S E R V I C E   M A N U A L

Synthi A/VCS3

DK1/2 keyboard

KS sequencer

We reserve the right to make changes in technical specification and design
in the interest of continuing improvement in performance.

CONTENTS:

NOTE:

Transistor types used in our machines have varied from time to time.

The following types are the most widely used:

NPN sil BC 169C   2N 5172

PNP sil BC 258B   2N 4288

Fast NPN sil ME9002   2N 706

Fet 2N 5163

Fet 2N 5461

Diodes:

DK10 - small signal germanium

1N4148 - 1N 914

SYNTHI A ALIGNMENT

Synthi A	Testing Manual Board
1. Power Supply	A
2. Output Channels	A
3. Reverberation	A
4. Envelope Shaper	B
5. Filter Oscillator	B
6. Ring Modulator	B
7. Input Channel Preamplifiers	B
8. Oscillator 1	C
9. Oscillator 2	C
10. Oscillator 3	C
11. Noise Generator	C
12. Meter Amplifier	C

Board A is on the left side as you look at the opened back of the machine.
Board B is in the middle, with Board C on the right.

SPECIFICATIONS

Power: 100-130V or 200-250V ac.

Stereophones level: 10V p.p max into 50 ohms

Scope output: 5V p.p max

Signal output: 2V p.p max into 600 ohms

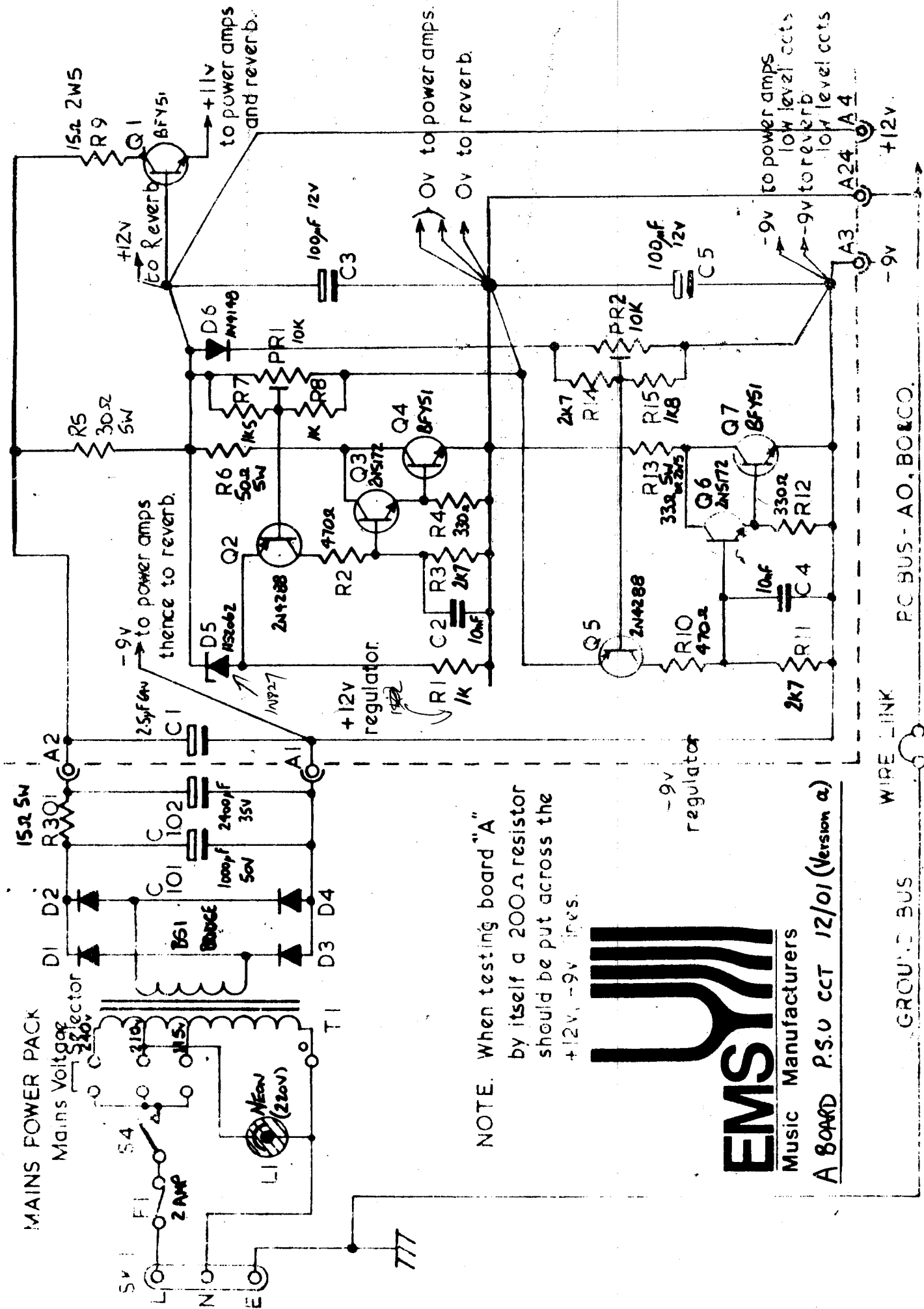Control output; 15V dc max into 10K ohm

Signal Input; ac - 1.8V p.p into 50K ohm. dc- 2.5V max into 50K ohm.

Microphone Input; 5mV into 600 ohms

Devices

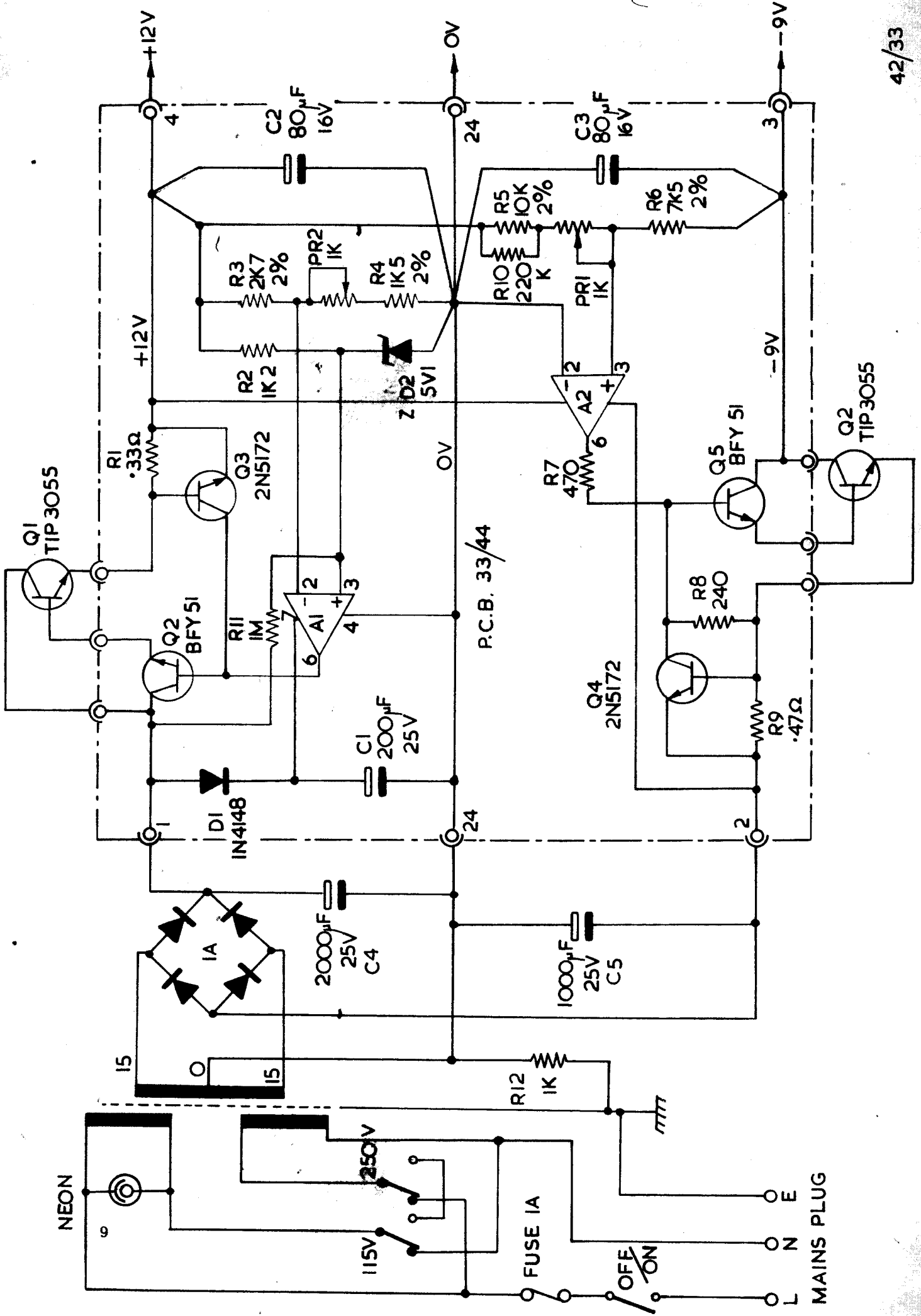|	
Oscillator 1	Range: 1Hz-10kHz (on dial)
	Outputs: Sine 2V p.p (with shape control) Sawtooth 2V p.p
	Control Sensitivity; 0.32 Volts/Octave
Oscillator 2	Range; 1Hz-10kHz (on dial)
	Outputs: Triangle/Sawtooth 3V p.p Square/Pulse 2V p.p
	Control sensitivity; 0.32 Volts/octave
Oscillator 3	Range: 0.02(40"period) - 500Hz(on dial)
	Outputs: Triangle/Sawtooth 3V p.p Square/Pulse 2V p.p
	Control Sensitivity: 0.26 Volts/octave
Noise Generator	Level: 3V p.p white and coloured
Filter/Oscillator	Range: 5Hz-10kHz (on dial)
	Cut-off rate: 18 dB/Octave
	Q: Variable up to 20 Frequency Control : 0.2Volts/Octave
Ring Modulator	Input level: 1.5V p.p max.
	Output level: 6V p.p max.
	Input rejection: -50 dB (with 1.5V p.p input)

Envelope Shaper

Duration: Attack   2ms–1s
          On   0–2.5s
          Decay   3ms–15s
          Off   10ms–5s (+Off position)

Trapezoid Output: ± 3V dc max.

Decay Control; 0.4 Volts/octave

Reverberation

Max time: 2s

Output Level: 5V p.p

Mix VC : –2V for 0%, +2V for 100% mix

Joystick

Voltage Output: 2 x ±1.5V dc

Meter Input

Control Voltage mode: ±1V dc

Signal mode: 4V p.p

Input Amplifiers

Sensitivity: 1.8V for High Level Inputs
             5mV   for Microphone Inputs

Output Amplifiers

Output level: 2V p.p into 600 ohm (panned)
              10V p.p into 50 ohm (unpanned)
              5V dc into 10K ohm (unpanned)

VC level: 15 dB/Volt

POWER SUPPLY   P.C. BOARD A

MAINS POWER PACK

Mains Voltage Selector

EMS
Music Manufacturers

A BOARD P.S.U CCT 12/01 (Version a)

NOTE. When testing board "A"
by itself a 200Ω resistor
should be put across the
+12v, -9v lines.

GROUND BUS

PC BUS - A0, B0&C0.

WIRE LINK

+11v
to power amps
and reverb.

to power amps.

to reverb.

to power amps.
low level ccts
to reverb.
low level ccts

+12v
A4

A24

-9v to power amps
-9v to reverb

A3
-9v

+12v
to Reverb

Q1 BFY51
R9 15Ω 2W5

R5 30Ω 5W

D6 IN914B
PR1 10K
R7 R8
1M5 1M

Q4 BFY51
Q3 2N5172

C3 100µF 12v

0v to power amps
0v to reverb
0v

PR2 10K
R14 2k7
R15 1k8

Q7 BFY51
Q6 2N5172

C5 100µF 12v

R13 2k5 5W
330Ω

R12 330Ω

R6 50Ω 5W

Q2 2N4288

R2 470Ω

R4 33Ω

R3 2k7
C2 10µF

R1 1K

+12v regulator.

D5 IS2062

-9v
to power amps
thence to reverb.

Q5 2N4288

R10 470Ω
C4 10µF

R11 2k7

-9v regulator

C1 25µF 6v

D7 IN927

A1

A2
R30 15Ω 5W
C 101 100µF 5W
C 102 2400µF 35v
BGE Black

D1 D2
D4 D3
T1

220v
210v
115v

L1 Neon (22ov)

S4
F1 2 AMP

L
N
E

777

Power Supply

Before turning on, set PR1 cw and PR2 ccw with only A board plugged-in.

Set PR2 for +12V ± 0.1V

Set PR1 for -9V ± 0.1V

Check PR2 again and reset if necessary

N.B. -9V rail is parasitic on the +12V supply.

Plug in B and C cards and recheck +12V and -9V rails.

These should not have altered. If they have, suspect either B or C board or poor regulation on A board. Plug-ni keyboard as extra load. +12 and -9 Volt rails should not have moved more than ± 0.1V measured always on the A board. (C board voltage may be 20 mV lower)

Monitor the rails on the scope (5mV/cm). Look for hum and noise. These should be much less than 5mV. Noise, if present, will probably be due to the zener diode.

Power supplies should stabilise on full load for specified fluctuations.

110/240 nominal :   +10% or -23%

110 nominal : 100V-135V for 125 sufficient

240 V nominal: 200V-260V

Hum can also be checked by the following:

Check Output Filters on 10

Output Controls on 10.0.10.10

Patchboard vacant

Monitor (5mV/cm) on signal output

Load unit with keyboard

100 Hz ripple as shown.

Noise can be seen which should never exceed 10mV p.p. Even with noise level up. With noise level down, the noise on this waveform should be quite low. Zener diode noise will be very obvious.

N.B. A2 normally gets hot, dodgy D1 gives large 100Hz ripple on Output.
Always clean edge-connectors and check clean presets on A board.

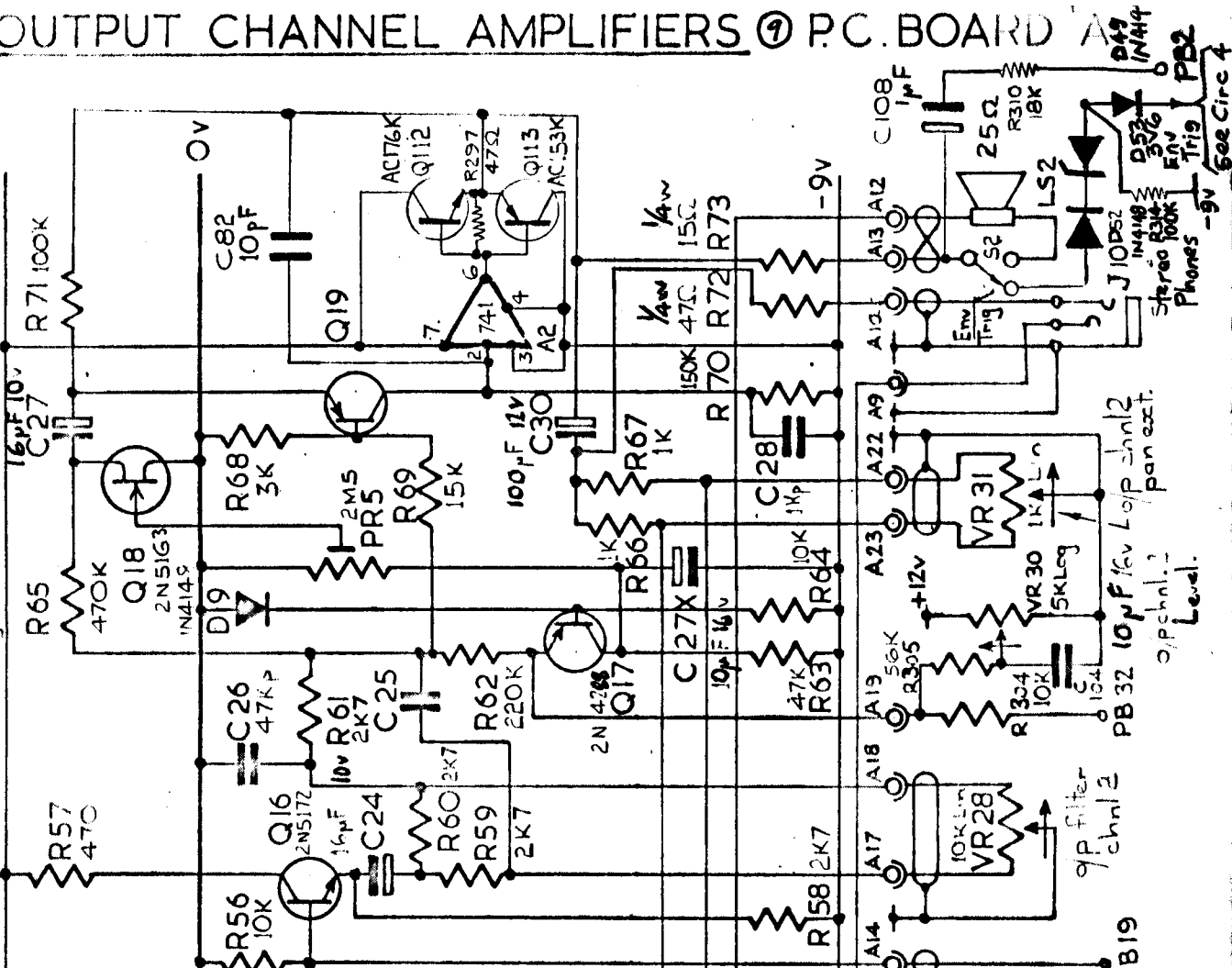5mV max.

2mV typ.

