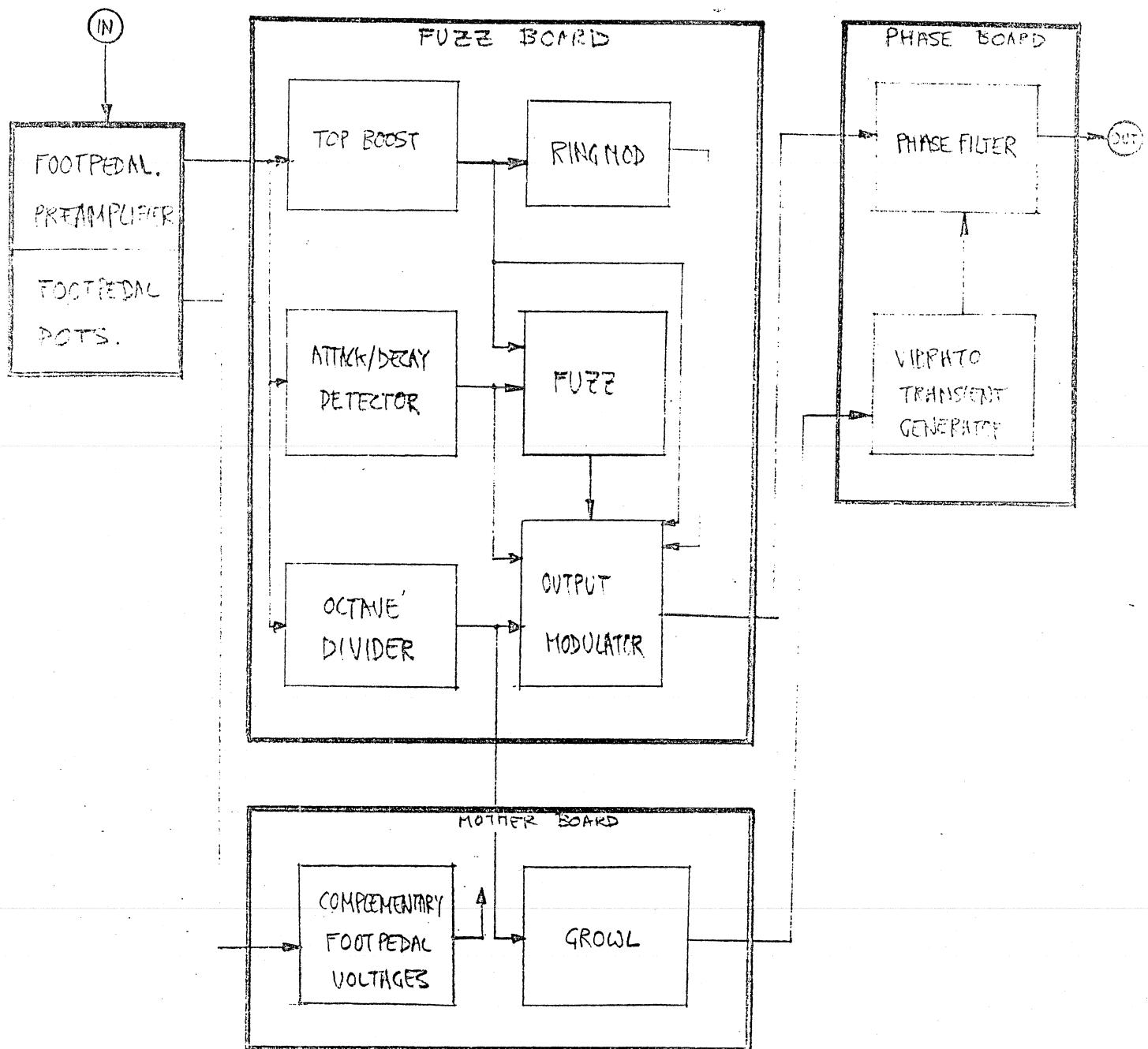


HIFLI  
CIRCUITS  
AND TEST NOTES

# HI FLI EXPLAINED



INTRODUCTION.

The Synthi Hi-Fli combines many well known processes in a single package, such as tone control, fuzz, octave dropping, modulation, phasing, wav-wav, vibrato etc.

The weighting of these effects is ostensibly at the control of the operator and can be manually set and/or controlled by a dual foot pedal and in some cases can be effected by a transient generator which, in turn, is triggered by the operator.

The purpose of this machine is to process musical signals, in particular, guitars.

CIRCUIT DESCRIPTION.

See Drawing No. II6/8.

Foot Pedal.

This is a two-stage, low noise preamplifier. The gain is approximately  $1/R_5$ . Two inputs are provided; one has an <sup>VRI</sup> attenuator to make it possible to accept high level inputs, this being necessary because the preamplifier gain never goes less than 3.3 (i.e. 33K/10K). The output of Q2 is AC coupled to a buffer (A1). This is because the buffer drives the rest of the Hi-Fli and it is DC coupled. Any DC offsets would stop many of the circuit functions.

The bypass footswitch provides a - 12v or floating signal to the Hi-Fli, the two footpedal pots, merely pick off a control voltage. Their pots, must be aligned to give a symmetrical bipolar output swing.

Fuzz Board.

See Drawing No. II2/6.

The tone burst generator waveforms will be useful to refer to whilst reading the Fuzz and Phase board explanations.

The audio signal from the preamplifier goes to three circuits: the top boost, the octave divider and the attack decay detector.

The Attack Decay Detector. This is used to determine when the input waveform starts and stops. The signal goes into A1 and A2, (I23), where it is equalised and rectified, (see TB 2,3), then it is logarithmically compressed by A6 and A2 (5,6,7) (see TB4). The compression is due to the exponential characteristics of the dual transistor A6 in the feed back loop around A2 (5,6,7). Now the compressed rectified signal is passed through a low pass filter, A3, which is a two stage Sallen Key Filter, cut off slope = -24dB/oct. The result (see TB5) is a compressed image of the input signal's envelope.

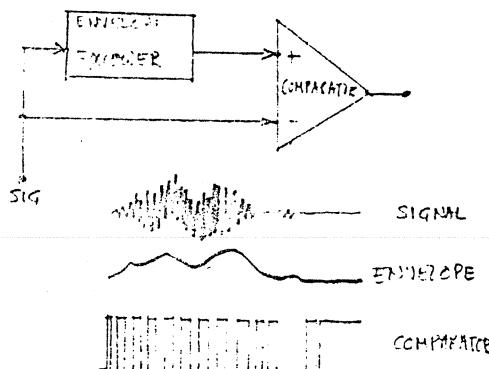
To detect transients in this envelope the waveform is differentiated by C9 and R25; also D5,6 to make sure that these transients are greater than  $\pm 600\text{mV}$  (see TB6).

The detected transients are used to drive A4 which comprises two schmitt triggers, one used to generate a pulse on an attack A4, (5,6,7.) (see TB8) and one used to generate a pulse on a decay A4 (I23) (see TB7).

The combination of these two, produces a pulse that goes low in between the attack and decay points A5 (I23) (see TB9) and this

is used to trigger the transient generator on the phase card. Also produced is an exponential decay waveform (see TB10); when A4, pin 7 is low C10 is discharged via D7. When it is high, D7 is reverse biased, Q1 is switched on and so C10 charges up, via the decay rate pot VR1, to 0v. This voltage is monitored by the Voltage follower A5(5,6,7) (see TB10)

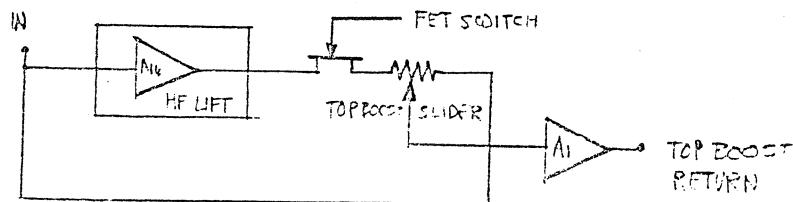
The audio input also goes into an octave divider (A7,8,9.) This circuit is primarily designed to detect the fundamental note of the input and then divided by two. It does this by having complementary envelope followers and complementary envelope comparators.



