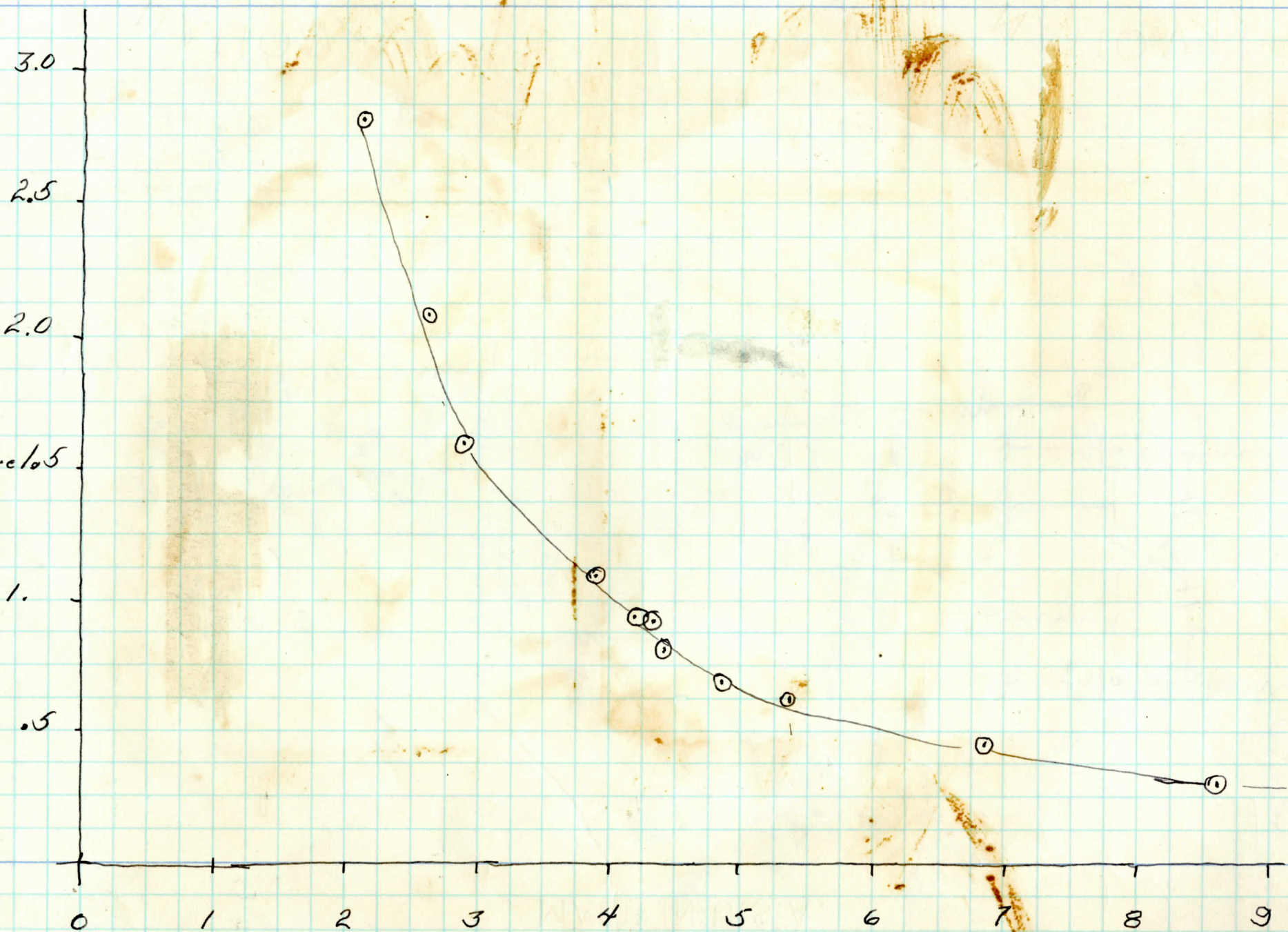


$5V/cm$
 $1ns/cm$



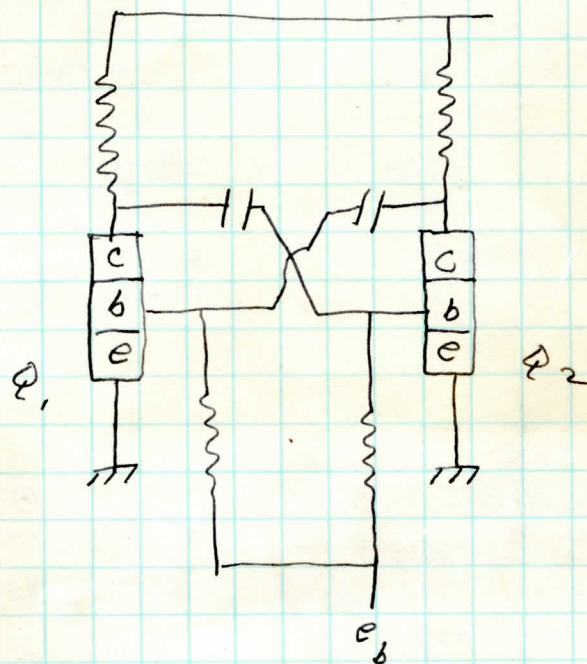
20% Res
 change
 produced
 28.5%
 change