OUTPUT CHANNEL AMPLIFIERS ⑨ P.C.BOARD 'A'

ALL 2N5172 NOW BC169Z

Ch.2 — Tone control, Control voltage summer, F.E.T. Mod. lw. Amplifier +12v

Ch.1 — Tone control, Control voltage summer, F.E.T. Mod. lw. Amplifier

+12v, 0v, −9v
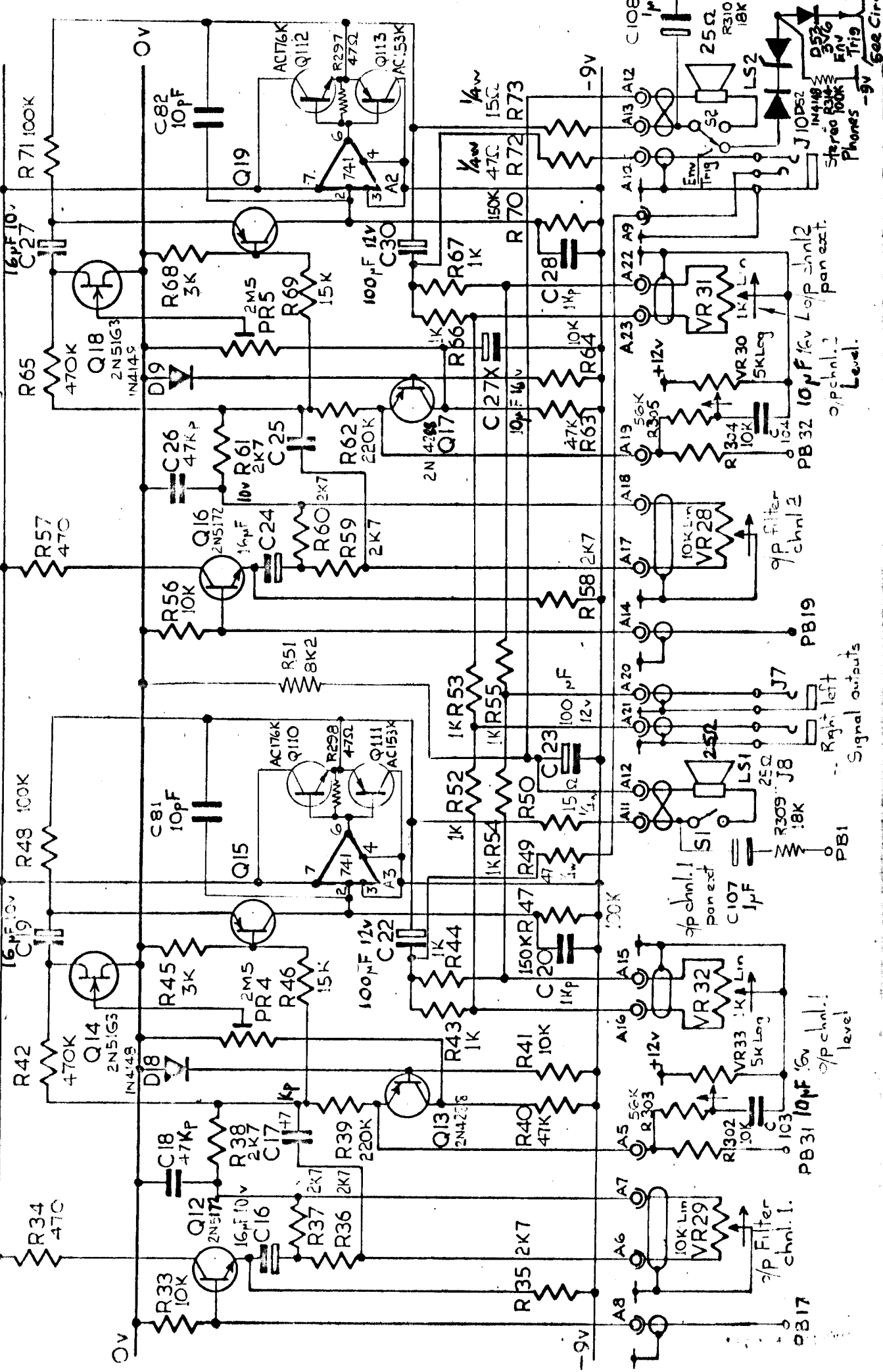
Output Channels

Set Output Channel Filters to 5.
Set Output Level row to 0.0.10.0 and connect traces of scope (5mV/cm)
to both signal outputs.

Connect full level ramp signal at 261 Hz from Oscillator 1 to both Outputs.
Trim PR4 and PR5 for minimum signal breakthrough. (Maximum 5mv p.p)
Replace presets if adjustment is erratic.

Reset Output Channel row controls to 5.0.10.5. Output levels should be
around 1V p.p and should be within 20% of each other. Check signal tracking
in the same manner for Output settings 4 and 6 as well. If one level is
consistently high, pad out resistor across its control pot (R305 = 56K)

Successful tracking will depend on the characteristics of the pots and
the correct matching of the FETs Q14 & Q18.

Connect the joystick row via two shorting pins to both VC level inputs.
Swing stick up and down to check for 20% level tracking tolerance.(Level
pots should be at zero). Inaccuracies in stick tracking may be adjusted
by altering the value of R302 or R304 (10K) which are mounted under the
patchboard rear.

Check correct operation of Pan controls, which only affect the Signal
Outputs. Check also the Output Filters. Use noise as a good source.

Check for max. outputs on the Signal Output socket of at least 2.5V p.p
before the onset of clipping. Level controls should be at about 6. Check
headphone signal is good. Check for instability of Output Amps by driving
hard with low frequency. (Oscillator 3 square wave). The level control of
the channel NOT being driven should be on zero. Monitor the two signal
outputs. The undriven channel will show breakthrough. Plug in headphones
and check for oscillation. Reduce drive to Output Channel 2. Keep checking
for oscillation. Then repeat for other Output Channel.

N.B. DC offset across loudspeaker is 1.8V ± 10%.

Hi-Zo drive amplifier.   Pick-up amplifier & voltage controlled mixer.

REVERBERATION UNIT
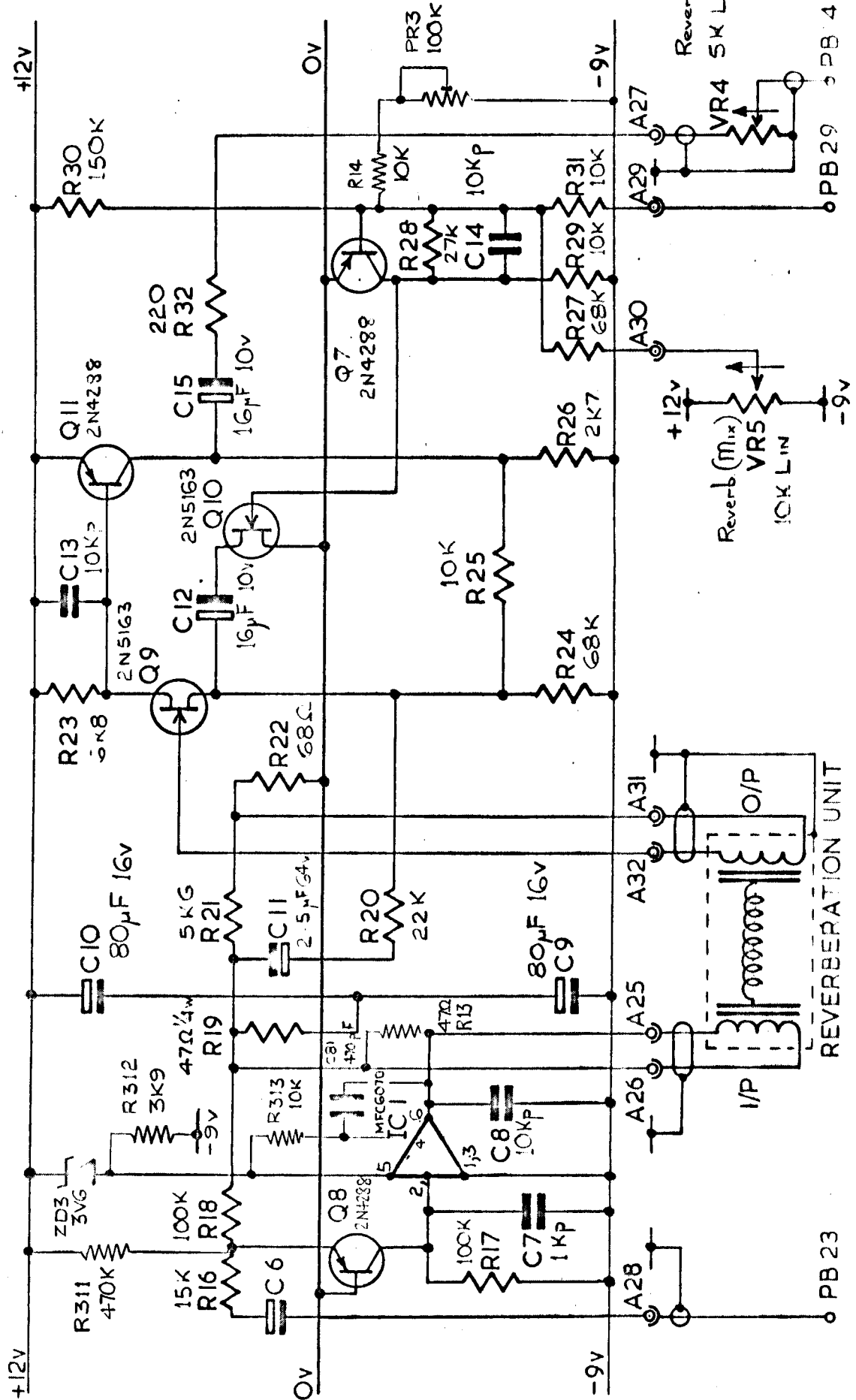
Reverberation

Set PR3 fully clockwise before operating. Feed large amplitude tone bursts into reverb. Adjust PR3 so that the output is dry at Mix setting of zero and reverberation progressively increases from setting of 2.

Maximum dryness on the Mix control should be no worse than that obtained with the VC Mix input row on the patchboard grounded.

Check voltage control of Mix with the joystick.

Hold input amplitude constant and sweep frequency of tone. Check for rattles, buzzes or abnormal resonances in the spring. Check spring is correct way round. If Mix control is wrong change Q10.

N.B. Reverb amplifier should clip symmetrically.

ENVELOPE SHAPER   P.C. BOARD B₁₃

Q48
Vp = 2.5 - 3.0

2N5172 now BC182L

THRESHOLD SET

445 3.5 - 4.0
OR > 1.5 ADJUST R143

+12v   +12v   0v   0v   −9v

Linear modulator

Hysteretic switch

RC integrator for on & off times
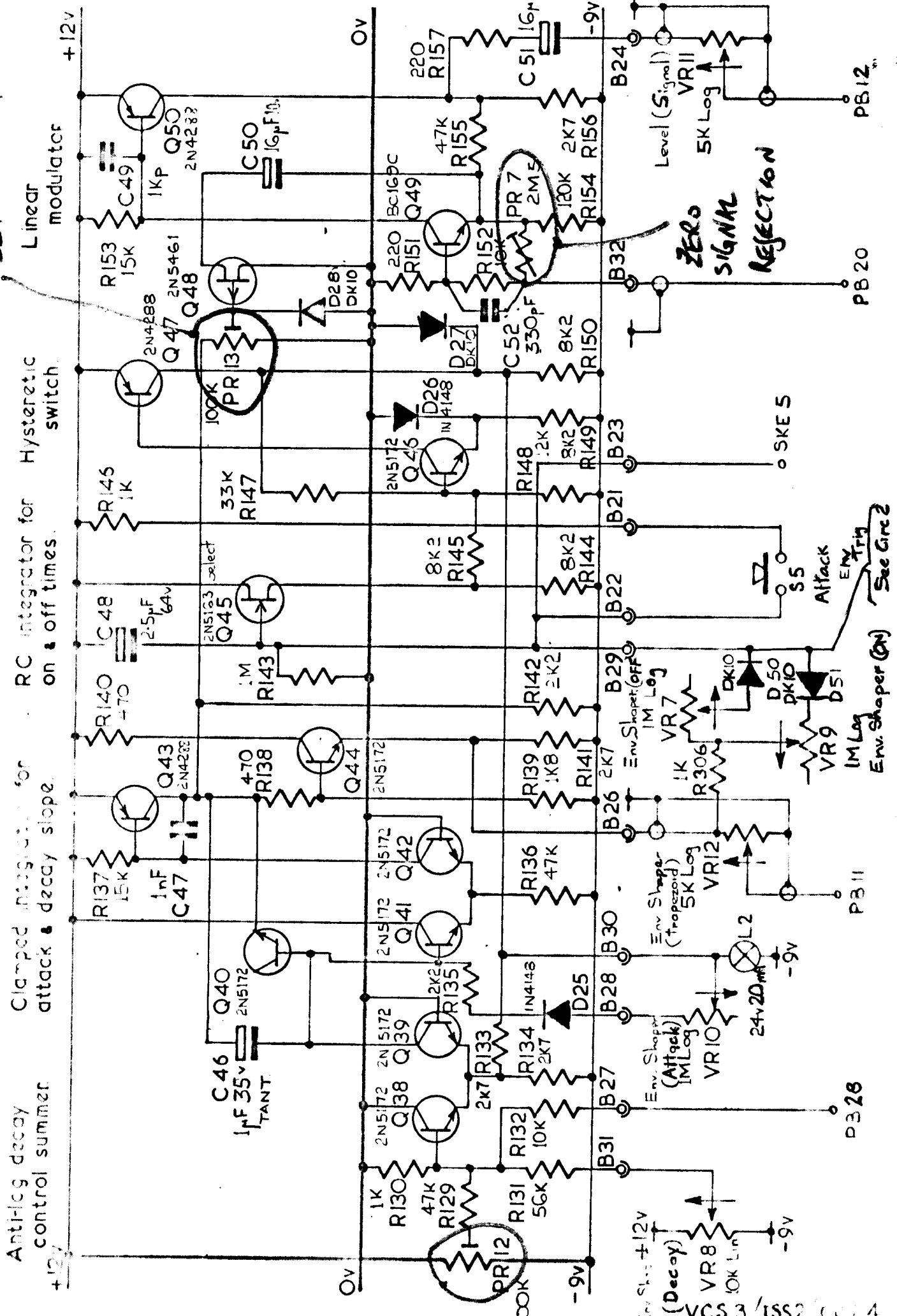
Clamped integrator for attack & decay slope

Anti-log decay control summer

Level (Signal) VR11 5K Log

ZERO SIGNAL REJECTION

Q50 2N4289
C49 1KP
R153 15K
Q48 2N5461
Q47 2N4288
PR13 100K
C50 16µF 10v
D28 DK10
R145 1K
R147 33K
Q45 2N5163 select
C48 2·5µF 64v
R143 1M
R140 470
Q43 2N4289
R138 470
Q44 2N5172
R137 15K
C47 1nF
Q40 2N5172
C46 1µF 35v TANT
Q39 2N5172
Q38 2N5172
R135 2K2
R133 2k7
R134 2K7
R130 1K
R129 47K
R131 56K
R132 10K
PR12 100K

R157 220
C51 16µF 10v
R155 47K
Q49 BC169C
R151 220
Q51 2N5172
R152 10K
PR7 2M5
C52 330pF
R154 120K
R156 2K7
R150 8K2
D27 DK12
D26 IN4148
Q46 2N5172
R149 8K2
R148 12K
R146 8K2
R144 8K2
R142 2K2
R141 2K7
R139 1K8
R136 47K
D25 1N4148
D50 DK10
D51
R306 1K
VR9 1M Log
VR7 1M Log
VR12 5K Log
VR10 1M Log
VR8 10K Lin
L2 24v 20mA

B24 B32 B23 B21 B22 B29 B26 B30 B28 B27 B31
PB12 PB20 PB11 P328

SKE5 S5 Attack Env Trig See Circ 2
Env Shaper (OFF) Env Shaper (ON)
Env Shaper (Trapezoid)
Env Shaper (Attack)
Env Shaper (Decay)

VCS 3 / ISS 2

Envelope Shaper

Put scope on 2V/cm and connect to Trapezoid output. With envelope controls at 0.0.0.0. Adjust PR12 so that frequency of trapezoid oscillation is about 90% of the maximum possible frequency. Connect Filter output on 261 Hz (Frequency setting 5) with maximum output to Envelope Input. Monitor Envelope output. Set PR13 clockwise.

Set envelope controls 0.0.0.10. Adjust PR7 for minimum signal. Adjust PR13 until signal reappears, then back off slightly. The finalenvelope shaper signal breakthrough should be 5 mV or less p.p. With the Attack button pressed the output signal should be greater or the same as the input signal.

Set controls 0.10.0.10. this gives maximum On time. Press Attack button which should recycle the envelope shaper and lamp should come On, staying on for about 5 seconds. (absolute minimum 4 seconds). This corresponds to an automatic recycle On time of 2.5 seconds which is the minimum spec. (On time is always shorter if recycled automatically). On time is controlled by R148 in conjunction with Q45.

Set controls 0.0.10.5. Press Attack button and time the Decay time. This should exceed 15 seconds, and the envelope shaper must automatically recycle at the end of the decay.

Set controls 0.0.0.7 to 10. Envelope shaper must not recycle with the Off time on 10, so check it doesn't on 7 or so, which will indicate the behaviour on 10. Check input breakthrough at the same time, and adjust PR7 again if necessary.

On and Off times are controlled by R148 (range 10-18K). If On time is infinite at 10, reduce R148, if Off time infinite, increase R148. The value of Vp for Q45 (3.5 - 4.0 nominal) is critical. Failure here upsets recycling. Also leaky C48 or dodgy envelope trigger components .

FILTER P.C. BOARD B

15

VCS 3/ISS.3/CCT 5
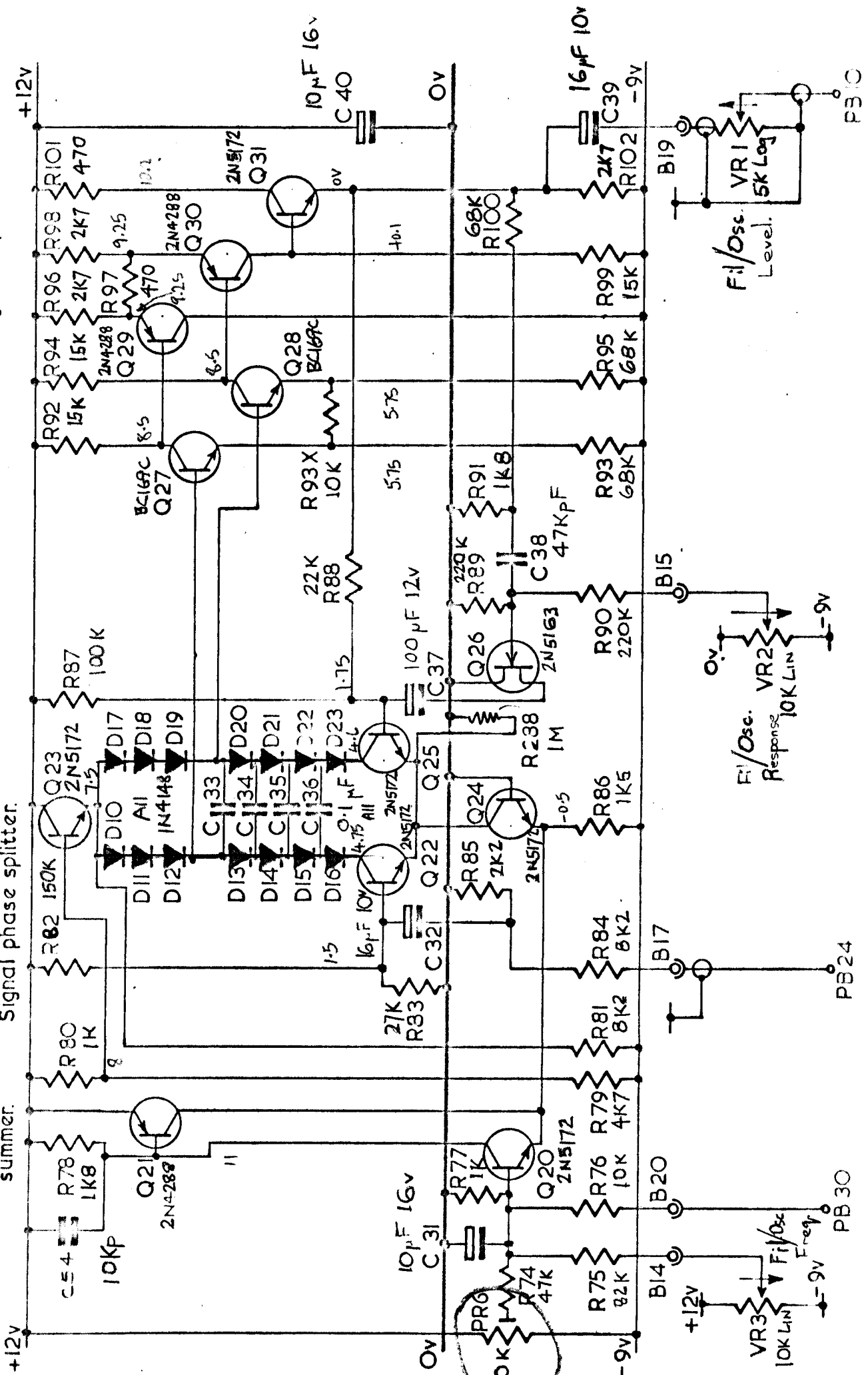
Filter/Oscillator

With Response on 10, level full and Frequency on 5, check for oscillation. About 1.5V p.p should be obtained. The shape should be reasonably sinusoidal especially when only just oscillating (on Response control).

