

**TABLE 1 THE EVEN-TEMPERED SCALE**

		Octave 1	Octave 2	Octave 3	Octave 4	Octave 5	Octave 6	Octave 7	Octave 8	Octave 9	Octave 10
<b>F</b>	frequency binary code	21.8	43.7	87.3	174.6 011000	349.2 010010	698.5 011110	1396.9 010101	2793.8 011011	5587.7	11175.3
<b>F#</b>	frequency binary code	23.1	46.2	92.5	185 111000	370 110010	740 111110	1480 110101	2960 111011	5920	11839.8
<b>G</b>	frequency binary code	24.5	49	98	196 000100	392 001010	784 000001	1568 001101	3136 000111	6272	12543.9
<b>G#</b>	frequency binary code	26	51.9	103.8	207.7 100100	415.3 101010	830.6 100001	1661.2 101101	3322.4 100111	6645	13289.8
<b>A</b>	frequency binary code	27.5	55	110	220 010100	440 011010	880 010001	1760 011101	3520 010111	7040	14080
<b>A#</b>	frequency binary code	29.1	58.3	116.5	233.1 110100	466.2 111010	932.3 110001	1864.7 111101	3729.3 110111	7458.6	14917.2
<b>B</b>	frequency binary code	30.9	61.7	123.5	246.9 001100	493.9 000110	987.8 001001	1975.5 000011	3951.1 001111	7902.1	15604.3
<b>C</b>	frequency binary code	32.7	65.4	130.8 100000	261.6 101100	523.3 100110	1046.5 101001	2093 100011	4186 101111	8372	16744
<b>C#</b>	frequency binary code	34.6	69.3	138.6 010000	277.2 011100	554.4 010110	1108.7 011001	2217.5 010011	4435 011111	8869.8	17739.7
<b>D</b>	frequency binary code	36.7	73.4	146.8 110000	293.7 111100	587.3 110110	1174.7 111001	2349.3 110011	4698.6 111111	9397.3	18794.5
<b>D#</b>	frequency binary code	38.9	77.8	155.6 001000	311.1 000010	622.3 001110	1244.5 000101	2489.7 001011	4978	9956.1	19912.1
<b>E</b>	frequency binary code	41.2	82.4	164.8 101000	329.6 100010	659.3 101110	1318.5 100101	2637 101011	5274	10548.1	21096.2

- 32 foot
- 16 foot
- 8 foot
- 4 foot
- 2 foot
- 1 foot
- 1/2 foot

Half tone factor is  $12\sqrt[12]{2}$   
 approximately 1.05946309.  
 Scale is based on A = 440Hz.  
 All frequencies in Hz.

**Note 1**

The binary codes are shown with the least significant digit to the left because the LED's on the front panel are in this order. Where a 1 is shown, that LED will be lit.

**Note 2**

The binary code will produce the frequency shown when connected to an oscillator switched to 4 foot.