Variation of Freq. of ϕ shift osc. p-131
c Variation of Feedback resistance

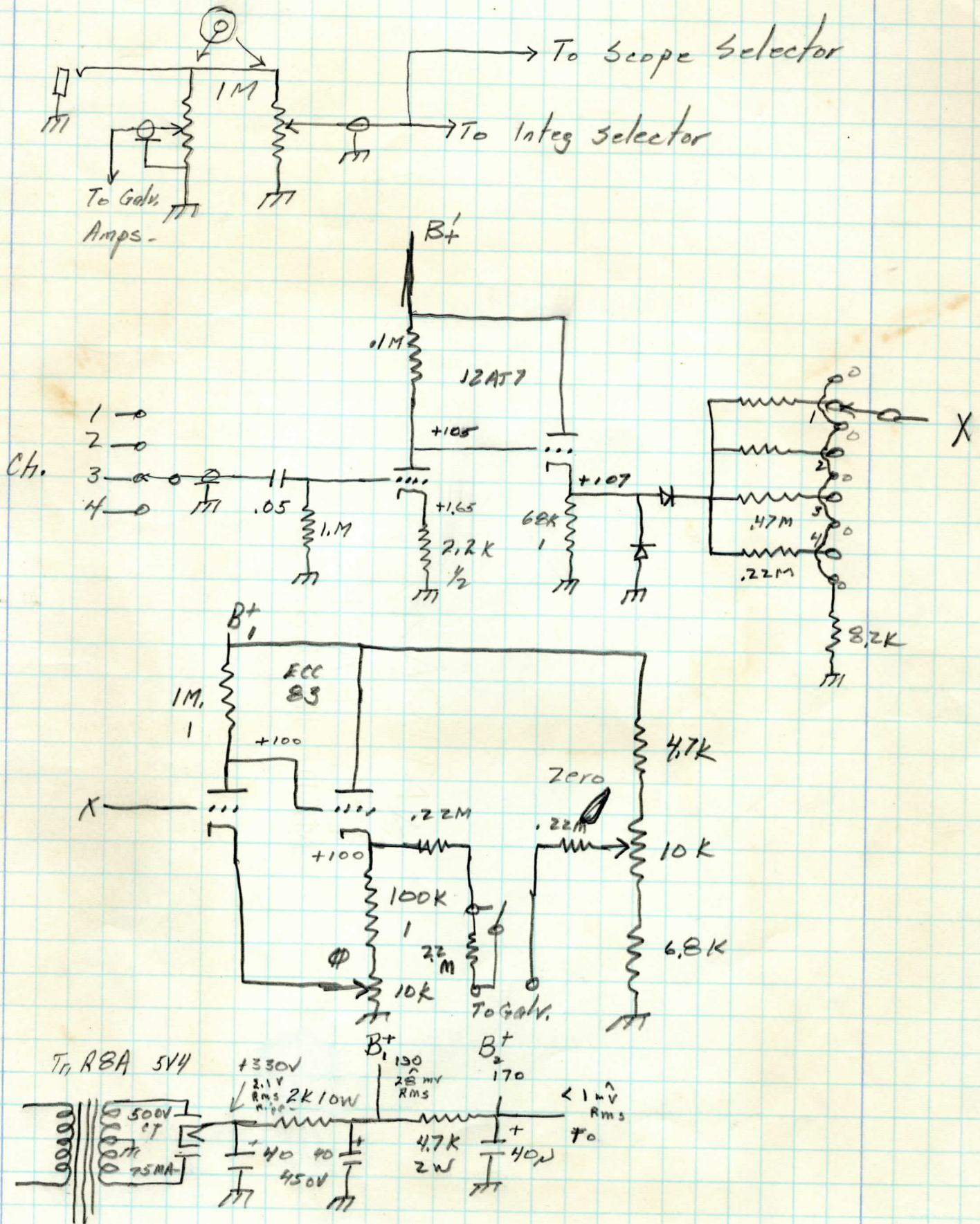


Freq X 45 C.P.S.