This arrangement is quite good as a fundamental note detector, and as a complementary system is used as well then a reasonable degree of integrity is to be expected.

The Envelope follower is made up of a perfect rectifier A7, with a fixed time constant. The comparators are A8 (see TB II, I2, I3, I4) which drives A9; a dual D flip-flop. This is a TTL device being powered by +5v which it gets from DI3 R51. A8 sets and clears the first stage of A9 which produces a neat square wave output (see TB15). The second half of A9 divides this by two, thus producing a sub octave signal (see TB16) which is applied to A10. The gain of A10 is controlled by the suboctave slider and the output of A10 is affected by the buzz switch which, when closed, acts as a low pass filter (see TB17). The output of A10 is used to affect the output modulator to give BUZZ noises.

The audio signal also goes into a top boost circuit A14 which gives it a high frequency lift.

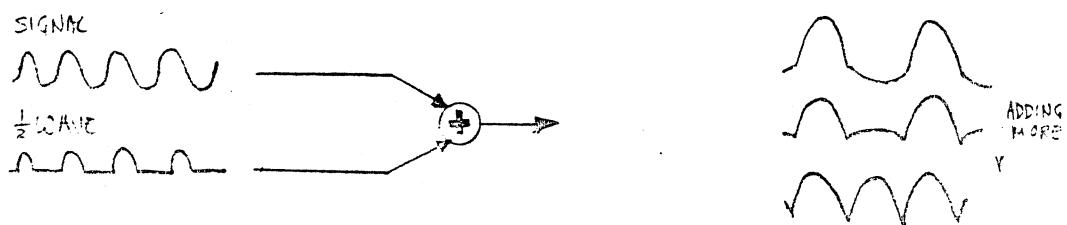


The top boost return signal is a mix of the equalised signal and the original, and is fed to the sustain fuzz, ring modulator and output modulator.

AI2 is a peak voltage detector; i.e. it remembers on CI9 the largest positive signal excursion. Therefore, when a note is struck, the peak amplitude is stored in CI9. This signal is fed via the attack rate pot to C20 (see TB20), which is buffered by AI2 (see TB19). The purpose is to make a Fuzz box whose amplitude is proportional to the signal level but whose harmonic structure isn't.

The top boost signal is fed into Q6 which is an amplifier whose collector load is driven by the output of AI2. Thus the signal out of AI2 defines the Fuzz modulation envelope (see TB21). The gain of the Fuzz is controlled by AI3, also, when a stop, (end of note), is detected, transistors Q4,5 short out CI9,20 and the Fuzz ceases, ready for the next attack.

Ring Modulation. This is not truly ring modulation but an approximation. Transistors Q2,3 act as a half wave rectifier and AI1 as a controlled modulator, so that as a controlled amount of inverted half wave rectified signal is added to the original the fundamental can be made to completely disappear. (see TB22).



The output modulator is a FET modulator. A matched pair of FET's is used so that the modulator switches off without having need for a preset or having an undesirable gap in the modulation. Also AI6 induces voltages onto the bias FET which in turn controls the modulation FET. The output then goes to the phase board where most of the business occurs.

#### Phase Board.

See Drawing No. III2/7

This board is by far the most useful in terms of the effects it generates, but although it has less sections than the Fuzz board, it may prove to be more difficult to understand.

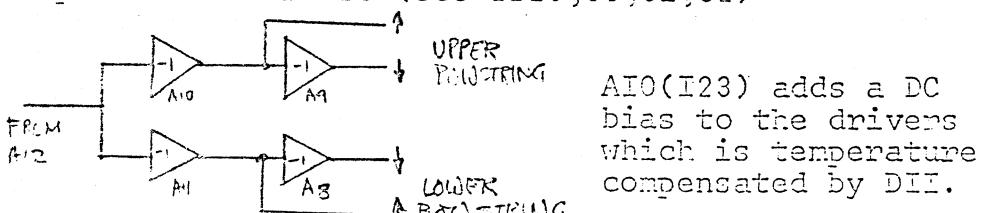
The phase board consists of basically three parts; a function generator, a set of bowstringdrivers and a phase filter. The function generator produces ramps, sine waves and attacking and decaying sine waves. The oscillator is a triangle square wave oscillator made from AI6, I5, (see TB23,24).

AI6 is a reversible integrator and AI5 is the schmitt trigger. The speed of oscillation is controlled by the current into pin 5 of AI6, the range switching between  $\sim$  and  $\text{M}\text{M}$  is acheived by transistor Q1 being switched on or off. The triangular output is fed to AI4 where the saturation effect of this IC bends the  $\sim$  into a  $\text{M}\text{M}$  (see TB25) The gain of AI4 can be controlled so that it can multiply a  $\sim$  with a ramp to produce a  $\sim$ . The output of AI4 then goes to AI3 which is a gain control, and then to AI2 which drives the LED's and the bow string drivers. Also at AI2, the 'direct Shift' is produced; that is, a DC level is added to the function. The output of AI2 goes via diodes D262-5, RI05-II0 and LED's I & 2 to the bow string drivers, the purpose of this network being to distort the function (see TB29). The ramp functions are generated by AI7, I3 and Q3. The attack rate is determined by the current into pin 5 of AI7; this I.C. being used to charge up C3, Q3 just being an emitter follower.

The capacitor C3 is reset by AI8 which is controlled by the reset pulse from the Fuzz Board (see TE 27, 28) the reset pulse just causing AI8 to drive a large current into or out of C3. The mode of the ramp (i.e. up or down) is controlled by the modulation switch. When the RHS of R21 is held positive by the switch rising ramps are generated, and when it is negative the mode of AI7, AI8 is reversed and the ramps fall. When the modulation switch is in the  $\text{M}\text{M}$  &  $\sim$  modes, Q3 emitter is held high by D6, 7 thus preventing the ramp generator from functioning.

In the  $\text{A}\text{N}$  modes, D4, 5 prevent the oscillator from oscillating. In the  $\text{M}\text{M}$  modes, both ramp generator and oscillator are functioning.

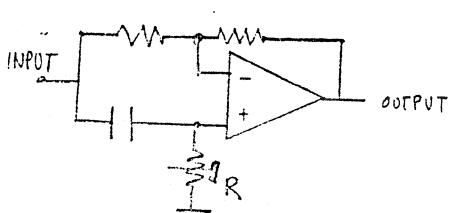
The bow string drivers drive the 200 Diodes in the phase filter. The distorted output from AI2 is fed into a pair of inverters (see TB29, 30, 31, 32)



Also AI1 (I23) and Q4 are used as a switchable inverter; when R41 is pulled negative, (MEAW), Q4 is switched on and the lower bow string drivers response to the output of AI2 is inverted.

The bow string drivers drive a string of 20 Diodes, which are forward biased and tapped in the centre. This forms the control for the Phase Filter.

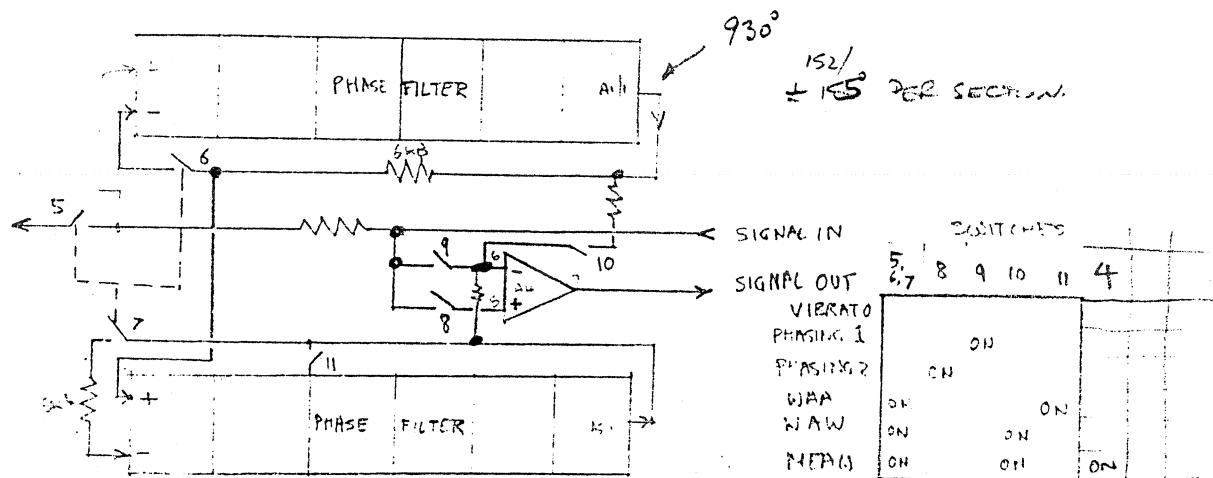
The Phase Filter is a phase delay line, having a delay of up to  $12\pi$  radians. Each section can give a maximum of  $\pi$ , phase shift.