Distortion should be eliminated either by diode bridging or by replacement of offending diode. Bad diodes can be detected by applying the tip of a soldering iron quickly to the diode body. Allow enough time for the diode to cool down before moving on to the next one.

Response control should make the filter oscillate only above 5 for all frequency settings. If this does not occur correctly, adjust R90 or suspect wrong Vp FET. Frequency range on the Frequency knob should be roughly 10Hz to 12kHz. If oscillations stop at one extremity of Frequency pot increase R75. Adjust PR6 for oscillation frequency of 261Hz with F on 5. Noise level of Filter output signal with Response set below point of Osc should be below 5mV p.p.

Check correct filtering using square wave input with swept F.

Intermittent noise: Try soldering iron tip on diodes.
R288 = 1 megohm stops Filter latching-up.

Double balanced modulator
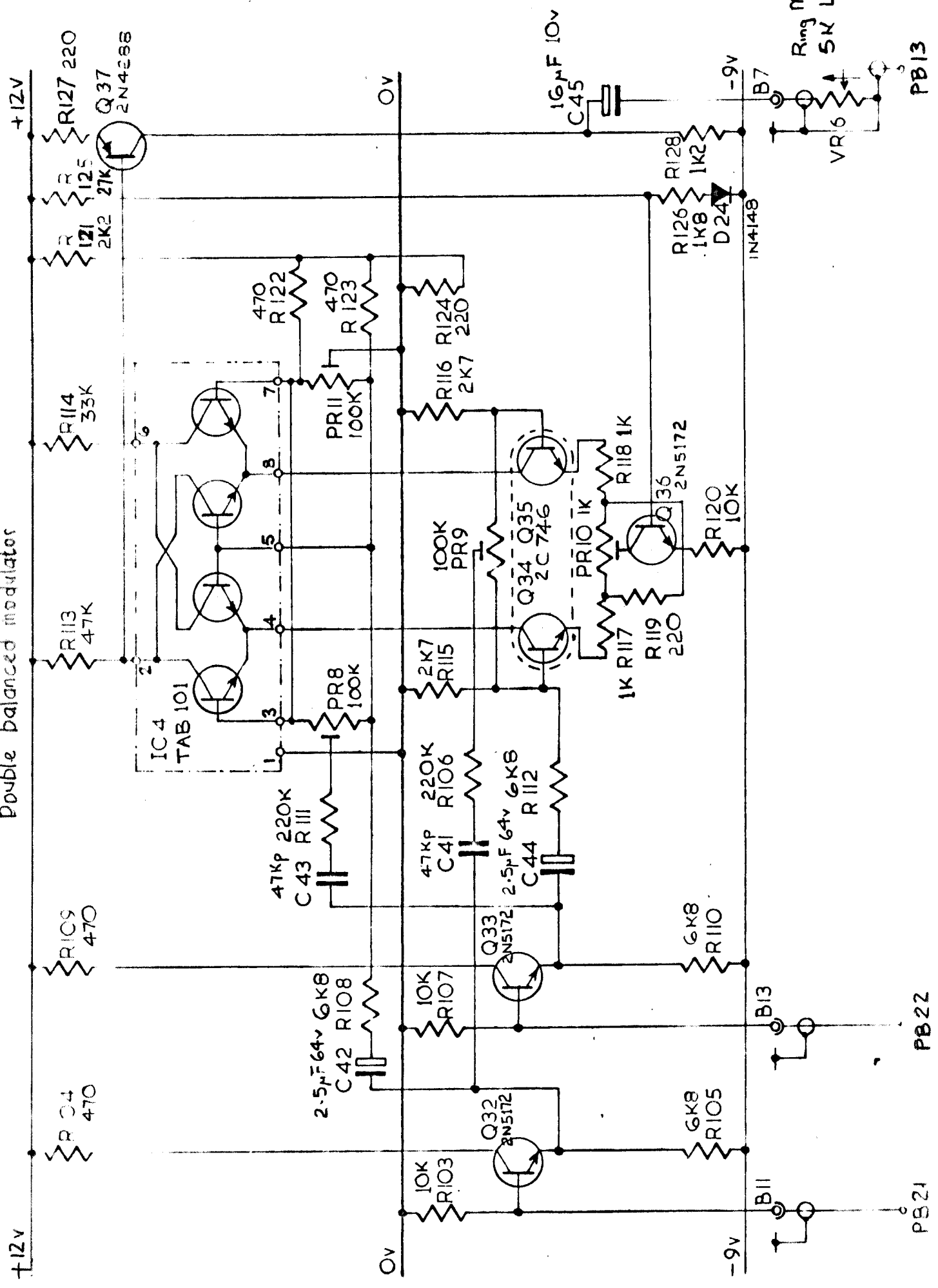
Ring Modulator

Use filter sinewave output, F on 5. Maximum response, maximum level
into both inputs of ring modulator. Ring Modulator level maximum.
Check output is double frequency of input, and at least as big.
Remove pin to Input B. Drive input A and adjust presets for minimum
breakthrough. (PR9 - second harmonic rejection, PR10 - fundamental
rejection).

Drive Input B by removing pin to Input A and reinserting pin for
input B. Trim presets for rejection. (PR8 - second harmonic, PR11
for fundamental). This one should NOT drift. Input A drifts quite
a bit and should ideally be adjusted with the back on the machine
after it has fully warmed-up. If this is not possible ensure that
Input B is used for the continuous signal to minimise breakthrough.

With an input level of 1.5V p.p up to 10mV p.p maximum is allowed
for breakthrough. This gives about 60 dB rejection.

If higher harmonics are a problem, then filter signal must be too
impure. Try backing off response, or use an external signal generator.
1.5V p.p at 261 Hz.

If reasonable rejection is unobtainable, change matched pair BC169C
or TAB101 where appropriate. 2C746 used on later models. Do not bridge
with resistors. Replace presets if adjustment is erratic.
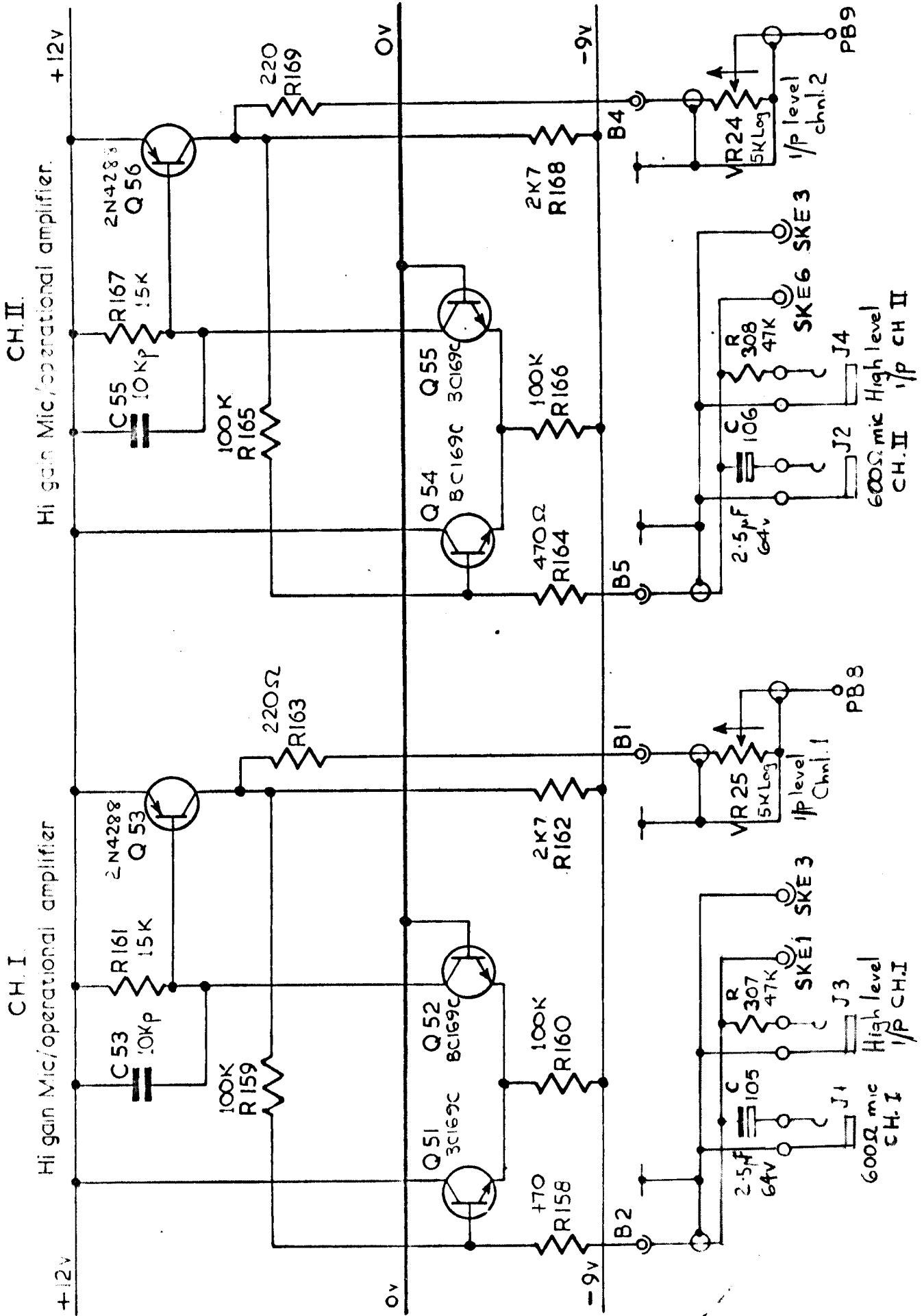
Input Channel Amplifiers
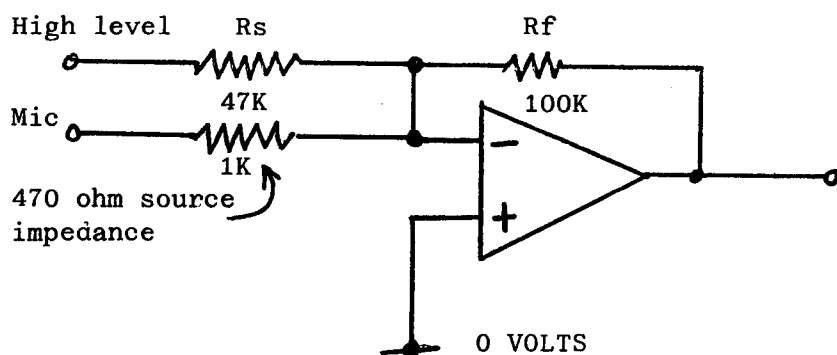
Inverting Operational amplifier

$$DC\ gain = \frac{Rf}{Rs}$$

High level gain   =   2

Microphone gain   =   100

Using a signal generator check the two inputs for the expected gains.
This is best done by monitoring the control output with shorting pin.
High level gain can be checked by applying about 2V p.p and looking
for 4V at the output.
Low level (microphone) gain :   50mV should give 5V p.p.

Check for minimal DC offset by plugging input channel inot the meter
switched to Control Voltages, and then rotating the input level pot.
No more than ± ½ a division movement should occur. (approx 200mV).

Pay special attention to condition of pot tracks.

OSCILLATOR 1   P.C. BOARD C.
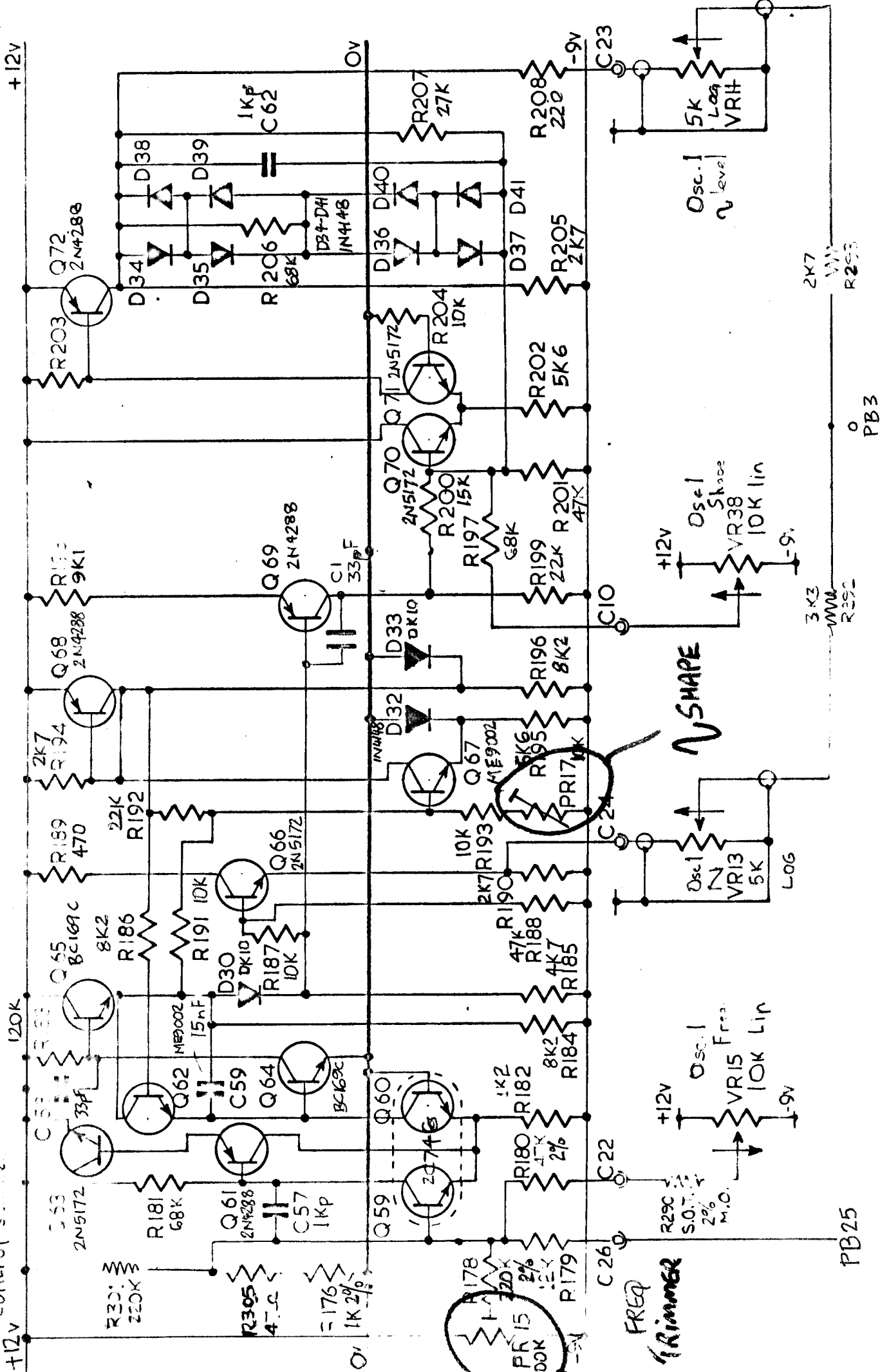
Oscillator 1

The first operation is to adjust the shape of the sinewave, since the adjustment affects frequency. Using the vernier control and PR15 if necessary, obtain an output of 400Hz. Turn the ramp down and adjust the sine shape control for the best sine shape. Trim PR17 to balance out the spike on the peak of the sinewave. This may best be seen by expanding the X and Y inputs on the scope.

NO GOOD   BEST

The best position is shown, where the small spike is triangular and balanced. A small thin spike may also appear but is not important.

Test the main shape control. A good sinewave should be acheived on 5. ($\pm\frac{1}{2}$ division). If further out, R197 or R201 may need to be adjusted.

Set PR16 halfway and leave it alone. Set frequency vernier dial to 6 and adjust PR15 for 261Hz. Rotate vernier to 8 and check for 2088Hz. Absolute mazimum error $\pm$ 1 division. For fudge procedure, see Osc 2 writeup.

Sine Output should be around 1.5V p.p
Ramp Output should be around 1.5V p.p

N.B. Ramp shape is not controllable.

Pitch characteristic is 0.32 Volts/Octave.

OSCILLATOR 2   P.C. BOARD "C."