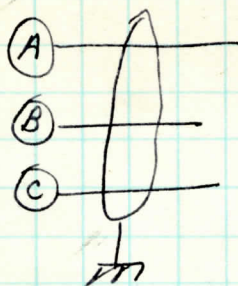
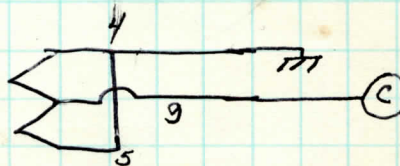
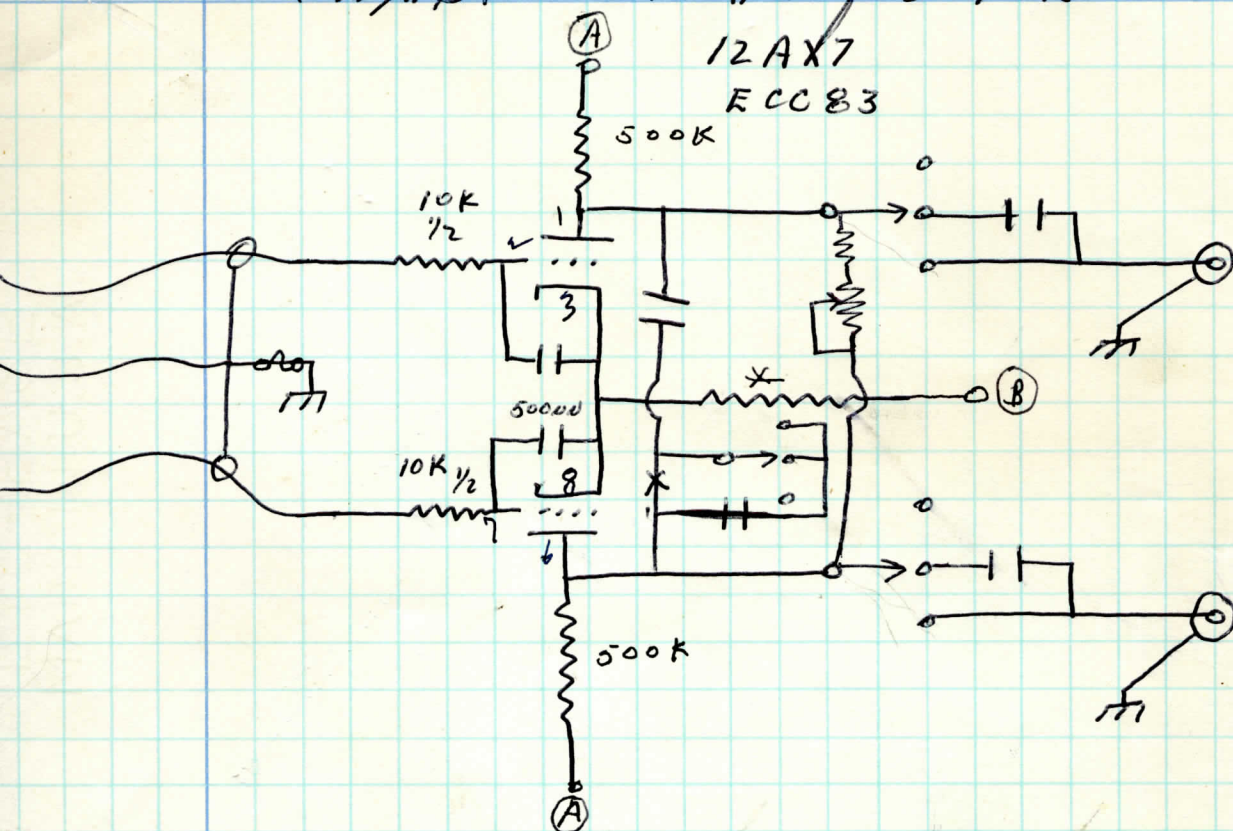
Multivib S.C.O.