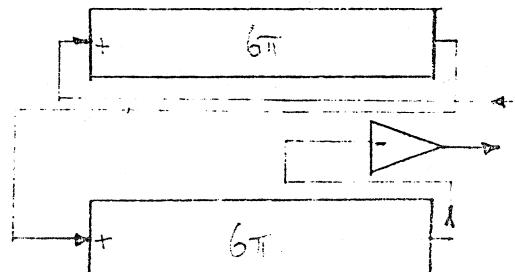
The phase shift circuit is a conventional  $\text{A}\text{N}$  pass filter; i.e. a filter that has a fixed amplitude response, but a frequency sensitive phase response.

Alternatively, for a fixed input frequency, the output phase can be varied by varying R. In the case of the Hi-Fli, R is the diode string. Using a controlled phase delay, it is possible to generate vibrato, phasing,

(swept notch) and waa-waw (swept peaks) sounds. To do this we need the services of some routing switches, viz Q5-II.

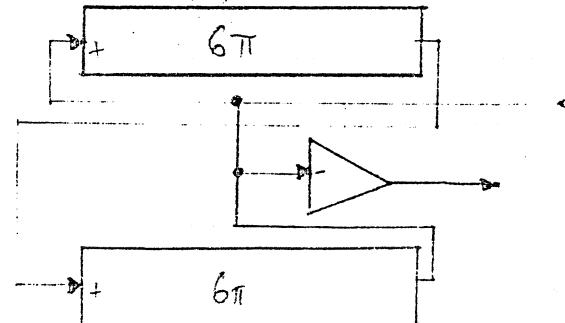


VIBRATO. All switches open.



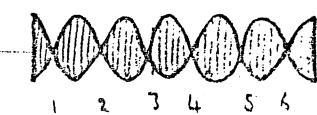
The signal goes through all the phase filters and out the other end. The varying phase shift manifests itself as Vibrato, (i.e. Frequency modulation)

Phasing I.



This is almost the same as vibrato except that part of the original signal is added to the phase shifted signal so that cancellation occurs every  $2\pi$  phase shift.

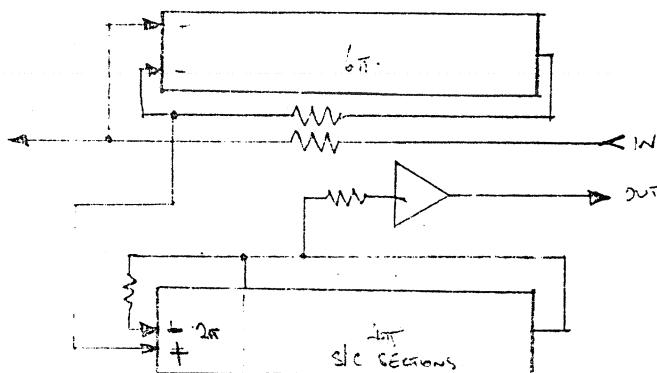
(See wobulator pictures.)



Phasing 2. is the same as phasing I except that the Switch 8 is closed and not switch 9.

WAA. Switches 5,6,7 and II are on.

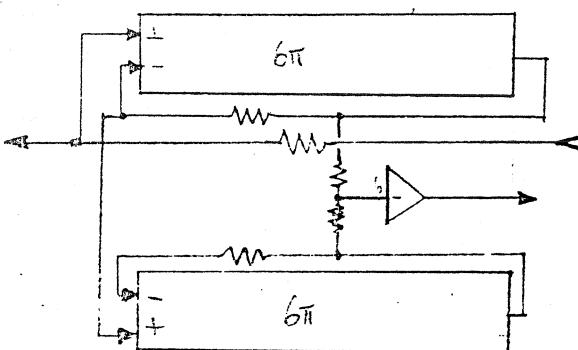
In the three following modes, the audio signal is injected into the bow string drivers.



WAA applies feedback around both the phase filters.  
Because II is closed, the most phase shift that can occur in the lower filter is  $2\pi$ , hence only one peak can be produced.  
(Feedback around the phase filter makes it act as a band pass filter).

### WAW & MEAW.

Switches 5,6,7 and 10 are ON for both these modes.

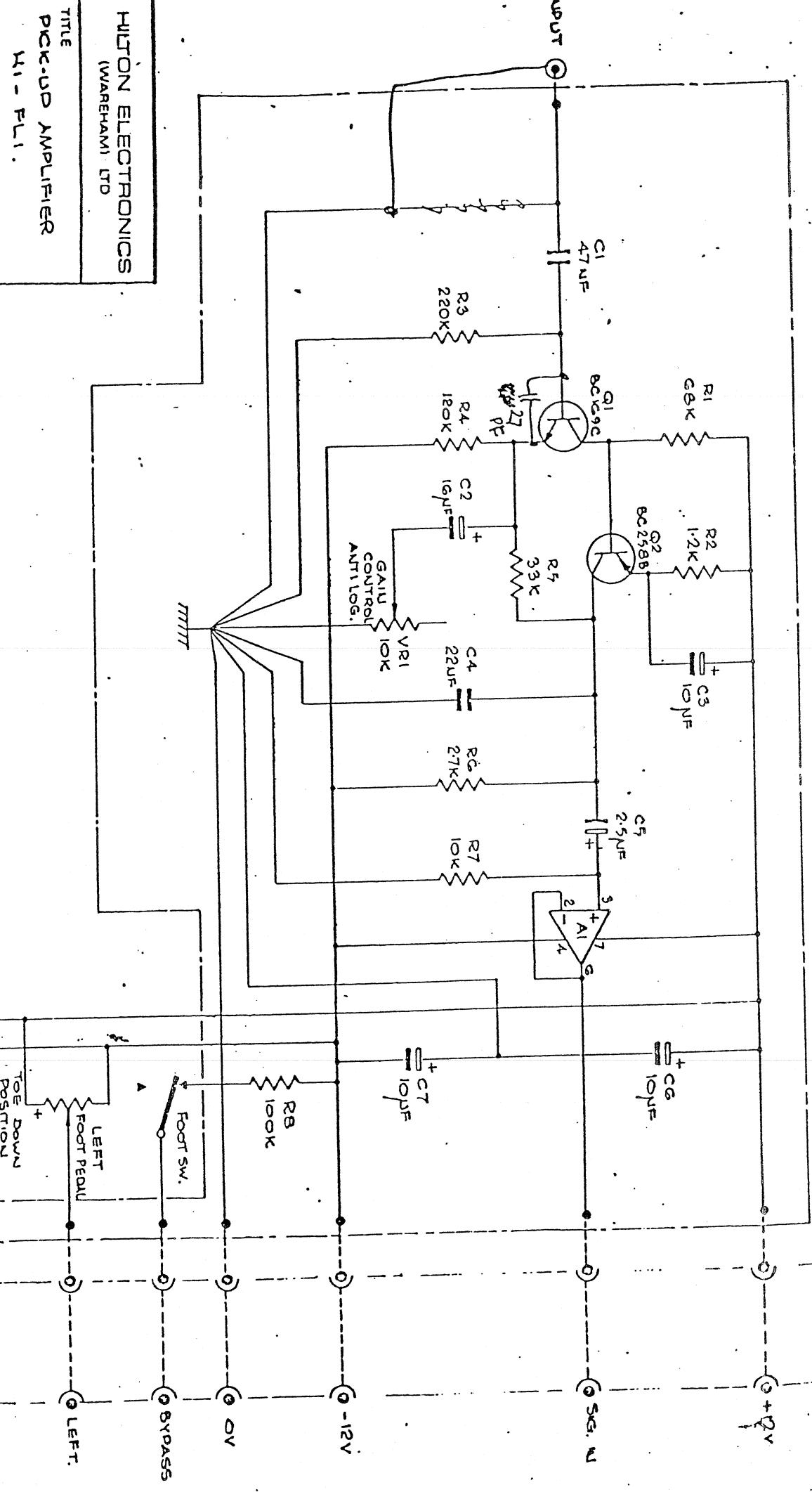


Feedback is applied around the phase filters so that a maximum of  $12\pi$  phase shift is available, or six peaks. In the Waw mode a DC bias is applied to the lower bow string via R42. In the Meaw mode the control of the lower bow string is inverted (AII (I23) Q4).  
DR.