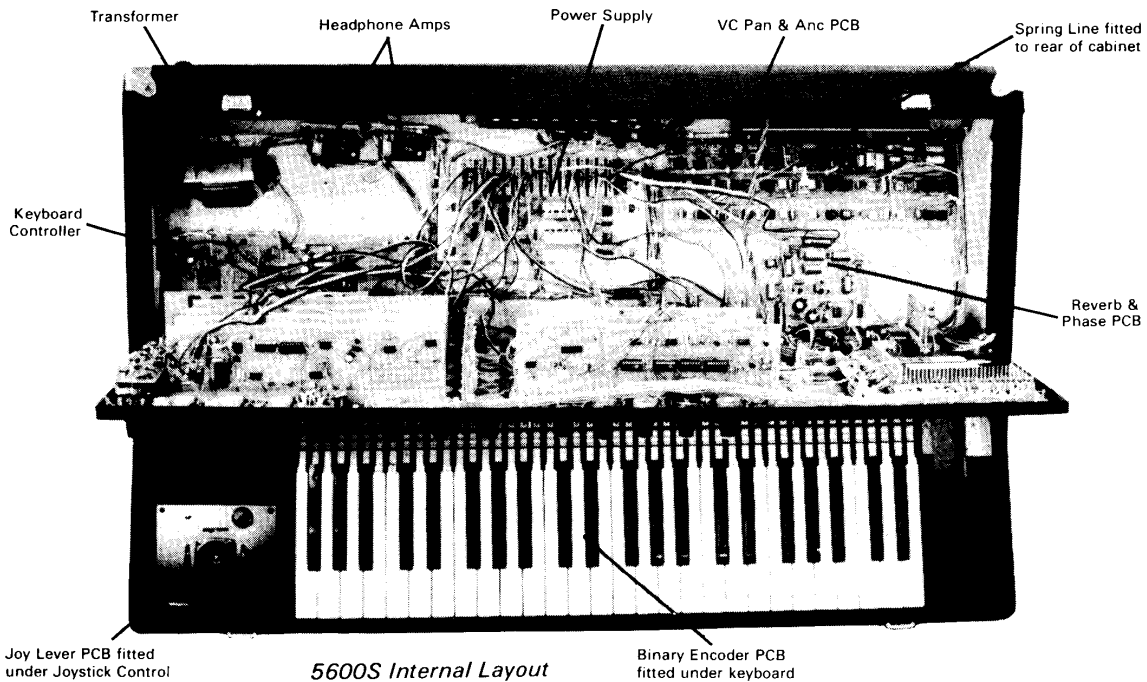
**TABLE 2 WIRING SCHEDULE**

Name of Wire	Osc. 1	Osc. 2	Osc. 3	Osc. 4	Sample & Noise	Kbd Controller	Kbd Encoder	Mixer	Envelope	Trans A	Retrigger	Trans B	VCF 1	VCF 2	VCA 1	VCA 2	Reverb & Phase	Rear Panel	VC Pan & Anc	Joy Lever	Ext. I/P	Patchboard	Type of Wire	
Input Osc. 1	16																					V1	MS	
Sync.	19	18	18	18																			HW	
Shape 1	20	20	20	20																		V5	MS	
Shape 2	21	21	21	21																		V6	MS	
O/P Osc. 1	28							1																HW
O/P Osc. 2		28						2																HW
O/P Osc. 3			28					3																HW
O/P Osc. 4				28				4																HW
I/P Osc. 2		16																					V2	MS
I/P Osc. 3			16																				V3	MS
I/P Osc. 4				16																			V4	MS
O/P Noise					5																		H6	MS
I/P Sample & Hold					10																		V28	MS
O/P Square					13																		H19	MS
O/P Sine					14																		H18	MS
O/P Sample & Hold					15																		H27	MS
Ext. Trig.					18				10	26	26										10		MS	
Foot Sw Control					19																			HW
Foot Sw Control					21																			HW
Foot Sw Control					41																			HW
Glide Control					20	26																		HW
Glide Control					21	25																		HW
Glide Control					22	48																		HW
Glide Control					23	49																		HW
Retrigger					24																			MS
O/P Retrigger					25				5	5													SK11	MS
Sine Modulation					27	21																		MS
I/P from Encoder						1	2																	HW
I/P from Encoder						2,3,4,5	3,4,5,6																	HW
I/P from Encoder						6	7																	HW

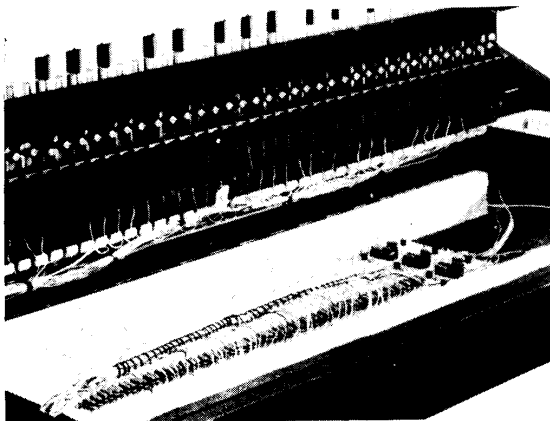


**TABLE 3**

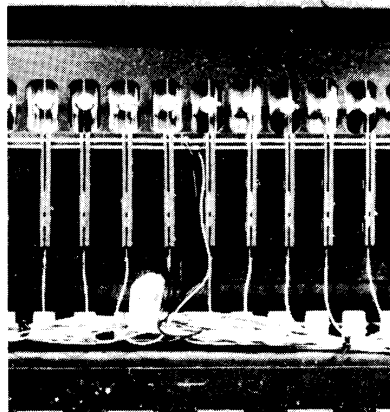
Adjust	RV1	RV2	RV3	RV4	RV5	RV6	RV7
Range	32ft	16ft	8ft	4ft	2ft	1ft	½ft
Frequency	587.3	1174.7	2349.3	4698.6	9397.3	18974	37948