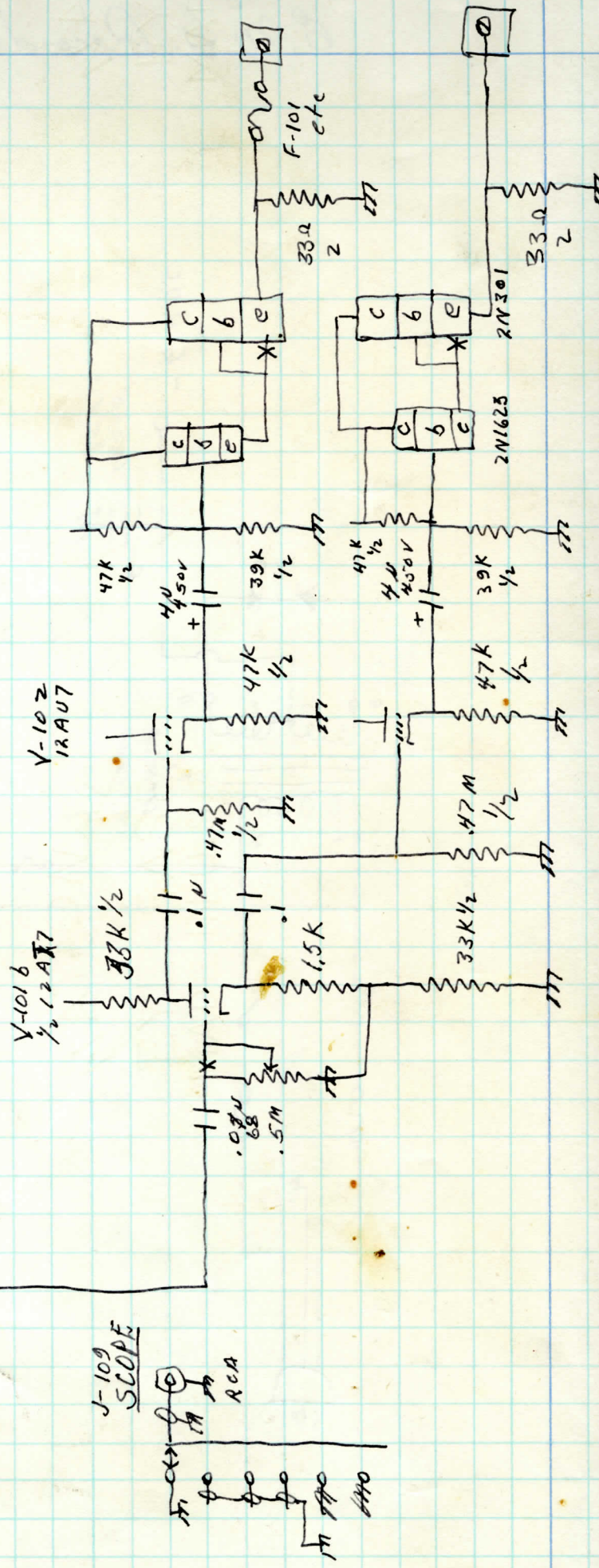
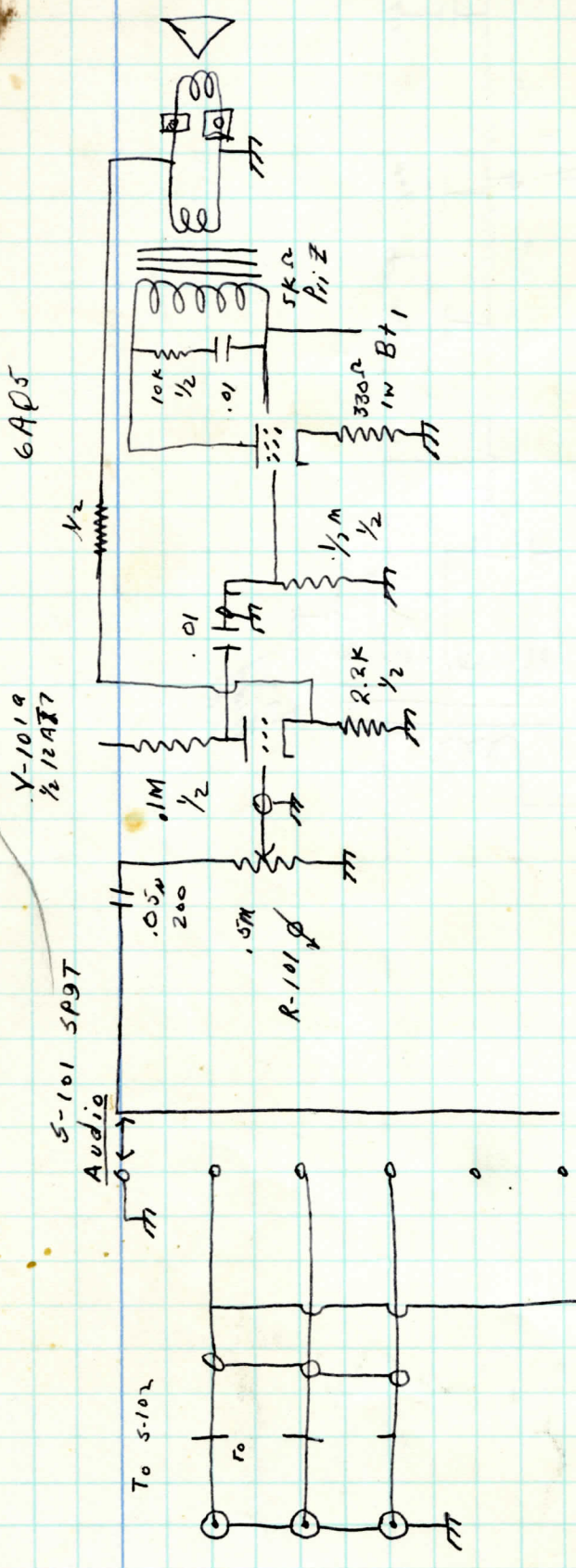