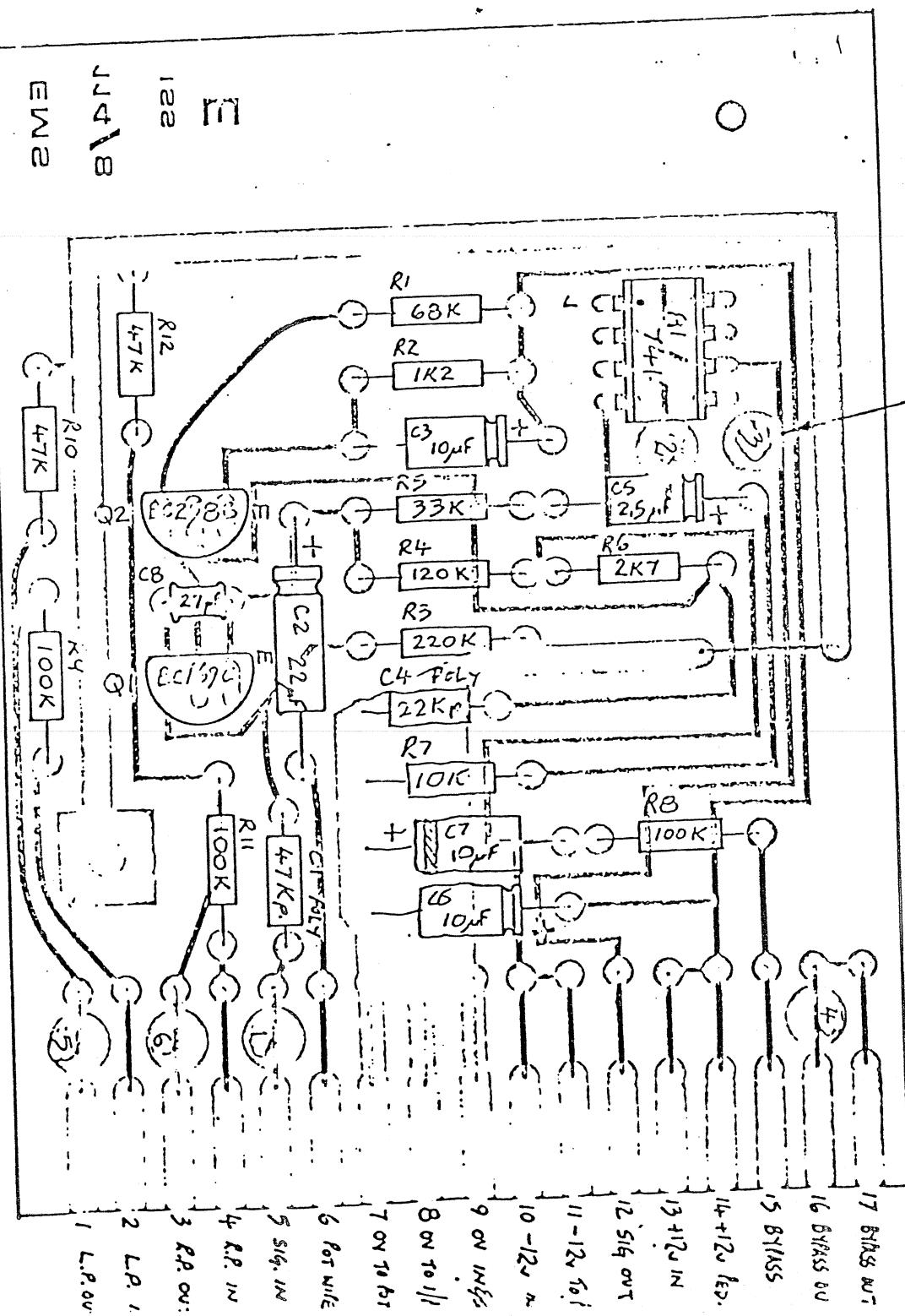
HILTON ELECTRONICS  
 (WAREHAM) LTD

|                   |     |        |      |
|-------------------|-----|--------|------|
| ISSUE             | DRN | DATE   | MATL |
| B.                | Q2. | 1-3773 |      |
| PICK-UP AMPLIFIER |     |        |      |
| W1 - FL1.         |     |        |      |
| FINISH            |     |        |      |

DAG NO 113/8



THESE ARE TEST POINTS



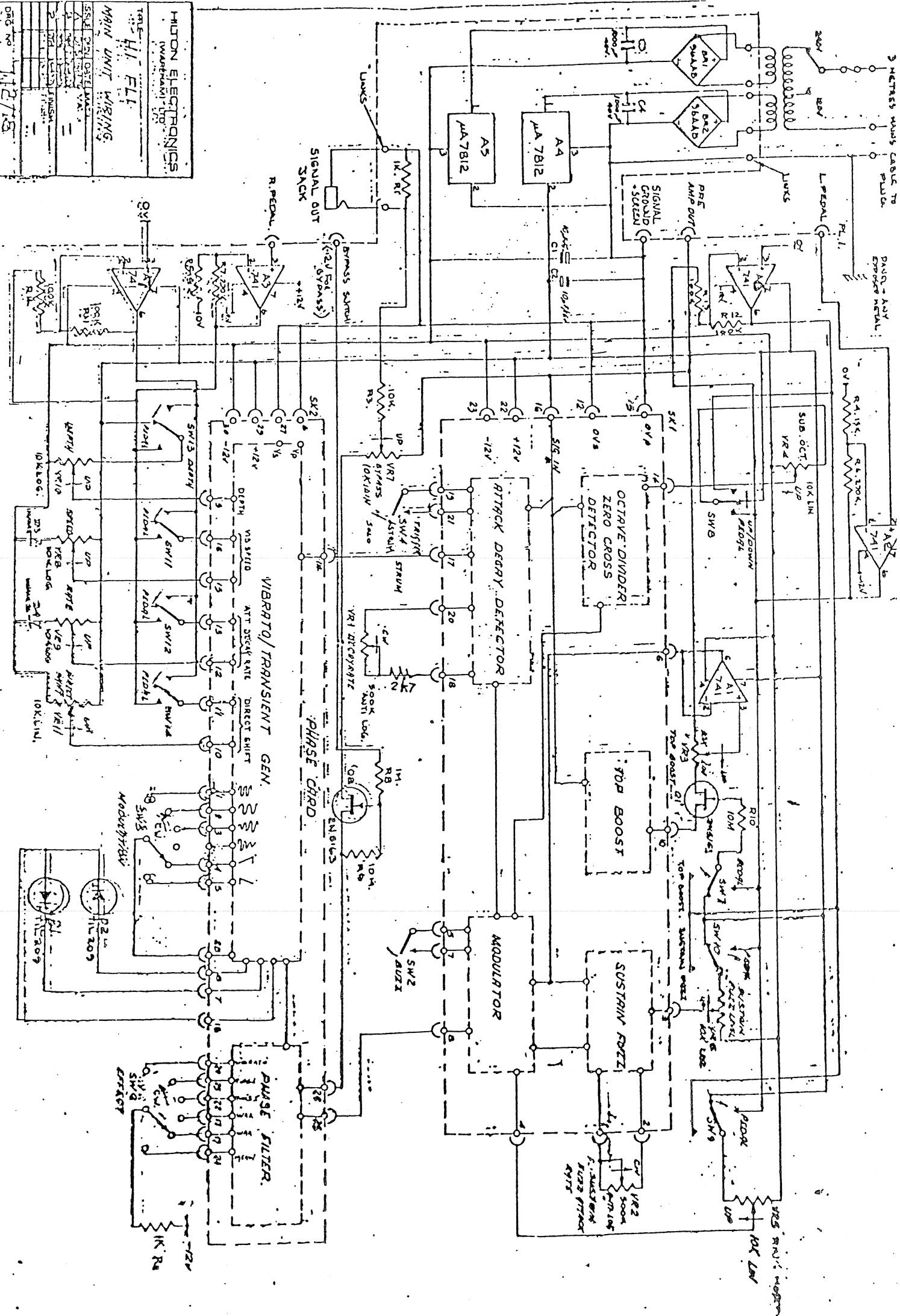
|        |     |         |       |
|--------|-----|---------|-------|
| ISSUE  | DRN | DATE    | MAT'L |
| E      |     | 11-1-74 | -     |
| FINISH |     |         |       |