23.
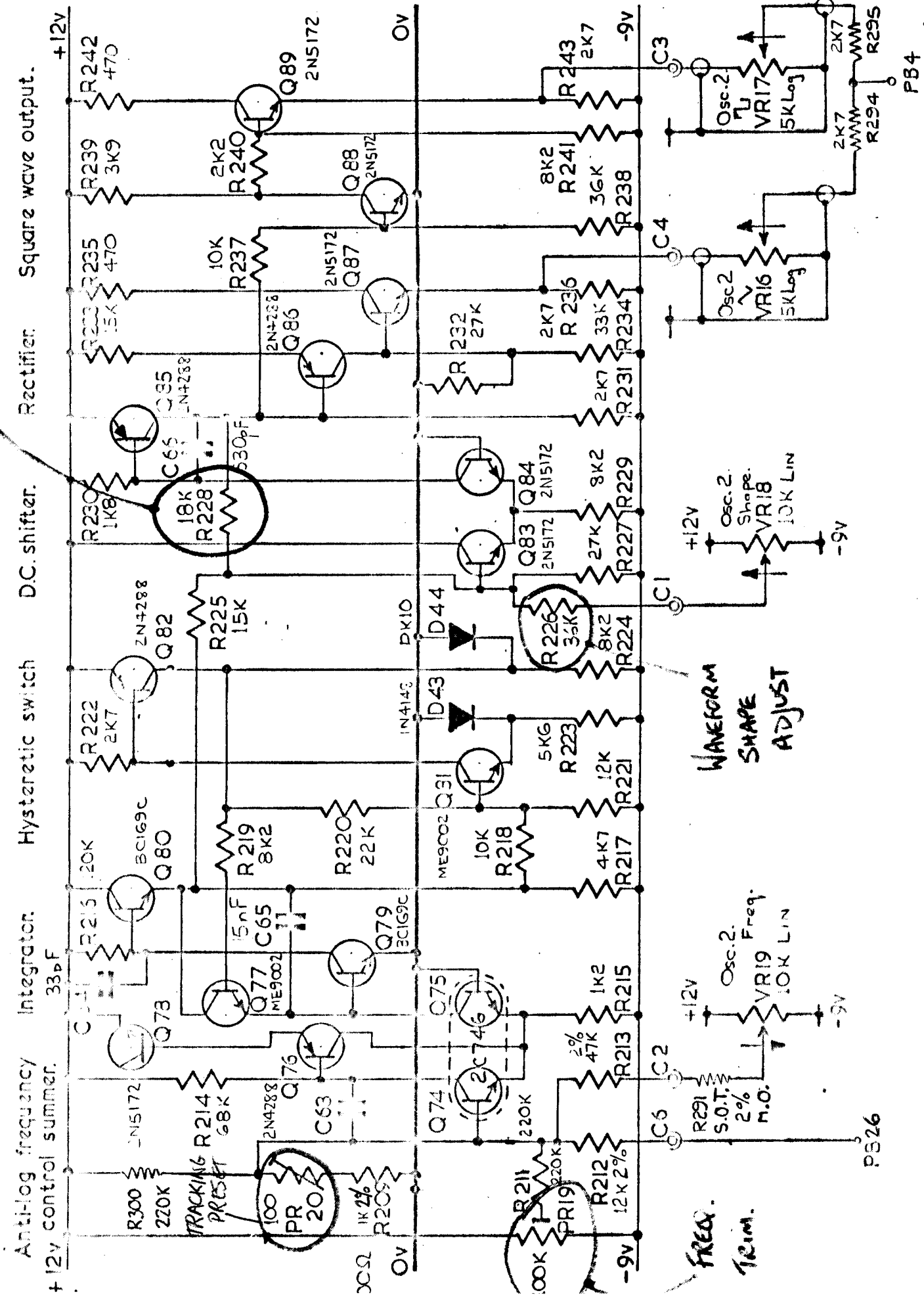
Oscillator 2

Set square level to zero, ramp at maximum. Set PR20 halfway. Vernier on 6.
Trim PR19 for 261Hz. Increase vernier to 8. Check frequency is about 2088Hz.
If beyond spec then R291 SOT will have to be added in the range 8-22K.
Check that 10 on vernier dial gives at least 10kHz.
If vernier dial at 8 gives less than 2088Hz then short circuit R291 and R213
will have to be reduced. These should be 2% resistors.
Shape controls should operate identically to those on Osc 3 (see next page)
except that levels are reduced, and the two outputs are summed into the
patchboard on Mark 11 machines. Remember to turn down unwanted signal.
Resistors R226 and R228 are the relevant ones to set the shape.
Pulse level should be 2V p.p. Ramp level should be 3.5V.
N.B. Osc2 and 3 waveforms are not symmetrical with respect to zero volts.

Tracking

Mix Osc 1 and Osc 2 ramp outputs into Output Channel 1. Use PR20 only
to trim the tracking of Osc 1 and Osc 2. Using the joystick on max with
range control to limit frequency range. Set both verniers to 6 and tune
for zero beats. Advance the joystick range control which will increase
both frequencies until the beats begin. Trim PR20 to zero beats, and
remember which way you turned it. (N.B. The preset is a very fine adjust-
ment, and when the tracking is nearly right it will be necessary to make
very very small movements). Having trimmed PR20, turn the range control
back to zero, readjust one of the verniers near 6 to give zero beats and
then advance range control of joystick to where it was before. If beats
are faster you know you turned the preset the wrong way. Repeat procedure
until tracking goes to about 2kHz. Ideally a test 'back' should now be
fitted and a final adjustment made after another 10 minutes have elapsed.

Faults

Tracking from 261Hz to about 2kHz should be achieved with a maximum of
3 beats per second on the way. A curved Voltage/Frequency response may
occur where zero beats are produced in more than one place. This is due
to a mismatch in the matched pair transistors (Q74 & Q75 for Osc 2). Fit
a new transistor here or in Osc 1.

N.B. Always use specially matched 2K7 pins for tracking tests.
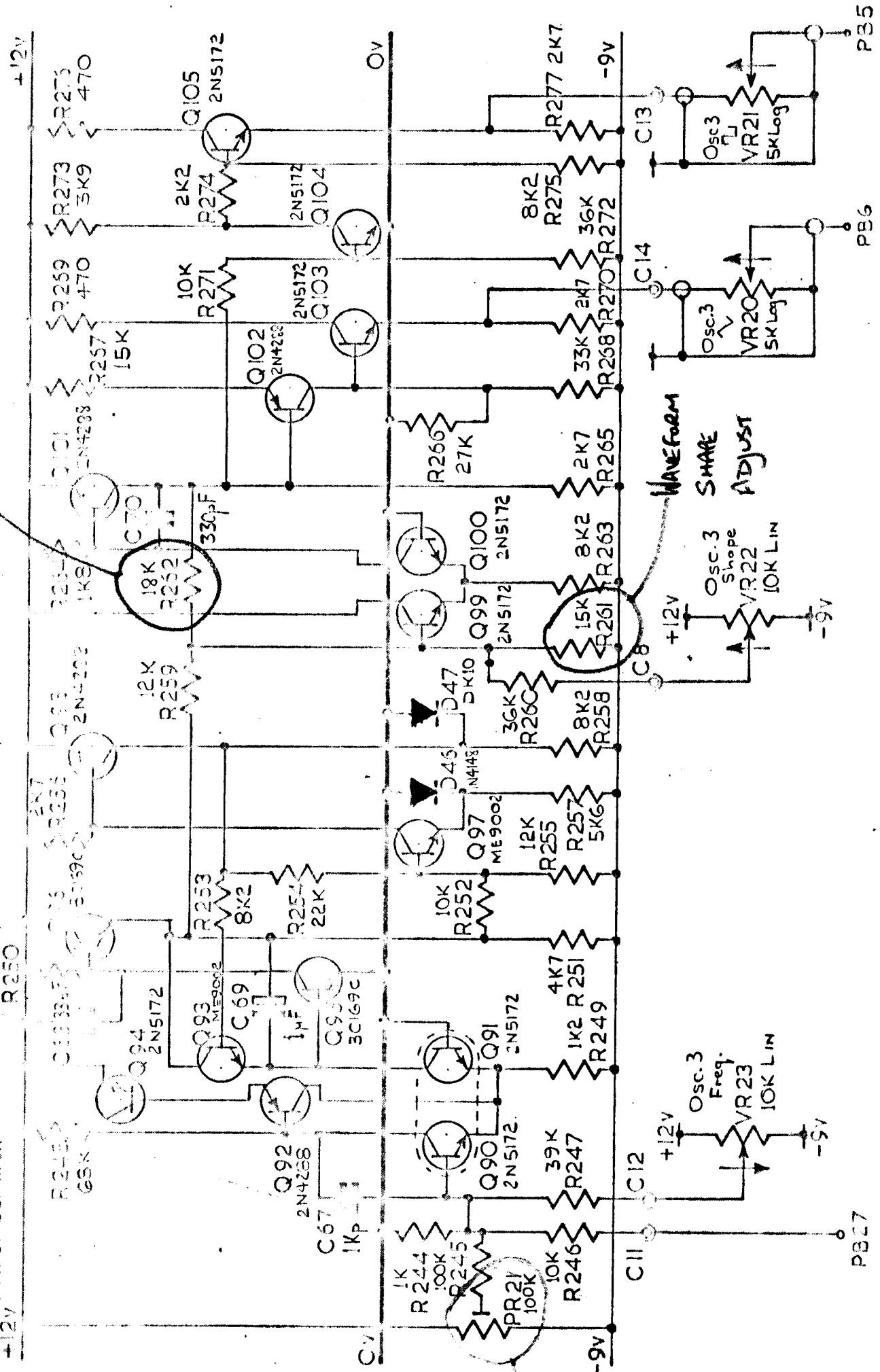
Oscillator 3

Check frequency control pot for even change in frequency.

Adjust PR21 so that when the vernier is at 8 the frequency is 63Hz.

Note: Vernier 10 should give 500Hz. Period at 0 should be greater than 20 sec.

Adjust values of R261 & R262 with pad resistors to achieve correct shapes

of waveforms as shown below:

6V p.p

Shape at 5

Shape at 0

Shape at 10

5V p.p
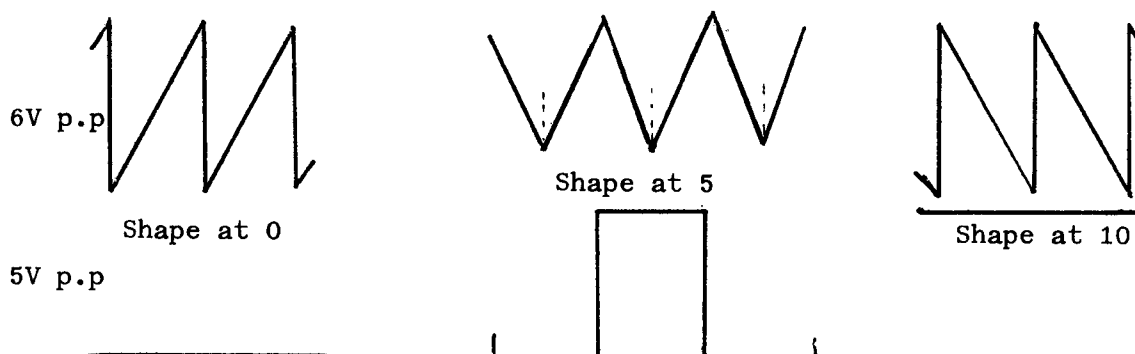
Triangle and square wave should occur on 5. Maximum of ½ division error

allowed.

Check Voltage control input.

Faults

Osc 3 breaks through to Osc 2 and to a lesser extent Osc 1. Effect dependent

on Osc 3 shape control setting. Triangle was 'furry', with 10mHz oscillations

visible all over C board. Strongest near Q101. Cause: instability in Q99.

Q100, Q101. Cure, C70 330pF change to 1nF.
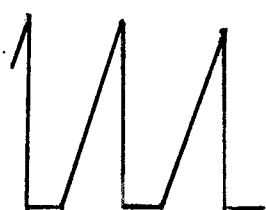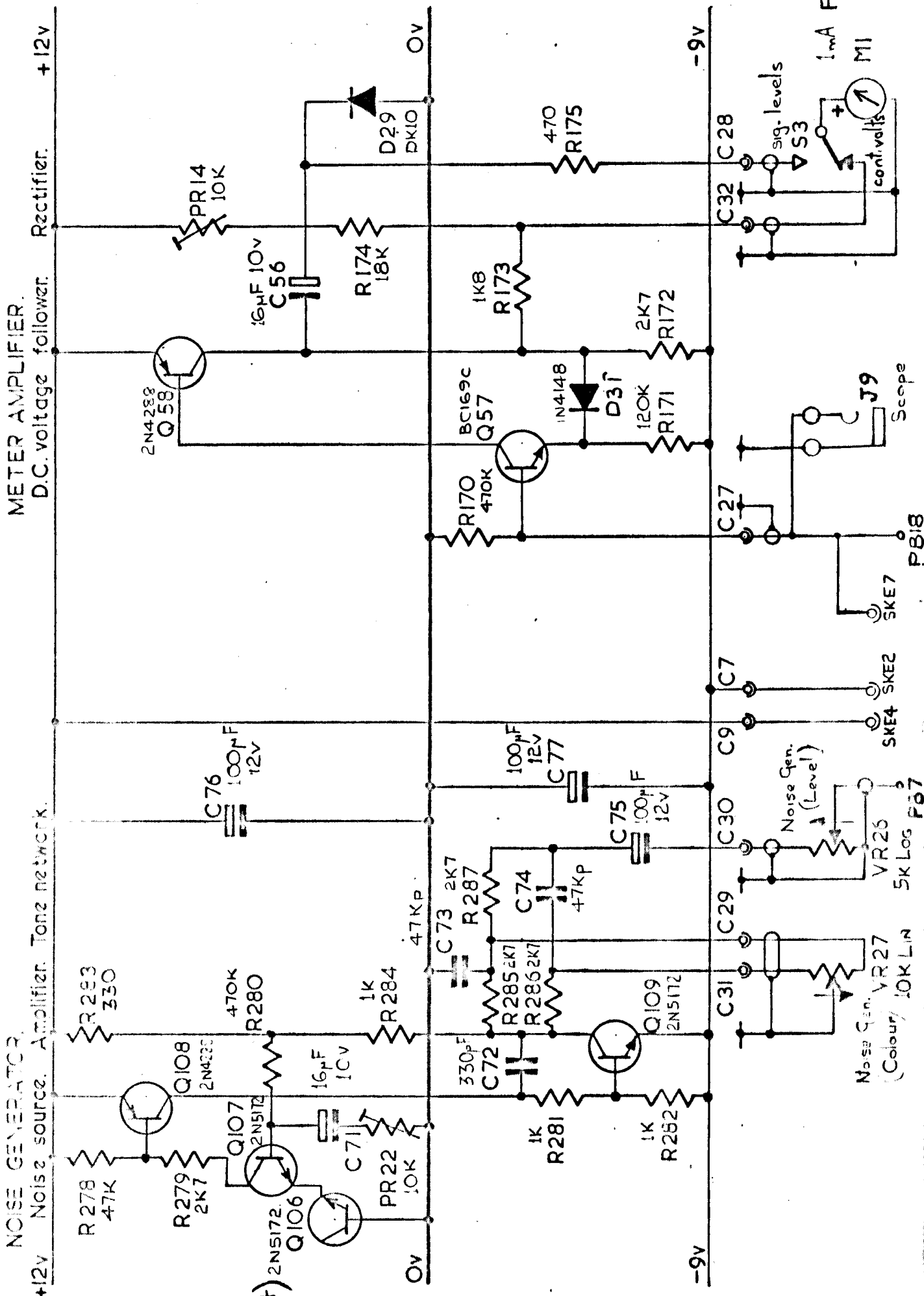
Ramp defects
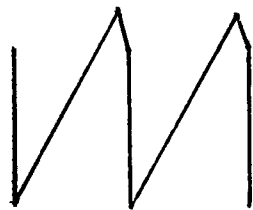
Ramp defects

Pulse defects at 0 and 1(

Noise Generator & Meter Amplifier

Colour control on 5, max output. Select a noise diode which gives
wideband noise and can be adjusted to give 3V p.p with PR22 roughly
midway (to give some later adjustment margin).
Lumpy or crackly sounding noise diodes should be rejected.

Meter

Check left hand zero of meter with machine off or switched to Signals.
Switch to Control Voltages and adjust PR14 for accurate centre zero.
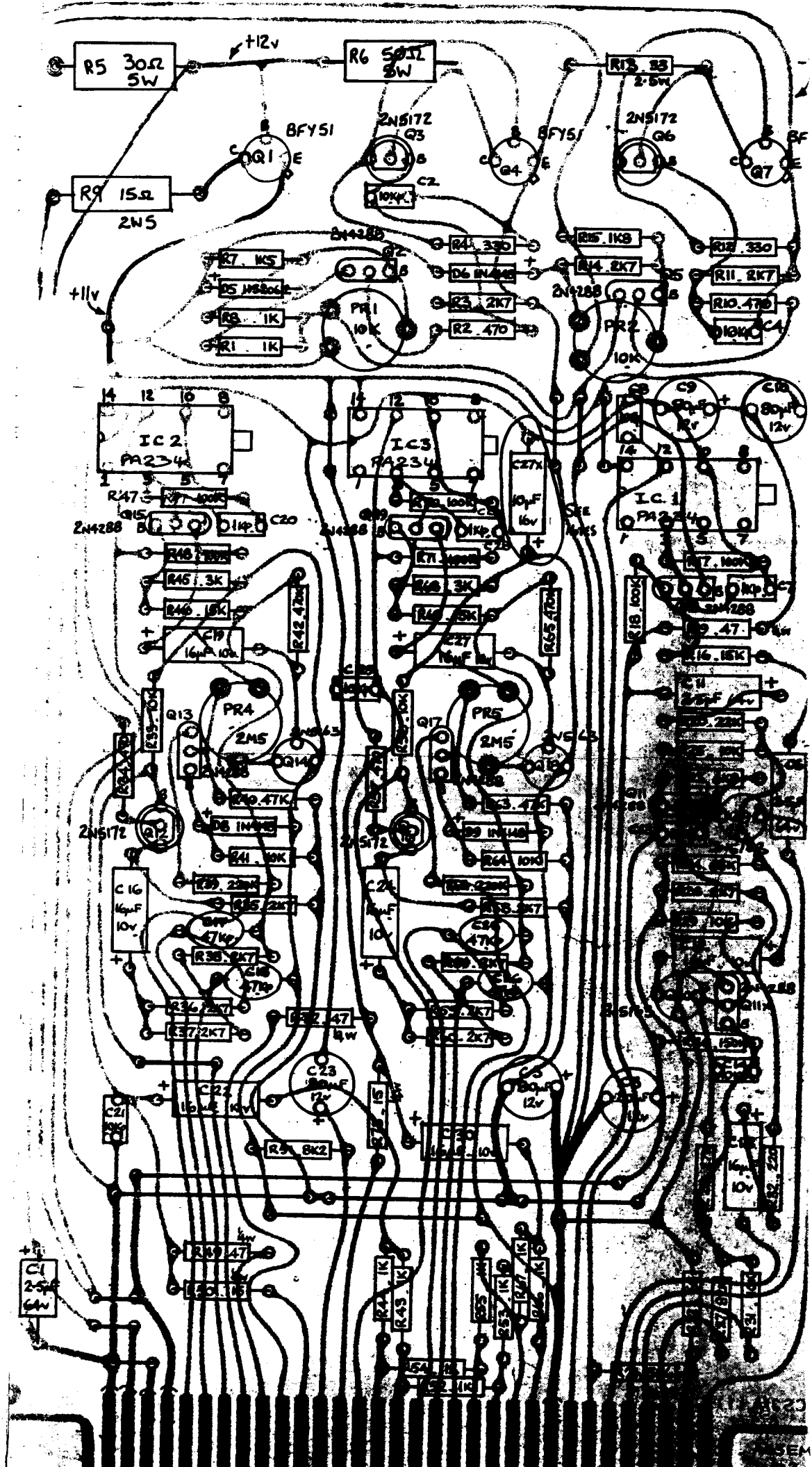Switch the meter switch a few times and recheck zero again.
Patch the joystick to Meter for swings in both + and - directions.