1.2.63 EMG Recorder



6" ~~P.P.G.~~ + 6" M.G. for Tek 502



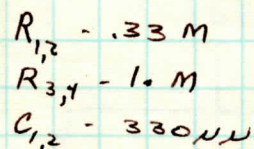


J-101
1-102
1-103
A Jacks

J-109
SCOPE
RCA

From
5-101

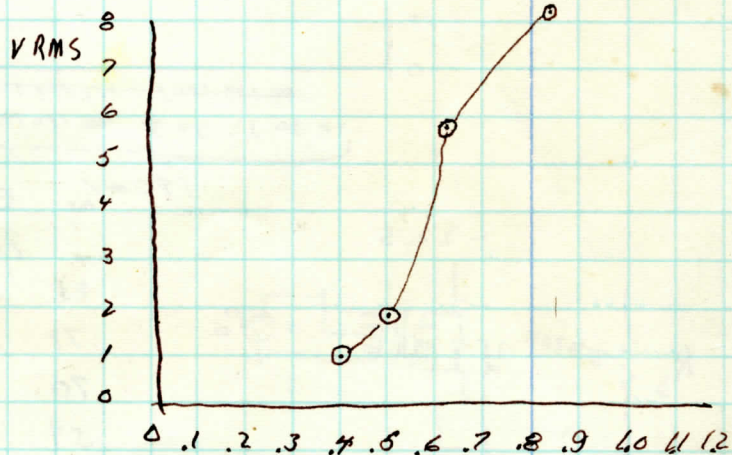
Multi rib -


$$B+ = 2.35V$$

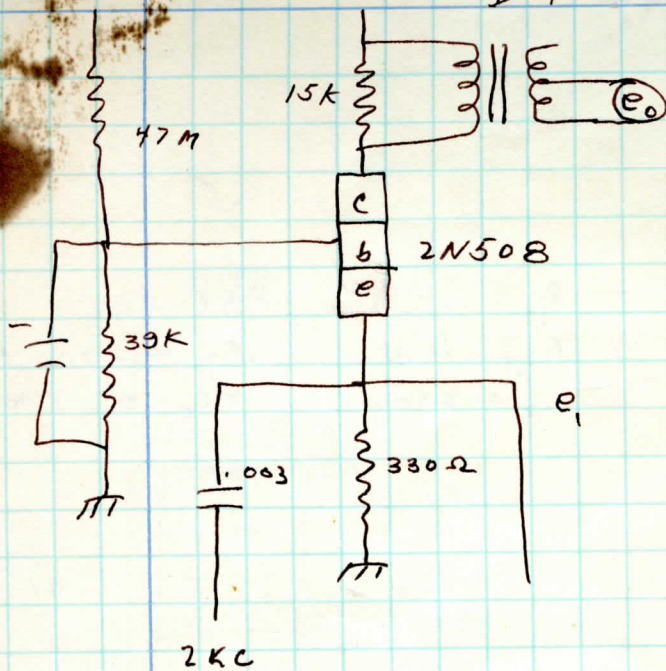