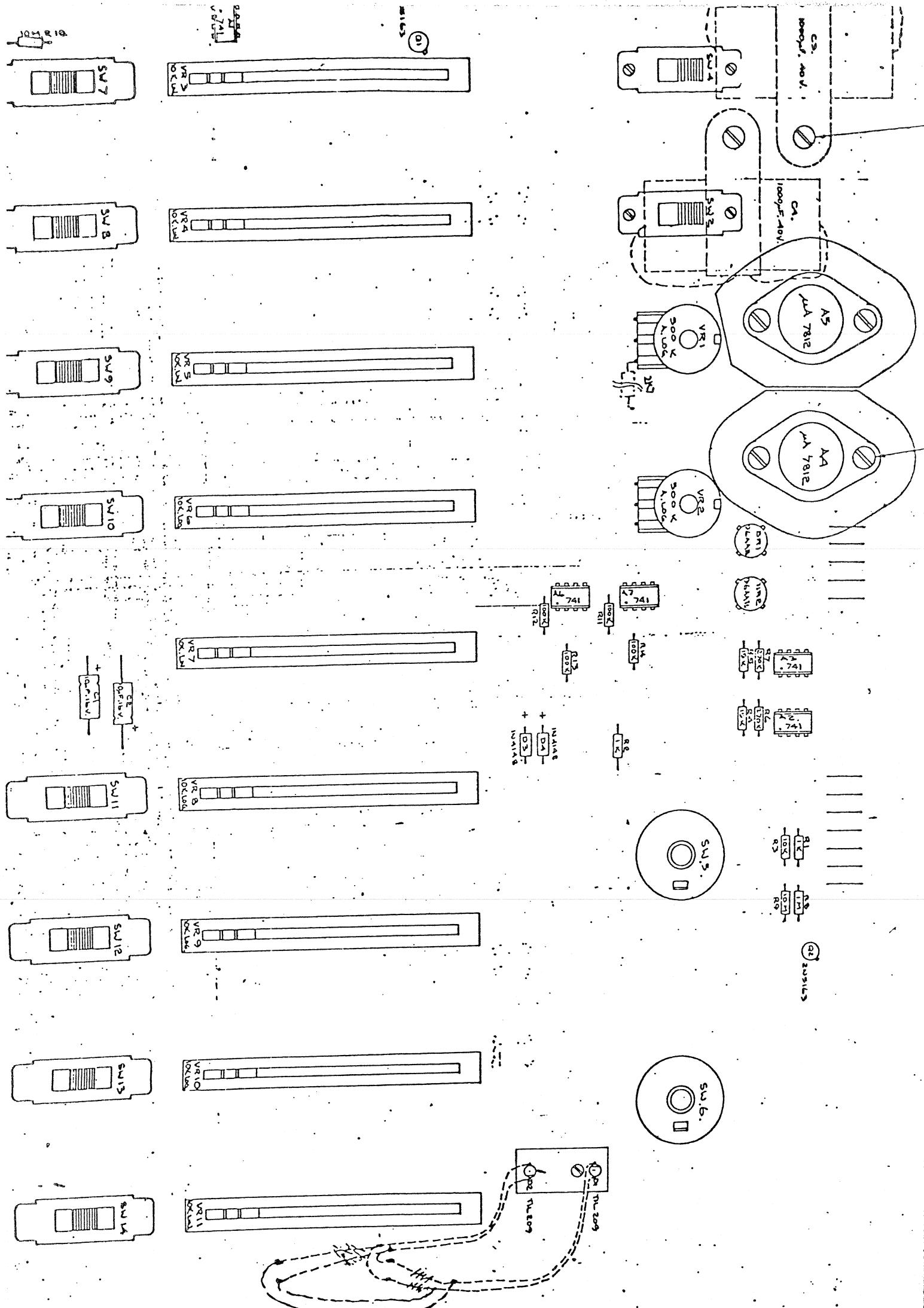
CRG NO 113/8

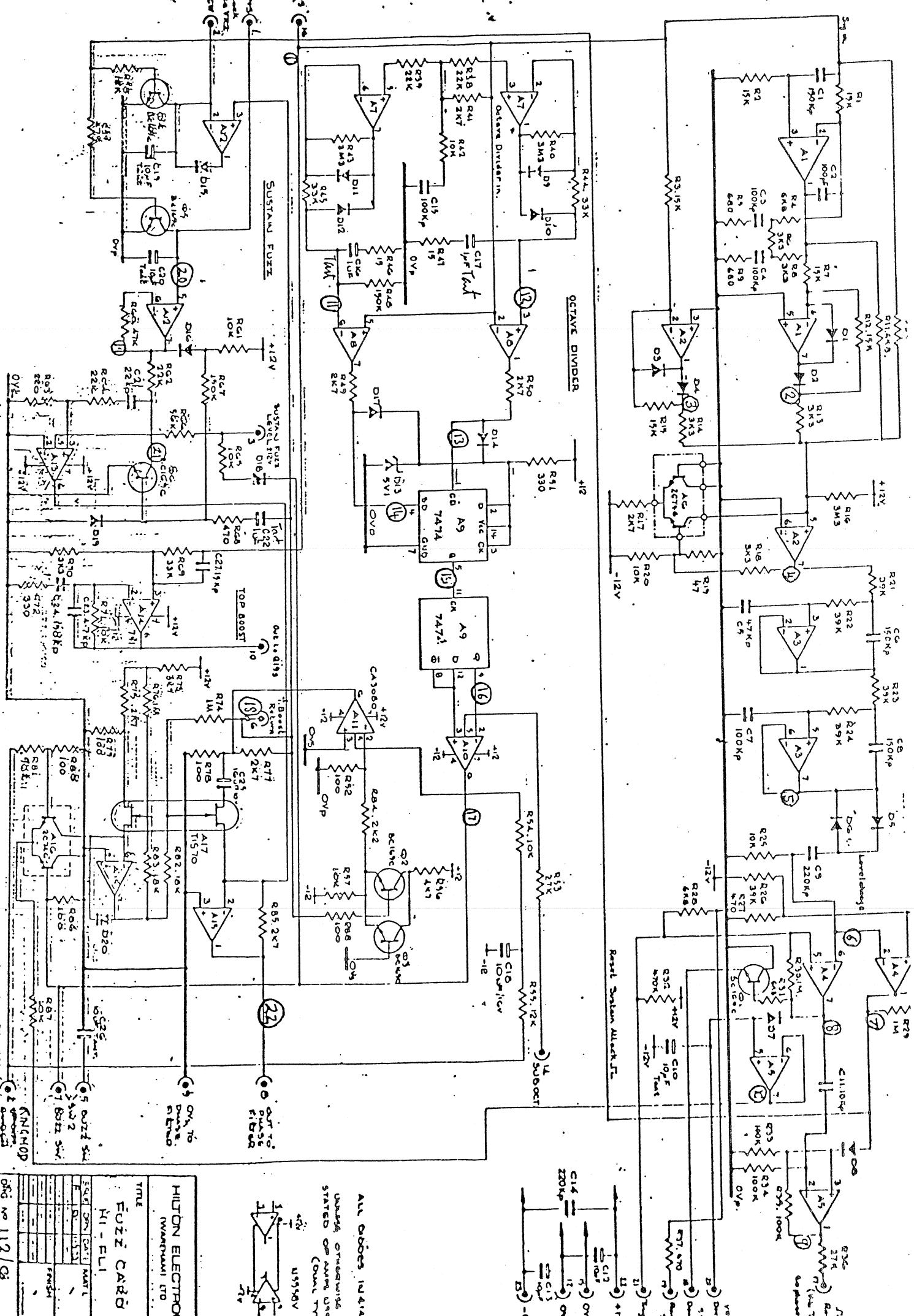
## HILTON ELECTRONICS

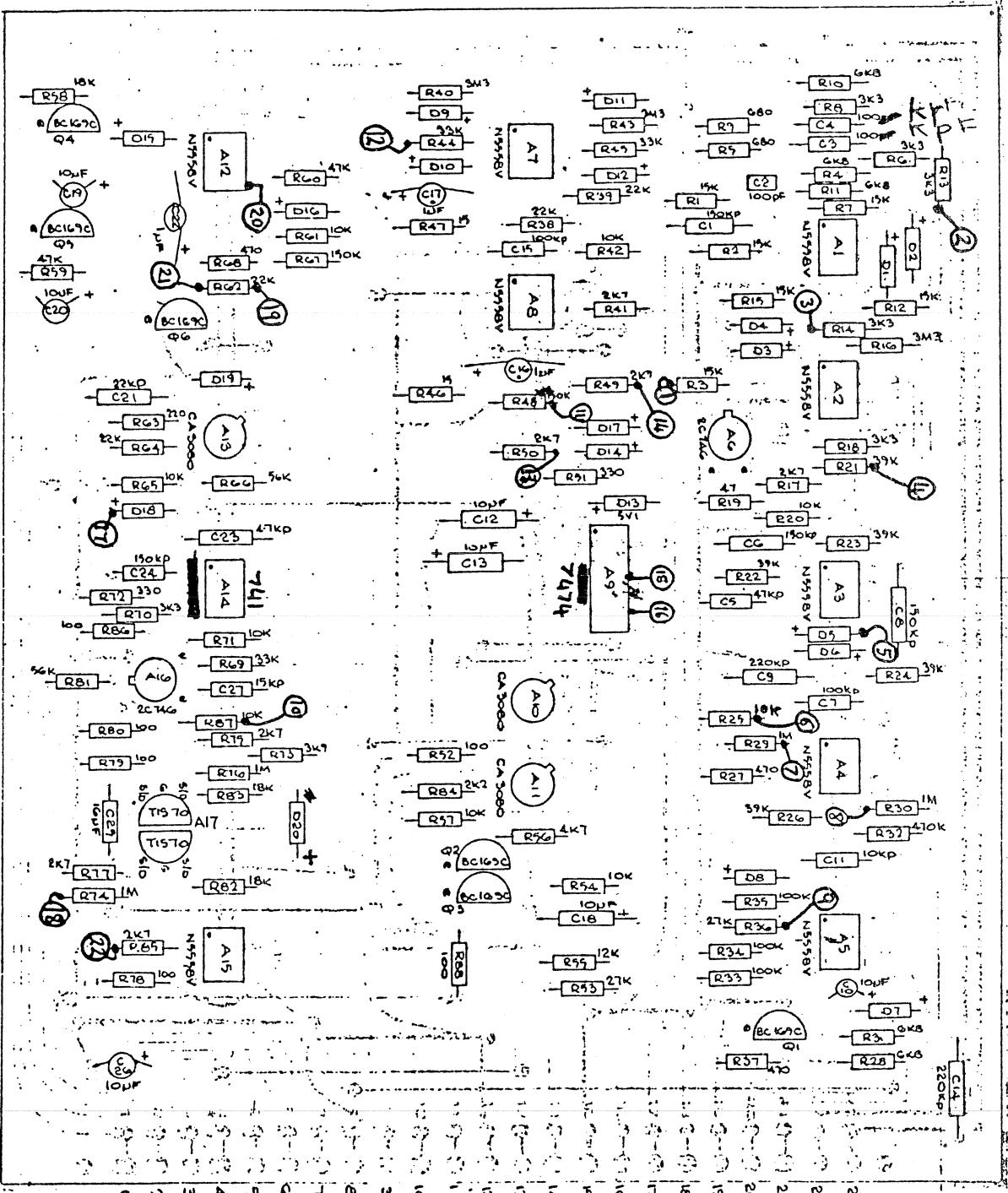
(WAREHAM) LTD

TITLE  
PEDAL AMPLIFIER PCB  
Assembly Drawing



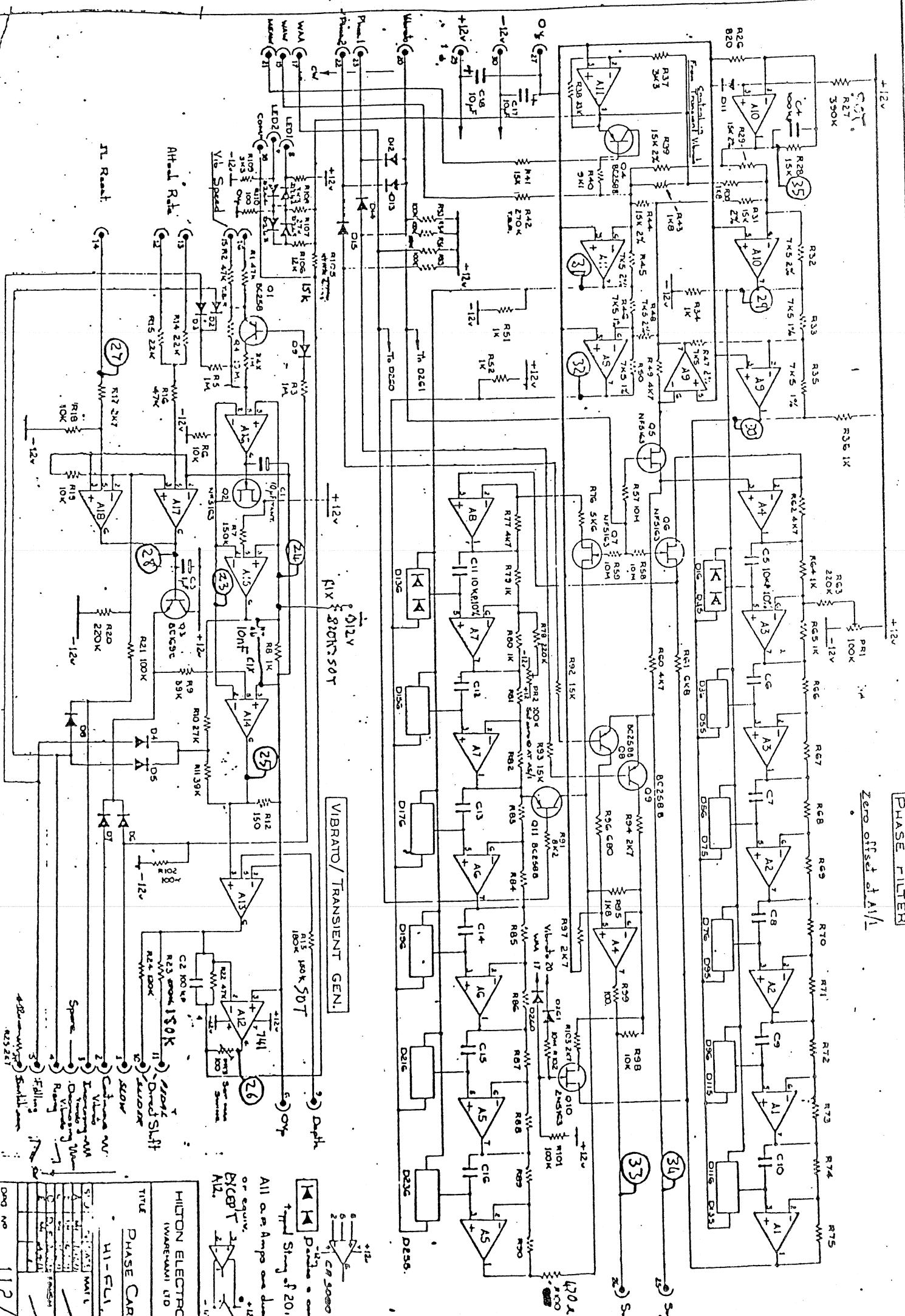


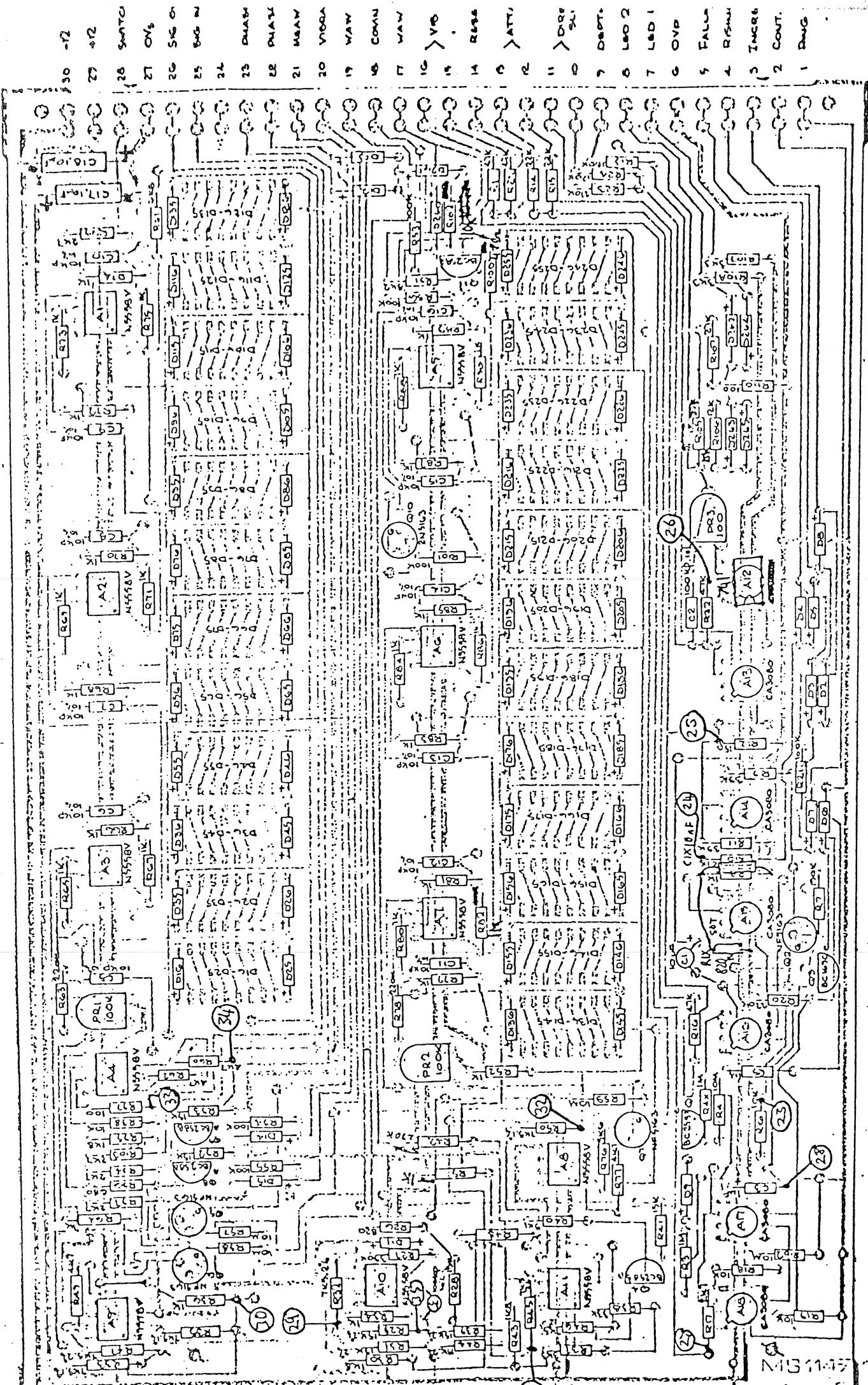




卷之三

Zero offset at 1/1





NOTE:-  
1. All zeroes lead to zero.

TEST SCHEDULE USE EXTRASCOPE  
TIME BASE 20ns/cm

F U Z Z C H R D reference!

①

1 2 3 4 5 6 all depend  
upon the gain of the

Preampl.

④ ⑤ when the signal  
level is increasing

the waveform  
suffers from the effects

of diminishing  
returns.

The sensitivity

switch sw4,  
Norfeld solo, straw  
modifier the HiFlis

"Sensitivity" to  
"start" signals.

Turn down signal  
level until signal

⑧ nearly disappears; ⑦  
switch to straw; then

⑨ will disappear.

⑩

If decay rate  
pot (not test 10)  
is set at too long

a decay, the  
signal size will

become reduced. ⑩

SIGNAL IN. PCB: PIN 16

TONE BURST. 1KHz  
Tone burst generator source  
TO TONE BURST, FIRST.