Check for needle sticking at either end of travel. Switch to Signals
and test with Osc 2 sawtooth at max level. Vary level to check proportionality.
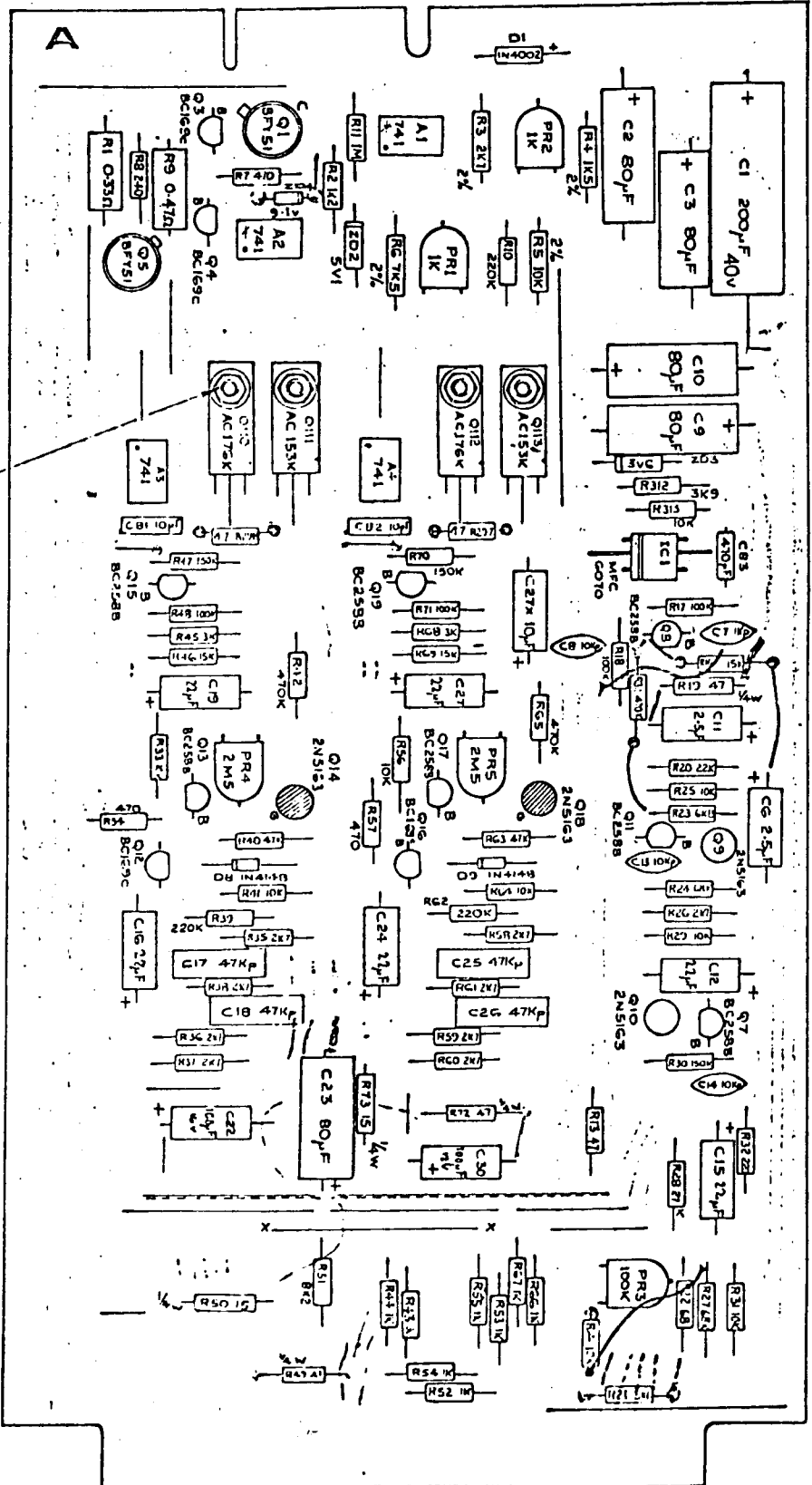

Faults
Watch out for the resistor R170 on the C board, which often touches the
-ve end of C76, and has been known to produce curious failures on soak
test.

MKI 'A' BOARD

TIP3055

QG — C B E
Q2 — E B C

A

NOTE! Q14 & Q18 MATCHED FOR V_p & I_{DSS}

D1 1N4002

C1 200µF 40V
C2 80µF
C3 80µF
C10 80µF
C9 80µF

Q1 BFY51
Q3 BC169C
Q5 BFY51
Q4 BC169C

R1 0.33Ω
R8 240Ω
R9 0.47Ω
R11 1M
R3 2K1
R4 1K5 2%
R2 142
R7 4Ω
R12 1K2

A1 741
A2 741
A3 741
A4 741
A5 741

PR2 1K
PR1 1K
ZD2 5V1
ZD1 9.1V

RG 7K5 2%
R15 10K 2%
R10 220K

Q10 AC176K
Q11 AC153K
Q112 AC176K
Q113 AC153K

R312 3K9
R313 10K

Q15 BC258B
Q19 BC258B
Q13 BC258B
Q17 BC258B
Q16 BC123V
Q14 2N5163
Q18 2N5163

R47 150K
R48 100K
R45 3K
R46 15K
R70 150K
R71 100K
RG8 3K
RG9 15K

C19 22µF
C27 22µF
C27 10µF
C8 10K

IC1 MFC 6010
C83 470P
R17 100K

R18 100K
Q8 BC239B
Q9
R19 47
C7 11P

R20 22K
R25 10K
R23 6K19
CG 2.5µF
C11 2.5µF
C13 10K

Q11 BC258B
Q9 2N5163
Q10 2N5163

R24 6K19
R26 2K7
R27 2K7
R7 BC258B
C12 22µF
R30 150K
C14 10K

R312 470K
R31 2K2
PR4 2M5
PR5 2M5
RG5 470K
R56 10K
R57 470

R12 470K
R21 BC169C
R54 470

R140 47K
D8 1N4148
R41 10K
D9 1N4148
RG4 10K
RG2 220K
R58 2K7

R17 47Kp
R18 47Kp
R16 22µF
R37 220K
R35 2K7
R43 2K7
R36 2K7
R31 2K7

C24 22µF
C25 47Kp
C26 47Kp
C23 80µF
C22 10µF
R73 15 ¼W
R72 47
C30

C15 22µF
R312 2K2
R87 8K1

R59 2K7
R60 2K7

R50 15
R8 8K2
R44 1K
R43 3.3
R51 1K
R55 1K
PR3 100K
R22 6K8
R31 10K

R43 4Ω7
R54 1K
R52 1K

NOTE:
1. C1 SHOWN AS 25V ON BOARD
2. R54 VALUE i.e. 470 NOT SHOWN ON BOARD
3. LINK BETWEEN POINTS X-X NOT SHOWN ON BOARD
4. POS. NOT SHOWN ON C16
5. C17,18,19,22,24,27,30 SHOWN AS NOT ON BOARD

HILTON ELEC

TITLE: 'A' BOARD SYNTHI AKS

32 ⟩ VR5 (w)
31 VR31
30 PB25
29 PB25
28 VR1
27 VR1
26 ⟩ Reverb
25 ⟩ Reverb
24 0V
23 VR31
22 VR31
21 VR28
20 J7
19 J7 (F)
18 PR32
17 VR28
16 VR32
15 VR32
14 PB19
13 LS2
12 LS14 LS2
11 LS1
10 J10R
9 J10R
8 PB18
7 PB18
6 VR27
5 VR27
4 +12V OUT
3 −9V OUT
2 − D.C. IN
1 + D.C. IN

Q36 2N5172   1N4118
R126 1K8   D24
R127 470
R124 220
R123 470   PR10 1K   R120 10K
R125 27K
R121 2K2
R119 220
R115 2K7   R112 6K8   C41 4740
R116 2K7   R106 220K

PR11 100K   R118 1K   PR9 100K   R117 1K   C44 25uf 64v   C42 2.5uf 64v

PR8 100K   12C746   Q35   Q34
R111 220K   TAB101 1C4   R108 6K8
Q37   R113 47K
R128 1K2
R127 220

R166 100K   C43 4740
R167 15K
R105 6K8   R110 6K8
C53 10K   C45 16uf 10v
Q55 BC169C   Q54 BC169C   Q56   BC258B
R165 100K   C104 470   R65 470
R168 2K7
R169 220   Q32   Q33   R107 10K   PR6 100K   R74 47K
R164 470   R103 10K   R84 8K2

R160 100v
R161 15K
Q52 BC169C   C63 10K   Q51 BC169C   BC258B
R159 100K
R162 2K7
R163 220
R158 470

R101 470   R99 15K   Q31 2N5172   Q49   PR7 2M5
R98 2K7   R102 2K7   Q30   C52 33uf   BC169C
R96 2K7   BC258B   BC258B   R151 120K
R92 15K   R97 470   R152 10K
R94 15K   Q28   R151 220   C50 16uf 10v
R95 68K   BC169C   R155 47K
R93 68K   R93X 10K   Q27 BC169C   R153 15K   BC258B Q50   Q48
D17 1N4148   D19 1N4148   1KP
D18 1N4148   C33 1uF
D10 1N4148   D12 1N4148   R142 2K2   D28 DK10   PR13 100K
D11 1N4148   D13 1N4148   R156 2K7
Q23   D20 1N4148   C47 1uf
R81 8K2   C34 1uF   R137 15K   Q43
R79 4K7   D14 1N4148   BC258B   Q42
D21 1N4148   R136 47K   Q41
C36 1uF   C35 1uF   Q40   2N5172
R80 1K   D15 1N4148
R82 150K   D22 1N4148   R134 2K7   R39
D16 1N4148   R129 47K
R87 100K   D23 1N4148   Q21 2N5172
Q22   PR12 100K   2N5172
R86 1K5   R140 470   R138 470
C32 16uf 10v   R139 1K8
R83 27K   BC258B   C37 80uF 12v   R141 2K7
C54 10K   R78 1K8   R135 2K2   Q38
PR6   Q20   R150 8K2
C31 10uF 16v   BC258B Q47
R133 2K7
R74 47K   R147 33K
RED Q26 2N5169   Q46 2N5172
R85 2K2   R149 8K2
R89 220K   R148 12K   D26 1N4148
R91 1K8   D27 DK10
R100 68K   R144 8K2
C38 47KP   Q45 2N5169   R143 1M
R77 1K   ORANGE   R145 8K2
R76 10K
C39 16uf 10v   C48 2.5uf 64v
R131 56K
R90 220K
R46 1K
R75 82K   C51 16uf 10v   R157 220
C40 10uf 16v   R132 10K

C

Component placement / PCB layout (hand-drawn). Selected component labels:

- Q82 BC258B, R222 2K7, R224 8K2, R221 12K, R223 5K6, R220 22K, D44 DK10, R219 8K2, Q81, ME9002
- Q98 BC258B, R256 2K7, R258 8K2, R255 12K, R257 5K6, R254 22K, D47 DK10, R253 8K2, Q97, ME9002
- Q68 BC258B, R194 2K7, R196 8K2, R193 10K, R195 5K6, R192 22K, D33 DK10, R186 8K2, Q67, ME9002
- PR17 10K, PR22 10K
- C71 16µF 10v, Q106, Q10?
- R280 470K, R279 2K7, R278 47K, R283 330
- C70 33p, C68 33pF, C58 33p, R216 120K, R250 120K, R183 120K
- Q79, Q95, Q64, BC169C
- R215 1K2, R249 1K2, R182 1K2
- R217 4K7, R251 4K7, R184 8K2
- R214 68K, R248 68K, R181 68K
- C65 15Kp, C59 15Kp, C69 1µF 160v
- Q75 Q74 2C746, Q60 Q59 2C746
- Q78, Q76 BC258B, Q94 BC259B, Q60 Q61 BC258B, 2N5112
- C63 1µF, C67 1K?, C57 Kp
- R300 280K 2%, R301 220K 2%, R305 47Ω
- PR19 100K, PR20 100, PR21 100K, PR15 100K
- Q109 2N5176, R282 1K, R281 1K, R284 1K
- R178 1K22, C73 47Kp, C74 47Kp
- R211 220K, R215 100K, R178 220K
- Q83, Q84, 2N5112, Q99, Q100, 2N5112
- R198 9K1, R199 22K, R185 4K7
- C75 80µF 12v, BC258B
- R225 15K, R239 1K, R255 12K, R244 1K
- R229 8K2, R263 8K2, R204 10K
- R217 27K, R261 15K, R202 5K6
- Q85 BC258B, Q121 BC258B, Q71 2N5112, Q70
- R230 1K8, R264 1K8, R205 2K7
- R228 18K, R262 18K, Q72 BC258B, R203 1K
- Q86 BC258B, Q87, Q102 BC258B, Q103
- D34 IN448, D38 IN448, D39 IN414B, D35 IN448
- R235 470, R269 470, D36 IN414B, D40 IN448
- R233 15K, R267 15K, D41 IN448, D37 IN448
- R234 33K, R2?8 33K
- R231 2K7, R265 2K7
- R236 2K7, R270 2K7
- R237 10K, R271 10K
- R239 3K9, R273 3K9
- R238 36K, R272 36K
- Q88 2N5172, Q104 2N5172, Q105 2N5172, Q89 2N5172
- R242 470, R276 470, R189 470, R170 470K
- R241 8K2, R275 8K2, R188 47K, R190 2K7
- R243 2K7, R277 2K7
- PR14 10K, D29 DK10, Q76 80µF 12v, C77 80µF 12v
- R213 47K, R247 33K, R246 10K
- 100pF, 33pF, C56 16µF 10v
- R171 120K, R172 2K7
- R173 1K8, R174 1K8, R175 470

Sloven Links

I N D E X

FIRSTLY. The Touch Keyboard and address clock.

The address clock is an oscillator, E28 (Pins 1,2,4,5,6), being a conventional schmitt trigger oscillator.

OPERATION   Pin 6 is high; D38, 43 are off, C1 and C1X charged up by way of Pins 1,2,4,5 until upper threshold voltage (about +1.7v) is reached, the schmitt then fires, Pin 6 goes low, D38, 43 turn on and discharges C1 and C1X until the lower threshold voltage (about 0.9v) is reached. The schmitt then reverts back to its original state etc.etc.

Note; Important rapid discharge

+1.7 v
+0.9 v

≃ 1.2 µS

+3.5v
+0.1v

60 nS pulses

(very important)
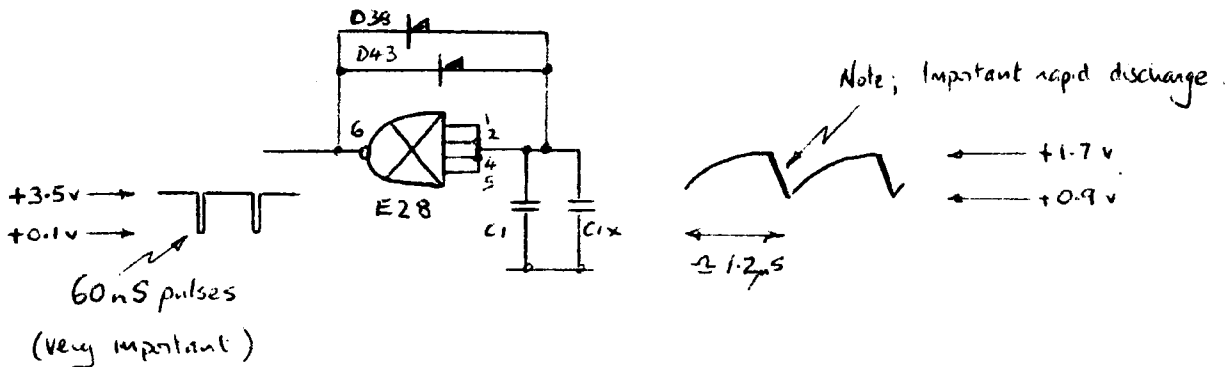
The pulses generated are used to compile various gating signals.

The signal is divided by 2 by E22 (8,9,11,12) and again by 2 by
E22 (2,3,5,6), and then by 16 by E23.   By gating these signals together,
a set of waveforms shown below is produced.

SEVENTH NOTE TOUCHED

Goes high when first note to be detected is found.

E25/9

E21/8 'ENABLE MULTIPLEXER

E7/10

E11/8

2/16   7/16

SEMITONE NOT PRESSED   TONE PRESSED   THIRD NOT PRESSED   FIFTH PRESSED

* Note INTERLACE of E21/8 & E29/8
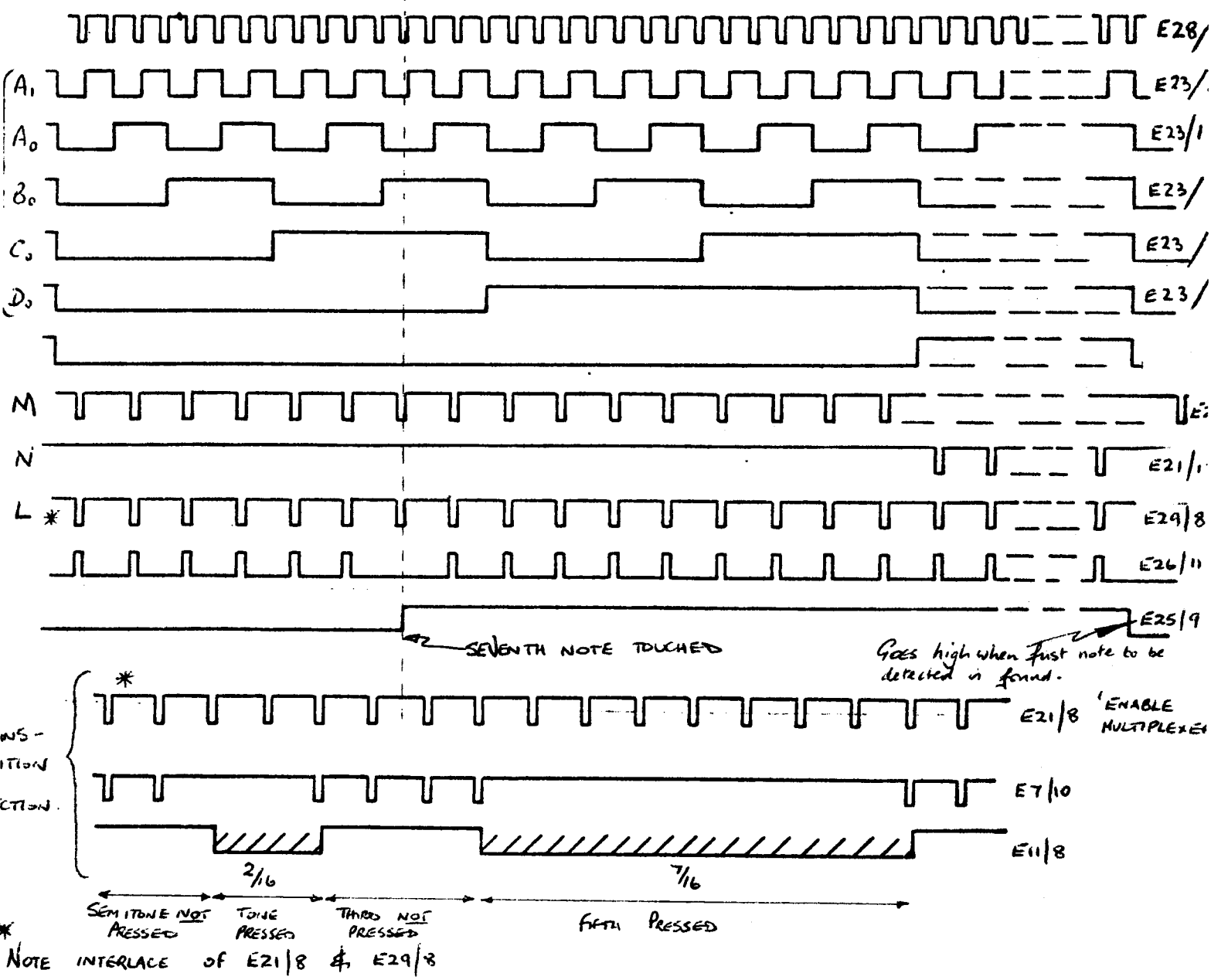
SIGNALS A1, AO, BO, CO provide a four bit address code to the
three data multiplexers.   The top two multiplexers, E15, E27 are connected
to the keyboard, and as only 30 notes are provided, then two inputs
(E27 pins 7,8) are left permanently unconnected.   The lower multiplexer
is the "transposition pad" unit.