$$e_0 \approx 22.5V \text{ P.P.}$$

$$\bar{e}_e = 0 \quad T \approx .8x$$

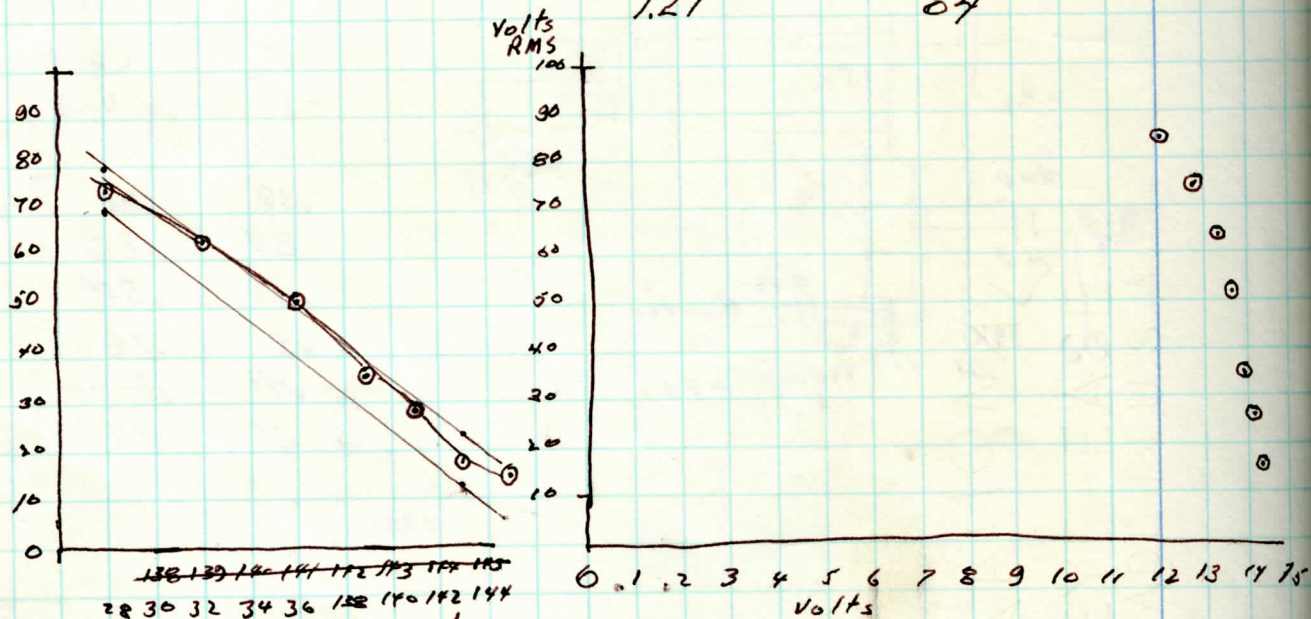
	e_b	e_o	R_K
- V.		$V_i R_{ms}$	
	1.32	1.0	420 K
	.98	.91	680
	.84	.82	1
	.63	.58	1.5
	.5	.18	2.2
10	.41	.1	3.3
9	.35	.07	4.7 M