JUNCTION OF D2, R13

" " D4, R14  
SWAVE RECTIFICATION

A2 PIN 7  
LOGARITHMIC COMPRESSED  
FOLIOWAVE RECTIFIED SIGNAL

A3 PIN 7  
LOGARITHMIC ENVELOPE  
FOLLOWER

A4 PIN 6  
DIFFERENTIATED ENVELOPE

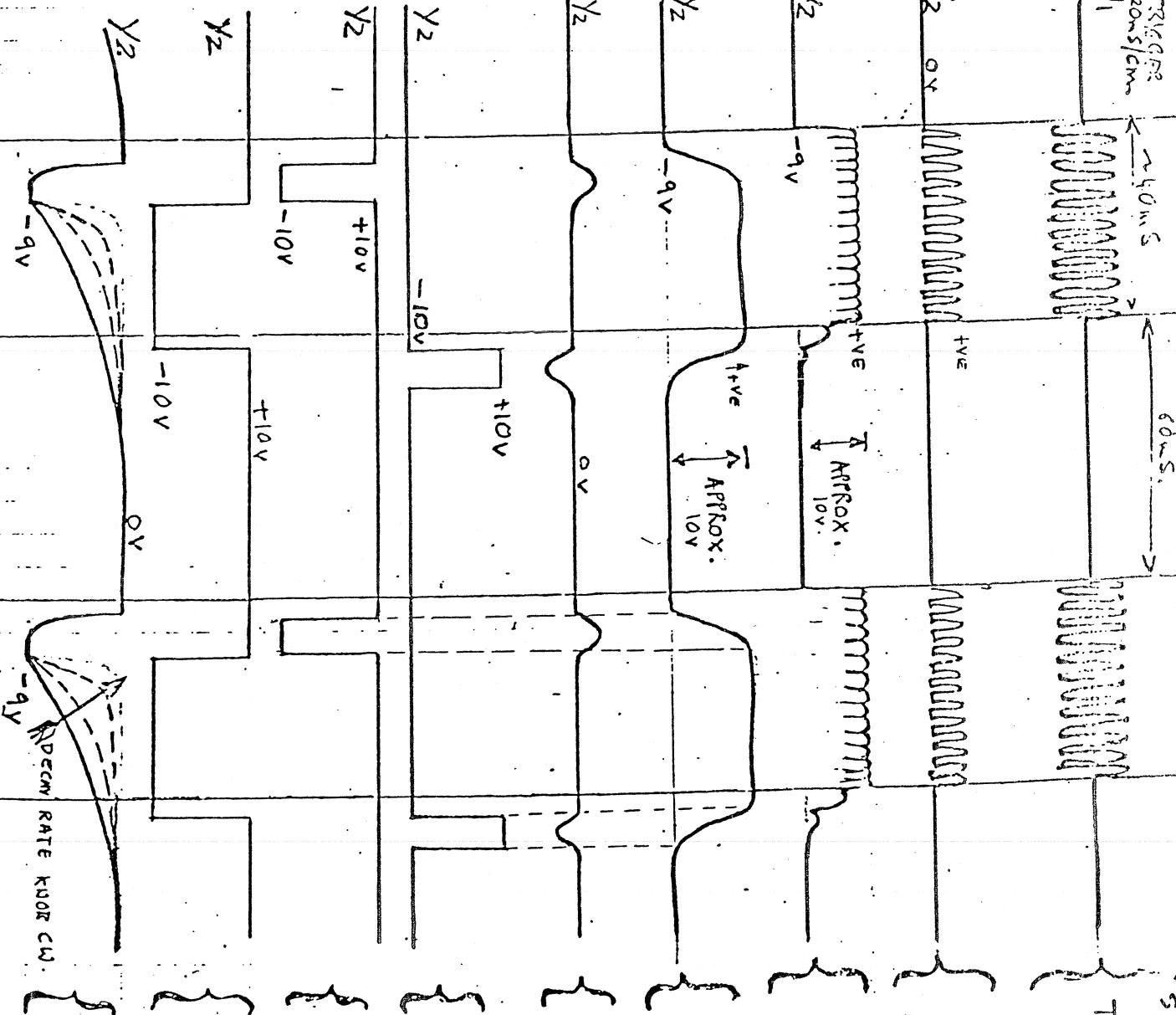
A4 PIN 1  
HYSTERIC STOP PULSE

A4 PIN 7  
HYSTERIC START DETECTOR

A5 PIN 1

HYSTERIC RESET PULSE

A5 PIN 7  
DECAY RATE GENERATOR



A8 PIN 6  
ENVELOPE FOLLOWER  
FIXED TIME CONSTANT

A8 PIN 2  
ENVELOPE FOLLOWER  
FIXED TIME CONSTANT

Tent(7). amplitude  
of signal is  
controlled by suboctave  
slider.

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

(12)

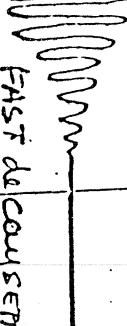
(12)

WITH THE SUSTAIN FADER  
FADE UP AND THE  
ATTACK RATE SET  
AT SLOW, THE OUTPUT  
SHOULD BE VERY SMALL.

(22)  $y_2$



0 v

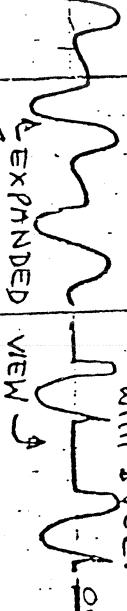


v

HIS PIN!  
ALL FADERS DOWN.  
OUR PUT IS THE UNPROCESSED  
SIGNAL.

AT SLOW, THE OUTPUT  
SHOULD BE VERY SMALL.

(22)  $y_2$



EXPANDED  
VIEW

WITH BUZZ.

(22)  $y_2$



TOO MUCH PREAMP

MIN

$y_2$

SLOW  
ATTACK.

PAST  
ATTACK.

{ SUSTAIN FUZZ FADER  
RING MOD FADE IN

### PHASE CARD.

SWITCH TRIGGER TO '1'  
TRIGGER OFF →

(23)

INTERNAL  
FUNCTION  
GENERATOR.

ON  
OFF

(24)

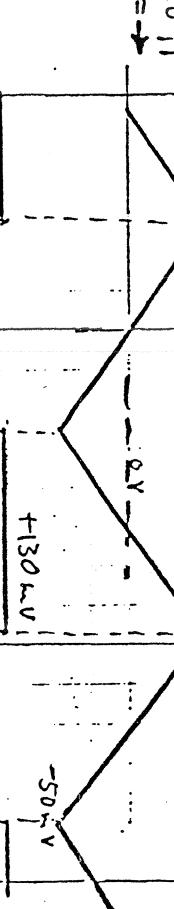
ON  
OFF

(25)

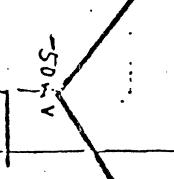
ON  
OFF

(26)

ON  
OFF



+50 mv.



-50 mv.

+120 mv.

ON

OFF

+120 mv.

ON

OFF

+120 mv.

ON

OFF

+120 mv.

{ HIS PIN 2.  
SET TO UNI. FREQUENCY  
TRIANGLE CONTROLLED BY  
MODULATION SPEED SWI  
ALSO, TRY MODE  
A15 PIN 6.

ALL PIN 6 SNIP THE  
SET RESISTOR IF  
WAVEFORM IS ASYMETRIC

{ A12 PINS. The Amplitude  
should directly controlled by  
effect with slider. The Direct  
Slider will directly affect the

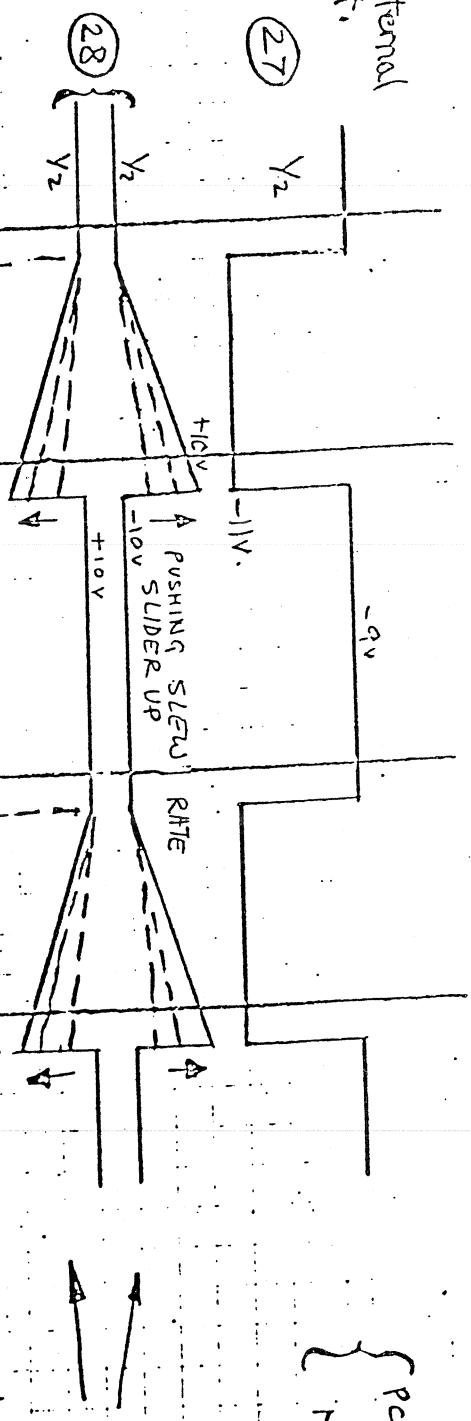
switch back to external trigger. it tones burst.

28 is the ramp modulation.

It is combined

with the sinewave to give up and down waveforms.

{ PCB PIN 14.  
reset pulse.



A12 PING.  
Control modulation set to 0%  
SWITCH Tone burst to slow  
CRO time base to 10ms/c  
EFFECT: Depth to Maximum  
DIRECT SLIDE IN CENTRE  
MODULATION SPEED to MAX.  
SCREW RATE to  $\frac{1}{3}$  UP.

AGAIN. (26) Y<sub>2</sub>  
BACK ON TEST POINT (26) Y<sub>2</sub>  
Y<sub>2</sub> or  
A10, 7  
SWITCH MODULATION TONE  
Modulation speed slider:  
Tone burst set to continue  
trigger off at Y<sub>2</sub>

AS ABOVE, EXCEPT. CENTRE  
MODULATION SET TO 0%  
AS TONE BURST IS SET.

Y<sub>2</sub>  
APPEND SINEWAVES  
-4V  
Average DC = -4V  
diodes shift waveform that DC level clipping may occur.  
Diode bowstring drivers

(29) Y<sub>2</sub>  
Y<sub>2</sub> or  
A10, 7  
SWITCH MODULATION TONE  
Modulation speed slider:  
Tone burst set to continue  
trigger off at Y<sub>2</sub>

AS ABOVE, EXCEPT. CENTRE  
MODULATION SET TO 0%  
AS TONE BURST IS SET.

SIMILARLY FOR  
ALL PIN 7 AND A8 PIN 7  
respectively.  
Note: that when the modulation effect is set at max, the control

(31) (32)  
A9, 11 complementary  
Tone point (29) and independent  
of control modulation setting  
as long as tone burst is set.