MULTIPLEXERS — an electronic 16 way switch; single pole.
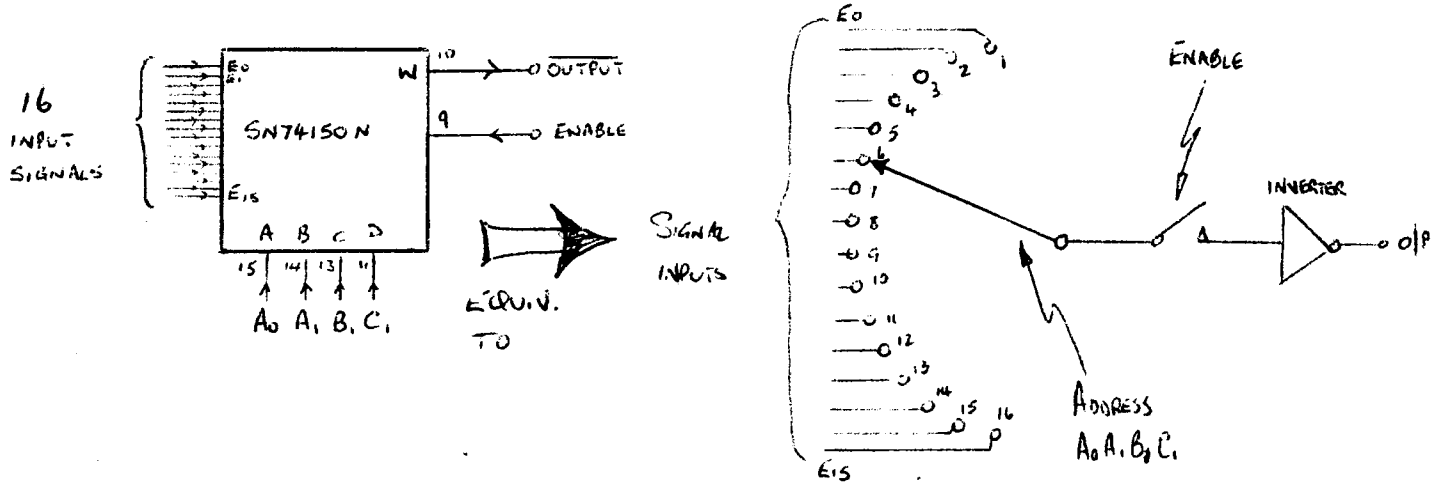
The 16 inputs, E0 to E15, can be
considered as the 16 inputs to a
rotary switch. The switch position
(only one pole) is determined by the address code,ie AO, A1, B1, C1,
labelled ABCD on the actual device.

	Switch Position	(A AO	B A1	C B1	D) C1	
E0	1	0	0	0	0	
E1	2	1	0	0	0	
E2	3	0	1	0	0	
E3	4	1	1	0	0	
E4	5	0	0	1	0	
E5	6	1	0	1	0	
E6	7	0	1	1	0	
E7	8	1	1	1	0	
E8	9	0	0	0	1	
E9	10	1	0	0	1	
E10	11	0	1	0	1	
E11	12	1	1	0	1	
E12	13	0	0	1	1	
E13	14	1	0	1	1	
E14	15	0	1	1	1	
E15	16	1	1	1	1	

Where 0 = low voltage)
1 = high voltage) logic levels

This is known as a truth table.

Thus, for an address

D C B A
1 0 1 1   sorry about the reversed code

The switch is at position 12

A B C D $\Rightarrow$ 12
1 1 0 1

'A' is known as the least significant
bit — LSB

'D' is known as the most significant
bit — MSB

The ENABLE SIGNAL acts as a switch; that is when this signal is high (1)
the switch is open circuit, and the output (w) is permanently high.
When this signal is low (o) the switch is closed and so anyone of the 16
data inputs may be selected. The ENABLE IS SOMETIMES called the STROBE.

Note that the output shows the inverted data. Thus to summarise.

With a high (1) at data input 12, and address code of $\begin{array}{cccc} A & B & C & D \\ 1 & 1 & 0 & 1 \end{array}$

and an enable signal of logic 0, the output is (1) inverted, namely 0.

TOUCH SENSITIVITY.

The input to a TTL gate looks like:-

SN74150 N
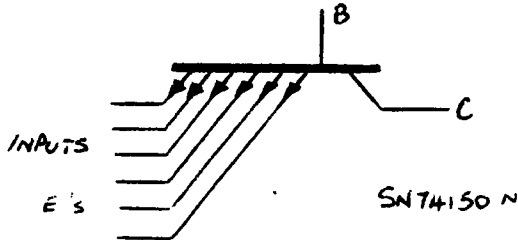
This is a multiple emitter, transistor, i.e. a transistor with, in this case, 6 emitters.

In the multiplexer, 4 of them are connected to the address code, one to the enable signal and the last to the touch plate.

The only time when all 5 inputs are high.
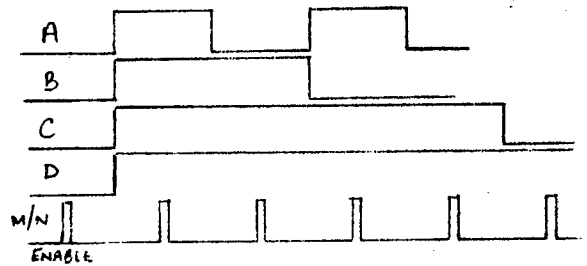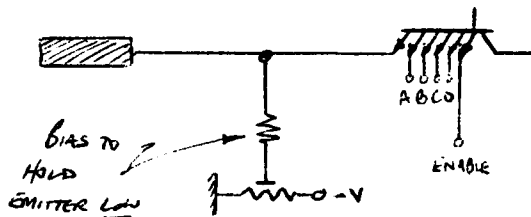
For each specific input there will only be one point in the Address cycle (32 bits) when all 5 emitters are high at the same time. When the bias is correctly aligned, the circuit will behave as follows:-

6th Emitter

(Comes on)
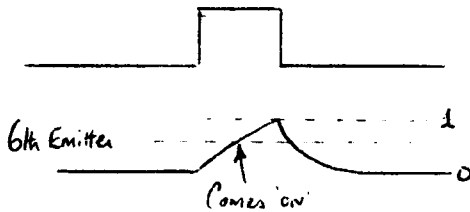
looking at the last trace we see that sixth emitter, which is connected to the touch plate, is dragged up, due to the associated capacitance of itself WRT its sister emitters. Infact, it is dragged up so far that it changes state from a '0' to a '1'. BUT when a finger is placed on the associated touch plate, the capacitance of the finger increases the total capacitance as seen by the emitter, increasing it by as much as 10 to 100 pF, and this is sufficient

to prevent it from changing state. Thus, pressing the pad with a finger will prevent the data multiplexer output from changing state.

1
THRESHOLD

FREE

0

WITH FINGER CAPACITANCE
~ A SLUGGED RESPONSE
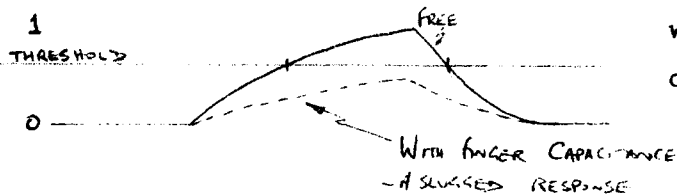
The enable signals 'M' and 'N' are

M

N
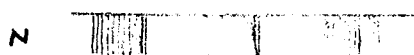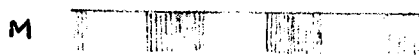
Thus one multiplexer is addressed, and then the other (i.e. E15 and 27) is then the other etc.

O/P N of E27

2 unconnected inputs   2nd top note selected.
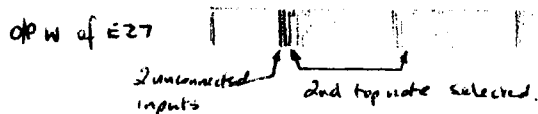
If more than one note is pressed, then several gaps in the outputs will be generated; however; the electronics that follow select the first note to appear, and as the keyboard is swept (addressed) from top to bottom, then the highest note of all the notes pressed is selected.

This piece of electronics is E26 (11,12,13) (4,5,6)
E25 (8,9,10,11,12,13), E16, E17, E18.

The two data outputs of MULTIPLEXERS E15, E17 are OR'ED together by E26 (11,12,13) (that is they are effectively just added together).

Sum of the o/p's   E26/11

'L'   E25/11 & E29/8   THE CLOCK FOR THE 'D' TYPE
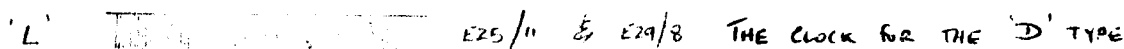
*WHEN looking for these waveforms, you much SYNC OFF of DO E23/11.

Now consider the 'D' type E 25 (8,9,10,11,12,13).

Assume that pin 8 is at logic 1. Therefore, Pin 5 E26 is at logic 1, and it is thus "enabled" in that is allows signals at its other pin (pin 4) to pass through it. The signal at pin 4 is the summed data output, which when it passes through the gate, is inverted. Notice that the clock pulses are coherent with the data signal.
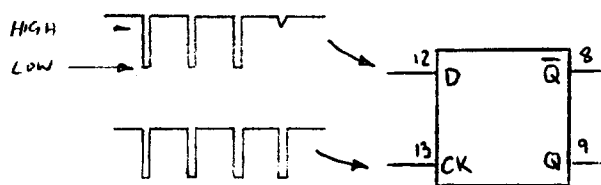
The D type operates as follows. It is an edge triggered device; that is data at its' D input is transferred to the Q output on the +ve transition of the clock. That is, put a 1 on pin 12, clock the device and a 1 appears at pin 9, the Q output. SO, in the present example, when there are no notes pressed, the data is low when it is clocked, and so Q remains Low. But, when that data is high, then Q goes high, therefore Q̄ (pin 8) goes low and in doing so inhibits E26 (4,5,6) the output of which thus remains high. The circuit has latched
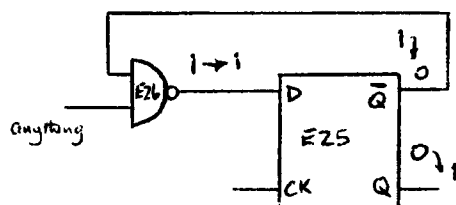
up, and it will remain latched up until it is released by a clearing pulse. Thuse, E25, Q9 goes high and remains there when it detects the first note. (See page 2, waveforms). Now, E25, Q9 clocks the D types E16,17,18, which are fed with the address code (A , A_0, B_0, D_0,). So, as soon as the first note is detected, its address is clocked into E16,17,18 which act as a one bit memory. At the end of one address sweep (about 100μ sec.) the D type E25 is unlatched by a negative going pulse produced by differentiating the address bit D_0 (23 pin 11) with the CR network C4, R44.

End of D_0

↓

-ve going

Pulse produced

C4

R44

+Vcc
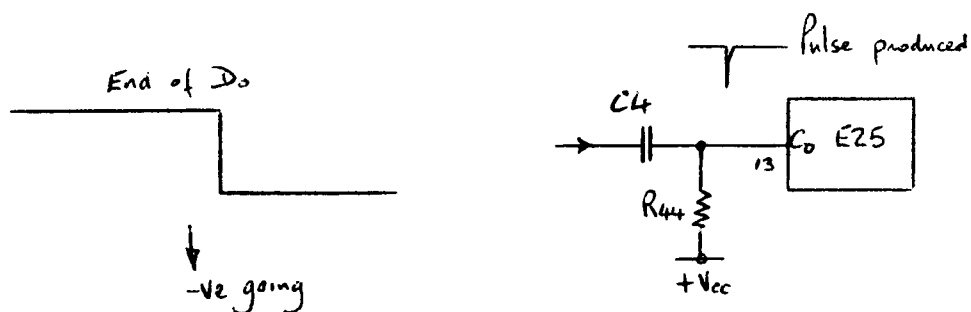
A low on the clear input of A D type clears the Q output to logic O

Thus, the D types E16, 17, 18 form a short term memory that is continually being updated (every 100μsec) as to highest key that is being selected. The output Pin 9 E25 is an <u>excellent</u> place to test the keyboard to see if the multipexer for the KB and/or the address code is functioning.

E25/9

32 BITS LONG

2ND BUTTOM NOTE PRESSED.

30 BITS MAXIMUM
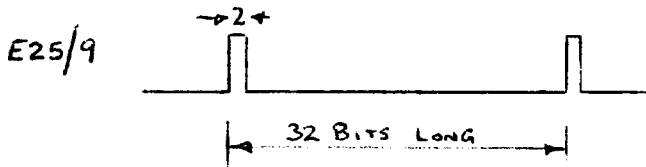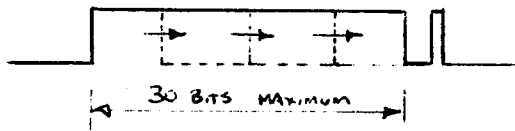
As YOU SWEEP YOUR FINGER UP THE KEYBOARD THE WAVEFORM CHANGES AS SHOWN. (THE PULSE WIDTH ELONGATES)

<u>RANDOM FUNCTION</u>   This is the same touch sensitive detector as for the KEYBOARD. However, as there is only one input, then no addressing is required. A slow clock pulse generator is used, (5KHz, 60n sec. pulses).

5KHz

60nS

E28

BIAS

PULSES DISAPPEAR WHEN RANDOM PAD PRESSED

E26

D E25

CK Q̄

E19
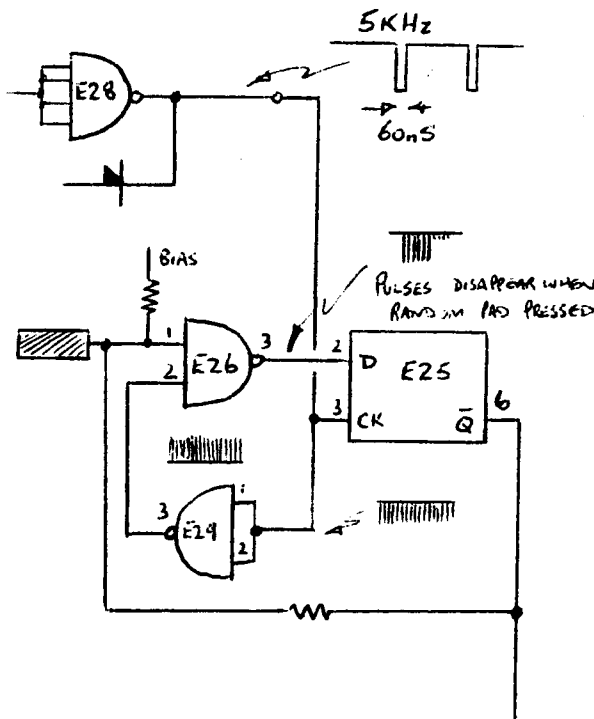
A separate oscillator, rather than the address oscillator is used, because:-

1. A long enough gap must be provided to allow the floating gate time to discharge.

2. If the address clock were to be used, the Random would not be random; this is because the network has a tendancy to select the largest clock pulse and this means that particular notes occur more readily than others.

The operation is as follows. When a missing pulse is detected by E25 pin 2, the $\overline{Q}$ output goes low and so the cct folds over. The $\overline{Q}$ is connected to the set input of E25. This will cause the Q output to go high and in doing so it ' records ' an address. (Any address in fact; it depends upon when the Random is pressed) . When the random is released, the set input of E25 pin 10 returns to 1, and the circuit operates as before. As the Q output E25 pin 6 can go low at anypoint in time, then any note is selected, and hence the term ' random '. **N.B.** The random function can generate errors; this is a design error.

The errors can be generated by the random accidentally selecting address code Binary 11111 (i.e. 32). This is the ' Skip ' code, and it will cause the .meter to prematurely reset, and the memory to corrupt. To demonstrate this phenonemum, try this test; Set the Sequencer clock speed to about 3 to 4 on the knob, press record and then tap the random pad. There is a 32:1 chance of generating the skip code, and this will be detected by a premature reset of the meter.

DAC

The short term memory E16,17,18 feeds Q1 to 5 which form a DAC. (Digital to Analogue Converter) Slightly re-drawing the circuit, we the following;
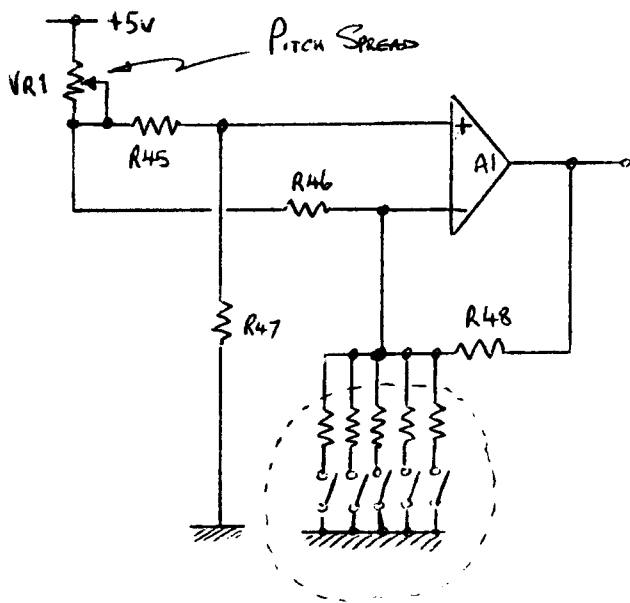
Inside the dotted box are 5 resistors and 5 switches. The resistors are R49 to R54, 1% m.o. resistors. The switches are Q1 to 5 and these are controlled by th stored address in E16, 17, 18.

When the address is 00000, all the switches are off, and so the circuit is just a simple differential amplifier, and the voltage at the output of A1 is 0V. When the switches turn ' ON ', the output goes negative.
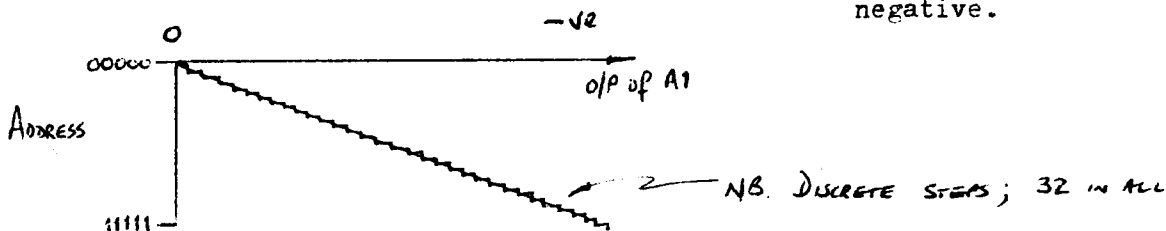
* NOTE WRT the short term memory E16,17,18. The lower half of E18 is different to the other 5 sections. This is the "key-pressed" section. It uses the clock line as its data input. This is because, when Q9, E25 is high, then a key is being pressed, and this is the data that it requires. It is clocked by $\overline{Do}$ (known as F@8, E26) at the end of an address sweep, and so its Q output (i.e. 9, E18) is high when a key is pressed and low when no key is pressed.