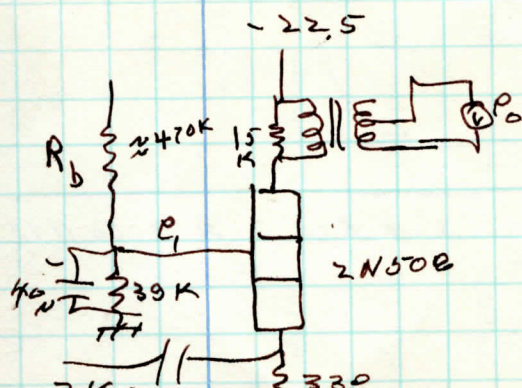
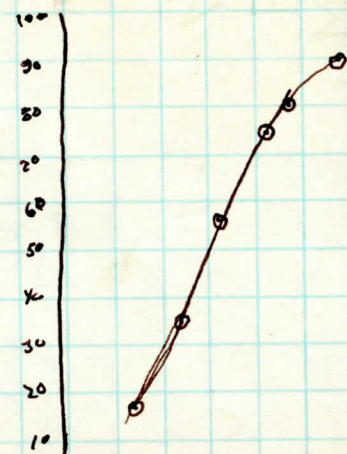
DOT



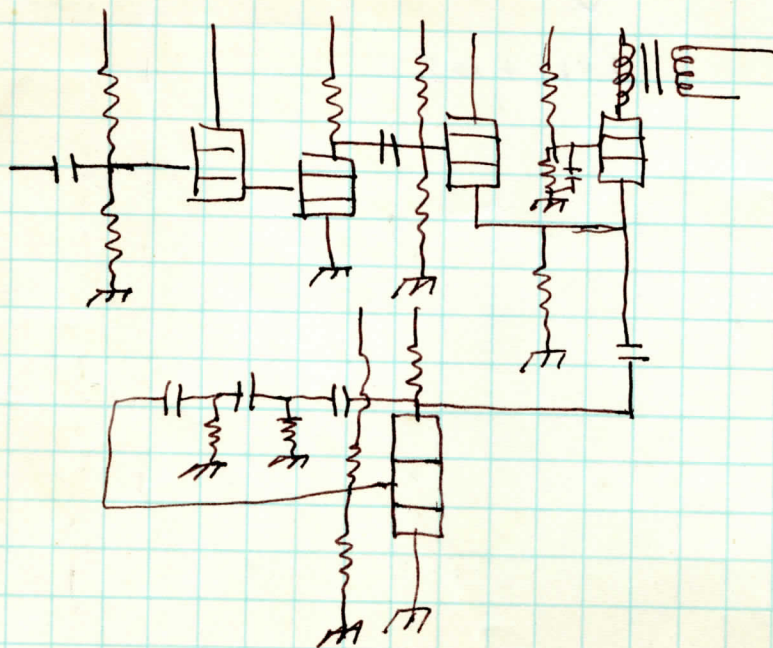
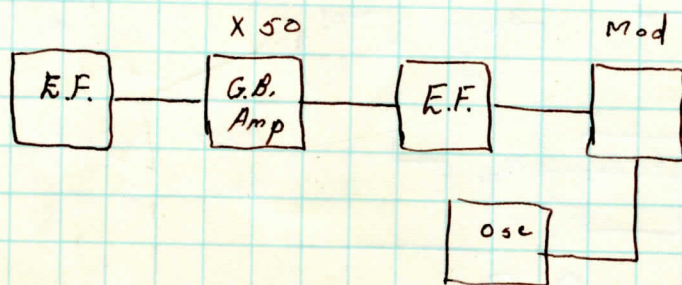
e_1 -VDC	e_2 mv RMS
1.48	100
1.6	98
1.72	88
1.91	34
2.4	3
1.50 ± 0.4	86
1.45	14
1.43	18
1.41	28
1.39	36
1.36	51
1.32	64
1.28	75
1.21	84



e_2 mv	e_1 mv
100	1.36
85	0.78
77	0.67
70	0.62
54	0.52
34	0.44
17	0.34



Tent. Schematic



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MK II EKG Computer- SCO, Demod, Tach., PVB interval meter