Note that the negative (1-0) transition of the $\overline{Q}$ output (8, E18) is used to control the envelope trigger by turning transistor Q6 on when a key is pressed. The envelope trigger control pot is used to determine whether the trigger is generated from the real time or recorded output.

DYNAMIC RESPONSE The crystal gives the K.B. a dynamic function, but this is only employable in real time. That is, no information about the key pressure is recorded. The crystal produces a click when the K.B. is hit.
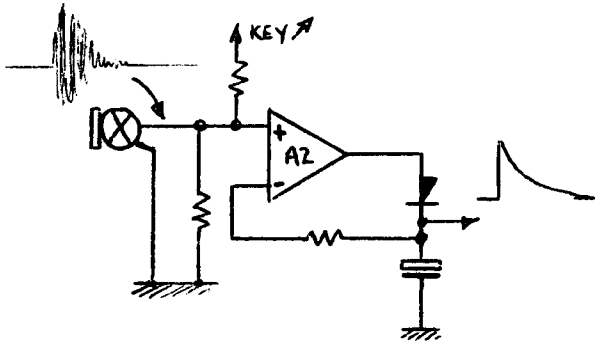
The network is a voltage follower with a diode in the feedback loop. The junction between the diode and the capacitor tries to follow the +ve voltage transient of the input and decays slowly (due to the storage of the capacitor) after the signal has ceased. This voltage is used to control one of the output channels on a Synthi A.

RECORD, PLAY, CONTROL LOGIC * note RECORD AND PLAY are clocked from the random clock gen.

The RECORD and PLAY pads operate in the same way as the Random touch pad. However, the interconnection of E10 (1,2,3,4,5) with E10 (8,9,11,12,13) and E10 with E18, provide a sequential mode of operation. That is:-
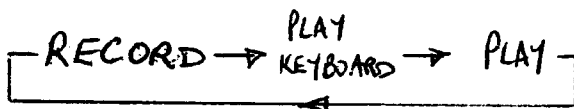
)
) these two
) sequences are
) permissible.
)

NOTHING HAPPENS

RECORD ⟶ KEYBOARD ⟶ PLAY ⟳ REMOVE FINGER - ALLOWS
SEQUENCE TO PLAY.
PRESSING 'PLAY' MERELY STOPS
SEQUENCE.
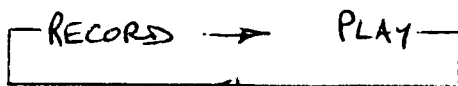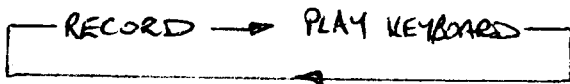
		RECORD	TOUCH K.B.	PLAY
E10	Q6	0	1	0 → 1
	Q8	1	1	0 → 1
		①	②	③ ③a

REVERTS BACK TO A 1 WHEN
FINGER IS RELEASED

ASSUME   E18/8 IS HIGH

E10/6 IS HIGH

E10/8 IS HIGH

1.   The record pad is pressed.   The data presented at the D input (2, E10) is high during the clock.   Therefore Q goes high, $\bar{Q}$ goes low. This sets E10 (* a low on its set input) and so the D type is latched up, and it will remain there until it is cleared.   The $\bar{Q}$ pin 6 is also connected to the clear of the lower E10 D type, but this has no effect as the D type is already in its <u>cleared</u> mode.

2.   When the keyboard is pressed the KEY voltage (i.e. E18, 8) goes low, and this clears E10 (2,3,4,5,6).   (The clear overides the set control).   The $\bar{Q}$ output (E10, 6) then goes high, whereas the lower D type still remains unchanged.

3.   Play is pressed.   A logic high is presented to the D input (12, E10) and so the $\bar{Q}$ goes low.   However as there is no...

3a.   latch up it returns to its high level as soon as the finger is released. Note, that when at the record mode, the clear input (13, E10) is low and so the lower half of E10 is prevented from changing state;   that is, Record Play does nothing.

<u>Control Logic</u>   This is <u>E6.</u>   The logic sequence (Above) is presented to E6.   The output sequence generated by E6 is as follows:-

	PIN	RECORD	KEYBOARD	PLAY
E6 (	8	0	1	0 no jump as above.
((	11	0	0	1
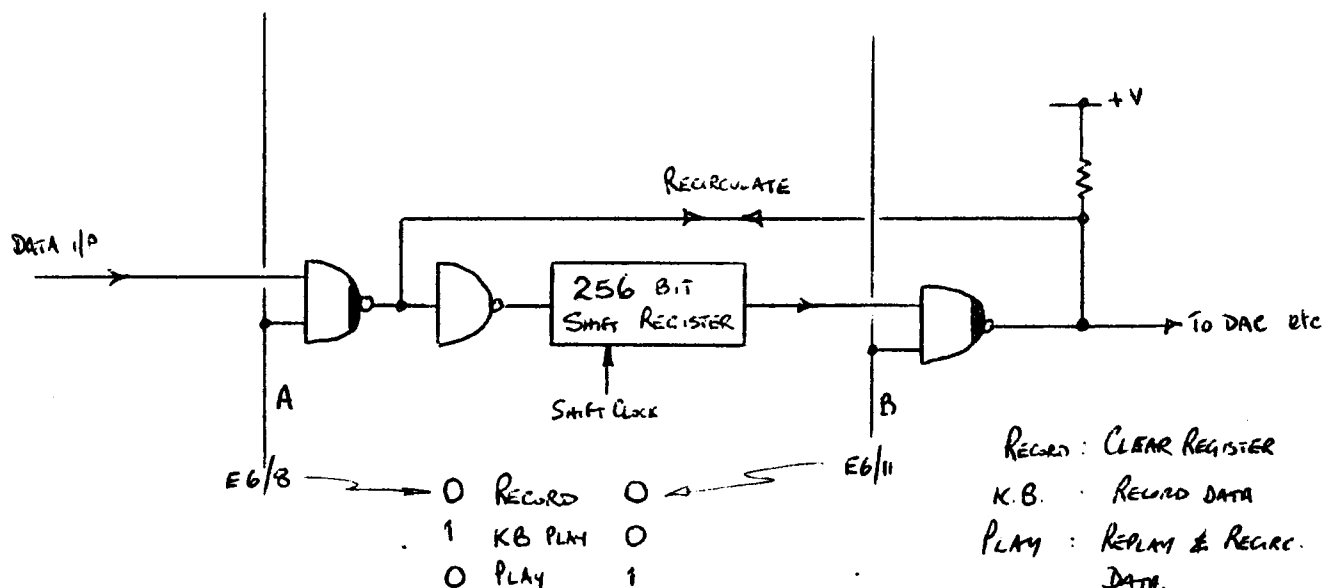
Lines A and B open and close the sets of input/output gates.
Only **one** set of gates (A or B) is ever open.
When the logic level on A is high, gates connected to it are open.
When the logic level on A is low, gates connected to it are closed.
RECORD MODE: Both sets of gates are closed. Clock to shift registers is very fast, latter fills with 0's

Keyb'd Mode. This is "record" mode (confused?); data is accepted,
because A is high. The data is clocked into the shift register at a slower
rate, this rate being variable. If you are unlucky, you can overfill the
shift register, and the front of the data is merely lost out of the end
of the device.

Play. Data is replayed and recirculated, because line B is high. The
replay clock rate is also variable. When an unfilled part of the shift
register is detected a skip mode is implemented and the shift register skips
all the blank locations until it finds the start of the data, which it then
plays at its slow rate. Pressing the play pad stops the shift clock from
operating in its "play" mode and so pressing play whilst the machine is
replaying does two things:-

1. Effectively pauses the device

2. Upon releasing finger, the sequence restarts (proceeded by a skip block).
If the shift register has been overfilled, then there are **no** blank locations
and so when the play is pressed, the machine rapidly searches for an empty
location and cannot find one. The result is a buzz sound as all the data
rapidly recirculates. Also, as there are no blank locations, the machine
does not know where the sequence start is. Therefore overfilled sequences,
when replayed will start anywhere.

The memory is a 6 bit word, 256 bits long. 5 bits are used to record the note selected. The sixth is used to trigger the envelope trigger; that is if the envelope trigger pot is in the right position.

SHIFT CLOCK/SKIP GENERATOR

E19, Q14, C6, R71, R70, R72, VR3 is the high speed skip generator. It is a schmitt trigger oscillator. When C7 is operational the oscillator reverts to a low speed clock generator. In normal operation pin 8, E3 is low, C7 is thus effective and so a slow clock is generated. (Normal operation is during the recording and playing back, and not the pressing of those pads).

In normal operation, the output of E2 is high (i.e. the input is not all 1's) and so is the input pin 9, E3. When RECORD is pressed, all the inputs to E2 are high, the output of E2 goes low, and sets the skip oscillator into its skip mode, by making C7 ineffective. The shiftregister is thus filled with 0's. Also, the two meterdivider circuits E20, E24 are reset to zero.

When the KEYBOARD is pressed, the input gates to the shift registers are opened, and so the inputs to E2 change from all 1's to a mixture of 0's and 1's. (Note an all 1's condition cannot occur in normal operation). The output of E2 goes to 1. Thus, the output pin 8 of E3 goes to 0, C7 is functional so the oscillator begins to clock in its slow mode. Also, the reset on E24, 20 is in its count mode, the clock being taken from E19 pin 8. The output from E19, 8 is differentiated by C16, R68 to give a very shart pulse, which appears at Q13's collector, and is used to drive all the shift registers.
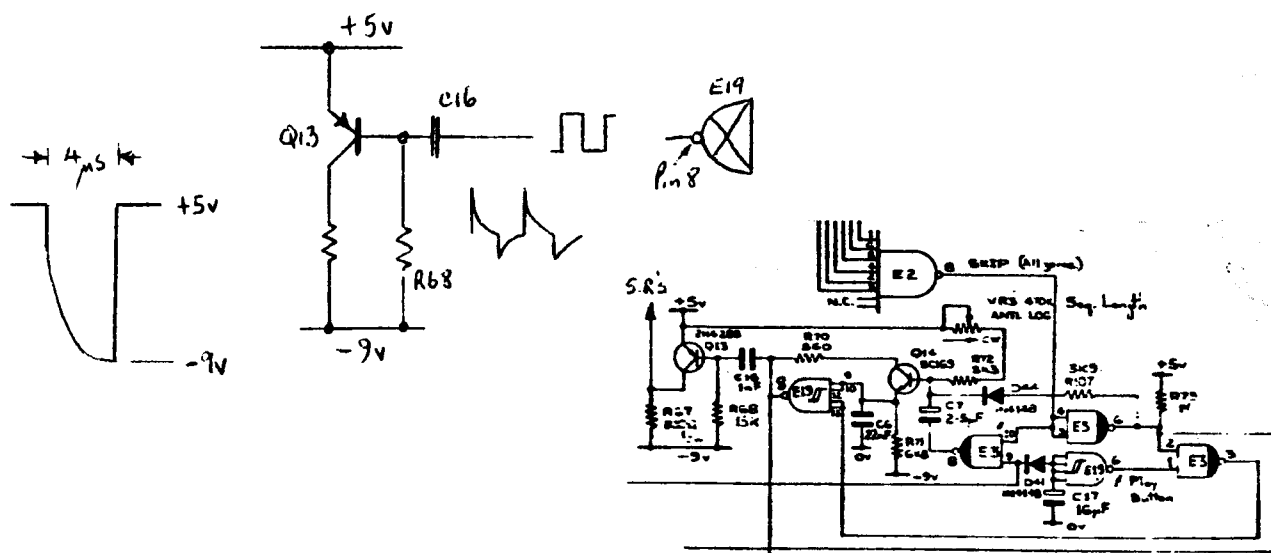
When the PLAY pad is pressed. Input pin 9, E3 goes low (but only for the duration of the pressing of the pad); this causes the data to rapidly recirculate (skip), usually for one bit only (because E3, 8 is high).

E3, 9 is low. Hence E19,6 is high.
E2, 8 is high.

Nothing happens until an "all low-state" of the shift registers is detected by E2 (*all 1's as seen by E2). When this state is located, E2 ,8 falls to 0, therefore E3, 6 goes high, and in doing so resets E20, E24. Also, there are now two high's at the input to E3,(1,2,3) and so E3, 3 goes low and in doing so disables E19 (8,9,10,12,13) the oscillator. If there are no empty storage locations,the network just rapidly recirculates, and a "buzz" is heard.

When the play pad is released, pin 9,E3 goes high, however E3, 8 still remains high; E19, 6 takes a short time to go low because of the effect of C17. (This eliminates spurious effects when operating the play pad.) When E19,6 goes low, E3, 3 goes high, thus enabling the clock oscillator. The clock is in its high speed mode (skip) and so it races past all the unused storage area and when it comes to the first piece of data, E2, 8 goes high, the clock thus reverts to its slow speed mode, and E24, E20 is set to its count mode. Thus, the stored data is replayed, and when the end is reached there is a rapid skip and the process repeats itself.

METER COUNTER

The clock is divded by + 16 twice, which is 256, the length of the memory. The 5 most significant bits are decoded in the meter DAC. This is E24 and the resistor network. The network is a "weighted/ladder" - (a Cockeral special).

LSB A₁
A₀
B₁
B₀
C₀
MSB D₀

dp

Clock
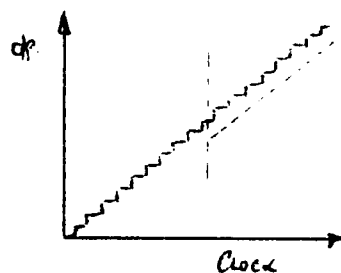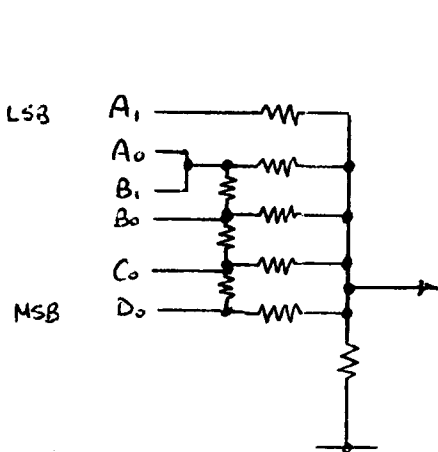
THE BIGGEST ERROR IN LINEARITY COMES ½ WAY WHERE A PRONOUNCED STEP CAN SOMETIMES OCCUR.

RESET   CLOCK
E3/6

IF SPARE MEMORY LOCATIONS EXIST

R 0
K 1
PP 1→0
RP 0→1→0

SKIP (All zeros)

VR3 470K Seq. Length
ANTI LOG

4 MODE OPERATION
R   RECORD
K   PLAY KEYBOARD
PP PRESS PLAY
RP RELEASE PLAY

N.C.

E2

+5v

2N4288 Q13

R70 560

Q14 BC169

R72 3K3

R67 820Ω ½w

R68 15k

C16 1nF

E19

C6 22nF

R71 6K8

C7 2·5µF

1N4148 D44

E3

3K9 R107

R75 1K

+5v

E3

E3

E19

1N4148 D41

C17 16µF

Play Button

R 1
K 1
PP 0
RP 1

R 1
K 0
PP 1
RP 1→0→1
SKIP PLAY

R 1
K 0
PP 1
RP 1→0→1
SKIP PLAY

R 1
K 1
PP 1→0
RP 1→Time Delay

METER COUNTER

CK

RESET

MEMORY DAC

The second DAC is a 5 bit
device with a 6th bit controlled
by the transposition pad. The
"transposition pad" bit is the
same order of magnitude as the MSB
of the address bits.

ADDRESS
LSB   MSB MSB +5v

TRANSPOSITION

WITH ALL SWITCHES OPEN
O/P IS ZERO.
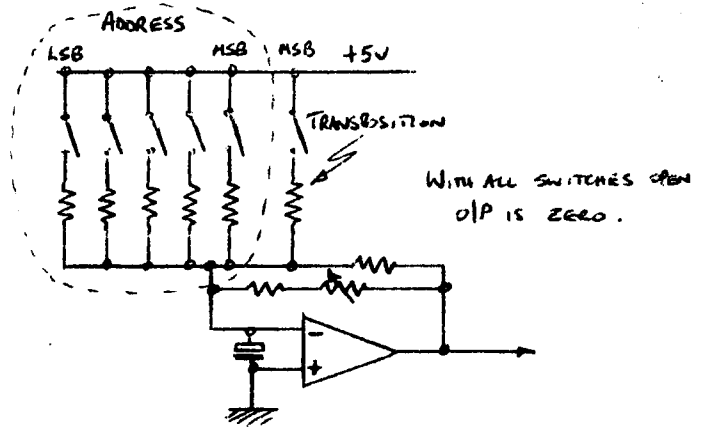
The switches are transistors Q7 and Q8—Q12 and the operation is
similar to the real time DAC. Note, that the transposition acts only
on the recorded output DAC, but no record of transposition playing is
stored in the memory. Transposition is real time only.

TRANSPOSITION.

The transposition multiplexer operates in a similar manner to the two
other multiplexers. One difference is a feed-back circuit E11 (8,12,11)
that causes single events to be multiplied. Looking at E7, we have:-
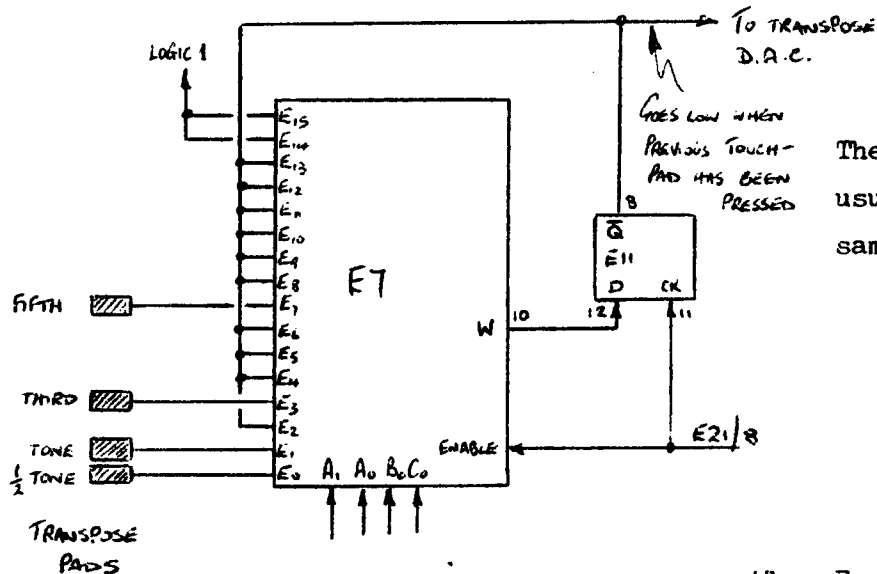
The multiplexer is addressed in the usual way, and is enabled and has the same touch sensitivity as before.

When Eo is pressed, it is prevented from going high, and so the output at W is high for Eo.

therefore pressing Eo produces a 1 bit pulse at E11 pin 8.
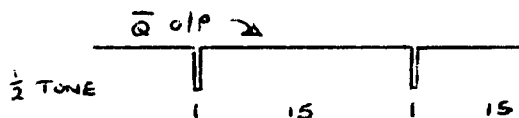
Pressing the tone causes W to be high for E1.   But the output $\overline{Q}$ of E11 is fed back to E2.   And so when E2 is addressed the output is again high but stops when it gets to E3.
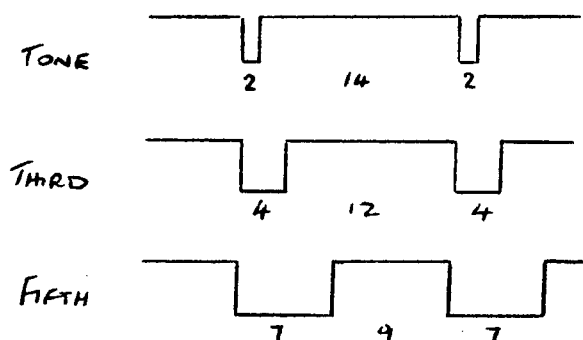
*Notice E14, E15 are never low.

Now, the output from E11 pin 8 is used to control the DAC on the recorded output.   As the transposition signal is a mark/space ratio signal, then the resultant product from the DAC must be smoothed out, this being accomplished by C5.   The transposition signal is used to control a logic switch of equal status to the MSB of the 5 bit DAC.

The thirty notes available from the keyboard form $2\frac{1}{2}$ octaves, (i.e. 12 notes per octave).   Therefore 12 logic bit = 1 Octave

or   1 semitone = 1 logic bit.

where 1 octave = 12 semitones.

The MSB of the address is equivalant to 16 logic bits.   Therefore as the transpose controls a switch of equal status to the MSB, then one bit of the transpose signal = 1 semitone.

Therefore, pressing the $\frac{1}{2}$ tone pad = 1 bit = 1 semitone.

pressing the   tone pad = 2 bits = 2 semitones.

pressing the   third pad = 4 bits = 4 semitones.

pressing the   fifth pad = 7 bits = 7 semitones.

that is, pressing the <u>keyboard</u> and the transposition pad, tranposes the note generated upwards by the respective amount.

* Example:- pressing the $\frac{1}{2}$ tone, third and fifth will shift a note

up by one octave. (That is, if the keyboard has been

adjusted to $2\frac{1}{2}$ octaves)

1 + 4 + 7   =   12 semitones   =   1 octave.

(* An octave - the ratio of two frequencies which are at frequencies of

F and 2F.   F being arbitary).

APPENDIX
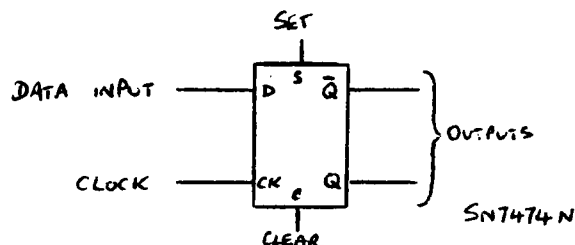
D type, used usually as a one bit delay or an edge detector.

Logic data is presented to the D input.   The data (0 or a 1) appears at the Q output after the +ve edge of the clock pulse, that is:-

data is transferred to the Q output on the +ve edge of the clock:-

<u>Set</u> - a 0 on the set puts Q to 1

<u>Clear-</u> a 0 on the clear puts Q to 0

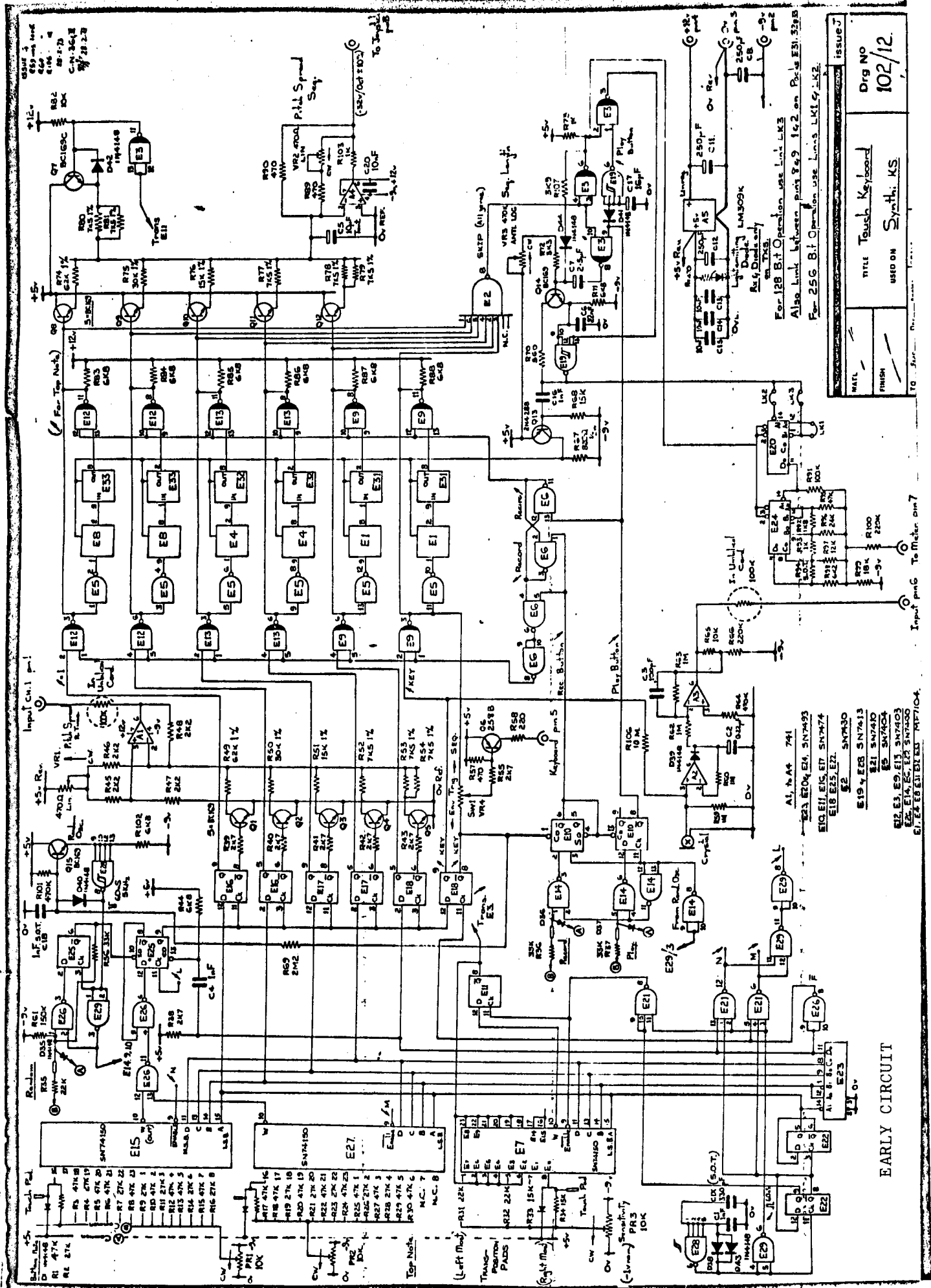set and clear are independant of the clock and overide the D input.

SCHMITT
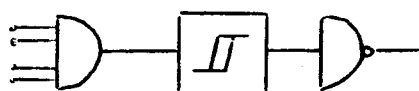
The SN7413N looks like a 4 input AND, followed by a schmitt trigger, followed by an inverter. The schmitt trigger exhibits a phenomena known as Hysterysis.
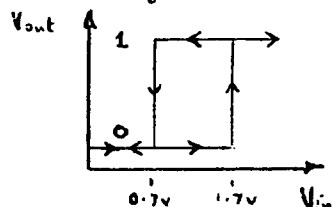
EARLY CIRCUIT
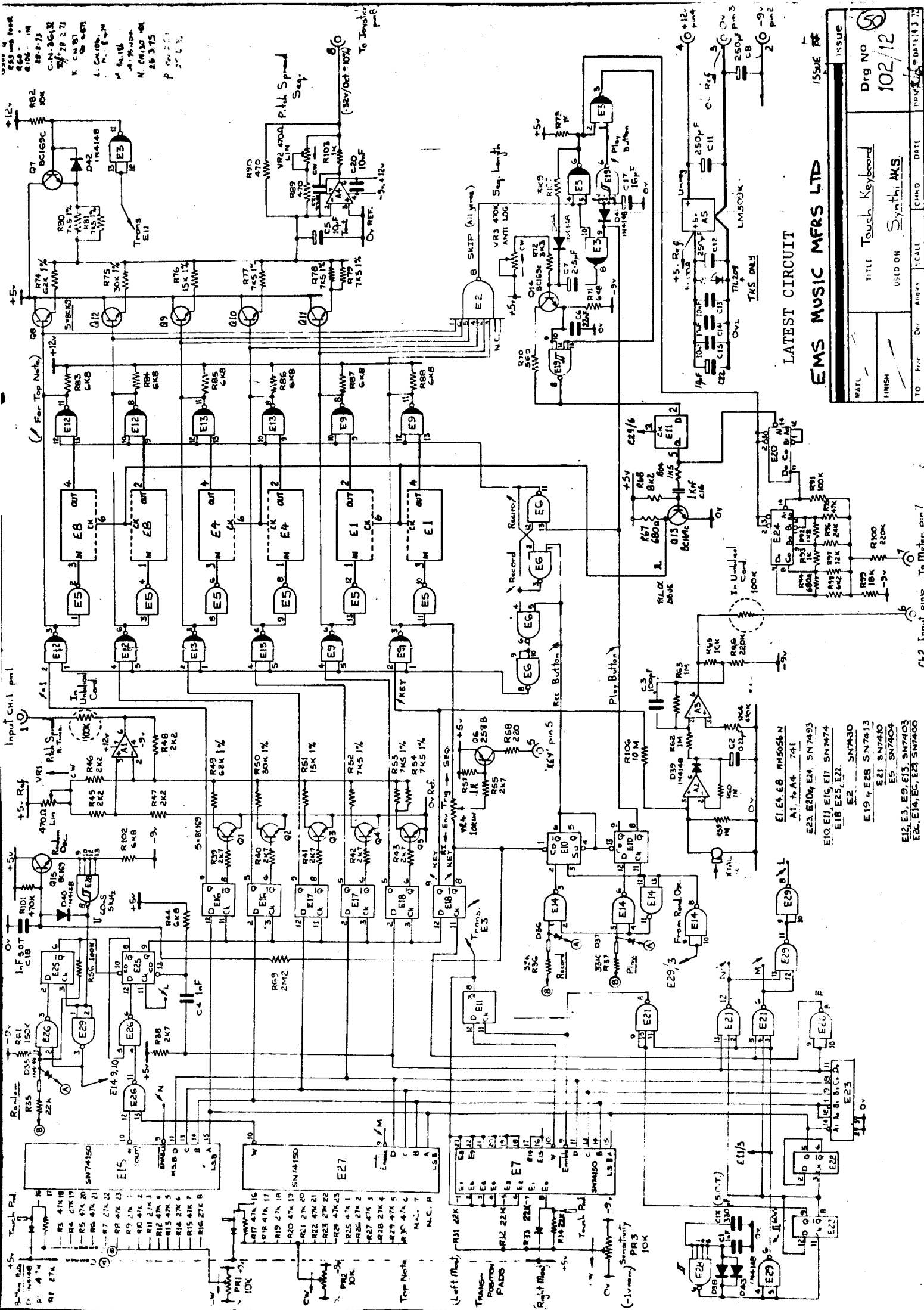
TITLE	Touch Keyboard
USED ON	Synth. KS
Drg No	102/12
	Issue J

LATEST CIRCUIT

EMS MUSIC MFRS LTD

| TITLE | Touch Keyboard |
| USED ON | Synth AKS. |

Drg No 102/12

ISSUE

HILTON ELECTRONICS
(WAREHAM) LTD

TITLE
TOUCH KEYBOARD
ASSY. AKS.

DRG No 103/4

NOTES:-
Pin 14 : +5V TYPES 7400, 7403, 7410, 7413, 7430, 7474.
Pin 7 : 0V

Pin 5 : +5V TYPE 7473.
Pin 10 : 0V

Pin 24 : +5V TYPE 74150.
Pin 12 : 0V

NOTE: WIRE LEADS SHOULD BE SOLDERED TO THE CRYSTAL LEADS
AND THE WIRE LEADS ARE TO BE SOLDERED INTO THE PCB
THE CRYSTAL SHOULD THEN BE ARALDITED TO THE BOARD.

UNLESS OTHERWISE STATED ALL DIODES IN4148

3K 33K 27K 47K 47K 27K 47K 47K 27K 47K 47K 27K 47K 47K 27K 22K

128 BIT STORAGE

WIRE LINKS
664 NUT BOLT 4 S A

C11 250μF 25V
C12 250μF 25V
C8 250μF 25V

22.0K

22 SWG SLEEVED LINK

W

THIRD ANGLE PROJECTION

DRG. No. 23/02

ISSUE	ALTERATIONS	DATE

DK2 CIRCUIT

TOLERANCE
INCH / METRIC
3 FIGURE ± ·005 / ± ·1
2 · ± ·010 / ± ·1

MATERIAL.

TITLE

COMPONENT LAYOUT   DK 2

USED ON

Components (partial):
R15 15K, R12 680, R17 6K8, R19 12K, R24 10K, R32 1K2, R33 4K7, R30 18K, R27 68K, R31 47K, R28 33K, PR5 10K, IC2 CA3046, R23 22K, R26 1K, R29 1K, R21 10K, C3 16µF 10v, R22 12K, R25 1K, IC1 CA3046, R13 22K, R8 100, PR4 10K, C11 10Kp, R54 4K7, R55 15K, PR2 1K, PR1 1K, 80µF C10 16v, 80µF C12 16v

C8 1µF, R41 10M, R42 10M, Q14 2N5172, R44 8K2, R45 15K, R47 12K, R49 12K, R40 33K, R32 3K3, R38 100, BC258B, Q15 2N5172, Q13 2N5172, Q4 BC258B, Q3, R16 6K8, R20 6N8, R14 12K, C2, R43 100K, R46 10M, Q16 2N5163, Q1, Q2 2N5163, R7 2K7, R3 12K, R2 820, R1 240, Q18 2N5163, R51 8K2, R52 22K, R53 33K, PR3 10K, R65 1M, Q11 2N5157, Q12 2N5163, Q6 2N5172, PR6 100K, R70 120K, A1 741, R68 820, R67 1M5, R66 2M2, ZD1 5V1, C7 ·22µF, M8 17v, R50 5K6, R35 6K8, R34 5K6, R36 10K, R37 5K6, R57 1K5, R59 470, R60 2K7, Q7 2N5172, Q8 BC258B, Q9 2N5172

NOTES.
1. C10 C12 & C8 TO BE MOUNTED ON TRACK SIDE
2. Q3, 4, 5, 13, 14 & 15 TO BE MOUNTED FLAT ON P.C.B.

ALL 2N5163 & 2N5457 SELECTED

Q1	2N5172
Q2	2N5163
Q3	2N5172
Q4	BC258B
Q5	BC258B
Q6	2N5172
Q7	2N5172
Q8	BC258B
Q9	2N5172
Q10	BC258B
Q11	2N5457
Q12	2N5163
Q13	2N5172
Q14	2N5172
Q15	2N5172
Q16	2N5163
Q17	2N5172
Q18	2N5163

SCALE	DRAWN	CHECKED
2:1	DATE 12·9·70	APPROVED
	M.C.M	TRACED

Electronic Music Studios

DK2

CIRCUIT DIAGRAM
DYNAMIC KEYBOARD

ISSUE #H

22 OF

54

D C10 14 & 12 added 20.7.71
C R45 R3 added 7H4 4-7-7. VR changed.
   MAIN P.C.B. PARTS LIST SHEETS 1-4
   E.C.N. 46 27.6.73
D R?? 2/7/73 F was DK1 20/7/73.

H. C.N. 116 Nov. 23.7.74
G. TRANSISTOR TYPE Nos ADDED Nov 23.4.74
   RES.COMBAS CN.98 RES.COMBAS CN.98

Dynamic Keyboard – Setting-up procedure

Set all knobs and presets halfway.

First set the keyboard zero volts at middle F sharp. Press middle F sharp with scope on Pin 13 of keyboard circuit. Adjust PR3 for 0 Volts ± 50 mV.

Check that top C gives 1.5V ± 200 mV

Check that bottom C gives −1.5V ± 200 mV

Check drift rate when key is released. Should be less than 100 mV per minute.

If greater suspect Q12. This should have a Vp of 2.5 – 3.0.

Keyboard Oscillator

Press middle F sharp. With VR1 (Frequency) at 5 and VR3 clockwise put scope on live connection of jack socket 'Keyboard Modulator'. Adjust PR1 for 248 Hz at F sharp or 261 Hz for middle G.

If PR1 is off range clockwise then snip R9.

If PR1 is off range counterclockwise then reduce R9 value by half.

Hold down bottom C, and set VR2 (Tuning) to 5. Press C one octave higher.

Trim PR2 to get exactly an octave higher than bottom C.

If PR2 is off range clockwise then snip R11

If PR2 is off range counterclockwise suspect circuit fault.

With Frequency at 0 press lowest note. Should be lower than 30 Hz.

With Frequency at 10 press highest note. Should be higher than 8 kHz.

Dynamic Voltage

Short across C9 and trim PR4 for +3V at Pin 12 on keyboard circuit.

DO NOT PRESS A KEY WITH SHORT IN PLACE.

Check for drift, which should be less than 100mV in ten seconds.

Check that Dynamic Range has no effect on keyboard oscillator loudness when turned to zero. If so re-adjust PR4.

Contact Displacement

Each note has two sets of contacts. One pair, that is not connected to the resistors, must be adjusted to make about .03" after the other pair. With practice it is possible to do this by eye using a fine pair of tweezers.

With VR1 and VR2 halfway, VR3 and VR4 fully clockwise and both switches up. Monitor the signal output on a scope. Strike each note with a even force. This should give about 10 dB less (⅓ as much) than hitting it hard. Maximum level should give about 2V p.p on the scope. Adjust the crooked member of the late pair where necessary. Closing the gap makes the note louder. If

Dynamic Keyboard - Contact displacement(continued)

visual alignment still gives performance inconsistencies this is almost
certainly due to contacts being dirty. This is a frequent source of problems
on the keyboard generally, giving swoops and dithering pitches at different
places on the keyboard. Use cotton buds and Isopropyl alcohol to carefully
wipe each surface of each contact. Extreme care must be taken not to disturb
the contact displacement, but this will restore precision to the keys. Never
use an abrasive substance on contacts since they are gold-plated. Blistered
plating means new contacts must be fitted.

Setting up DK2 keyboard

DK2 keyboards are duophonic, so that Channel 1 pitch voltage comes from
the lower note being played, with Channel 2 pitch voltage coming from the
upper note. This second upper note voltage is derived from the lower note
and PR6 needs to be adjusted to get the relationship right. Connect Channel
2 Voltage to control an oscillator with the Input Channel gain at maximum.
Hold down the bottom key with sellotape and play the top note. If the
oscillator pitch shifts adjust PR6 until there is no more movement.
Some keyboards were modified from DK1 (monophonic) to DK2 bY the addition
of a small pc board under the main one. In these cases PR6 is the preset
on the small board.