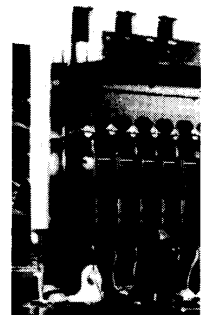
*5600S Internal Layout*



*Binary Encoder fitted under keyboard*



*Contacts fitted to keyboard*



*Fixing of bus bars to contact blocks*

**③ Setting-up Keyboard Controller for 3800**

1. On oscillator 1 set tune to centre, output to square wave and free run to zero. On keyboard controller set glide to off and modulation to zero. Temporarily connect a wire between pin 16 of oscillator 1 and pin 22 of the keyboard controller. Switch oscillator 1 to 4 foot and adjust the keyboard controller tune control so that a frequency counter connected to the oscillator output reads 4698Hz.
2. Remove the wire from pin 22 on the keyboard controller and from pin 16 of oscillator 1. Reconnect the wire from FPC1 to pin 16. Switch input on oscillator 1 to 'key'. Move the wire that comes from note 48 (top E) on the keyboard, from its pin on the binary encoder, to the pin at the far right of

the row, marked J, so that when note 48 is depressed, all six data lines are selected (indicated by all six LED's lighting). Adjust VR12 so that the frequency counter again reads 4698Hz.

3. Move the note 48 wire to pin A on the binary encoder and depress key 48. All LED's should light except number 1. Set VR10 to give 4435Hz.
4. Move the note 48 wire to pin B and depress key 48. All LED's should light except number 2. Set VR9 to give 4186Hz.
5. Move the note 48 wire to pin C and depress key 48. All LED's should light except number 3. Set VR8 to give 3729Hz.
6. Move the note 48 wire to pin D and depress key 48. All LED's should light

except number 4. Set VR7 to give 2960Hz.

7. Depress the top A#. All the LED's should light except number 5. Set VR6 to give 1865Hz.
8. Depress the second F# from the top. All the LED's should light except number 6. Set VR5 to give 740Hz.
9. Now check that each key produces the correct code and frequency as set out in Table 1.
10. Return the note 48 wire to its correct pin on the binary encoder.

**⑦ Setting-up Keyboard Controller for 3800 Continued**

Switch both oscillators to 'key' and listen at output. Set both oscillators to 2 foot, free

run to zero, tune to centre (zero) and waveform to sine wave. Temporarily remove the wire from pin 24 on keyboard controller and strap pin 22 to pin 24. Depress top C and adjust oscillator 2 tune

control to give as near to zero beat as possible.

Switch oscillator 2 to 'key mod' and adjust VR13 in the keyboard controller for zero beat. Remove the strap from pin 22 to pin 24 and reconnect the wire from pin 23

to pin 24. Turn the three modulation controls fully anticlockwise. Adjust VR4 on the keyboard controller for zero beats. Set VR2 to centre position (this preset has no effect in the 3800 synthesiser).

### Oscillator Construction

Assemble the four identical oscillator pcb's. Fit the pins and wire links, then all the other components taking care with the orientation of the polarised components. Solder the components then plug in all the IC's. Note that the bracket mounted components of oscillator 1 are wired slightly differently from those of oscillators 2, 3 and 4.

Prepare the maka shaft for SW1. Remove the  $\frac{3}{16}$ in. nut, washers and rotation stop washer, turn the switch fully clockwise and refit the stop washer in position 4. This restricts rotation to eight positions. Then fit a 1 pole 12 way wafer as shown in Figs. 12 and 13 and connect capacitors C5 to C11 keeping the leads as short as possible. Now add the second 1 pole 12 way wafer. Assemble the preset mounting pcb as per Fig. 10 so that the pins protrude from the track side of the pcb. Solder all components then slide the pcb over the maka shaft. The pins should line up with the tags on the second wafer. Put the 8BA nuts on the studs to hold the board in position then solder the pins to the tags. The switch may now be bolted to the bracket. Fix the other components to the bracket and bend back the two contacts on SW2 shown in Fig. 12. Fix the pcb to the bracket.

Wire the mounting bracket components to the pcb as shown in Fig. 12 for oscillator 1 and Fig. 13 for oscillators 2, 3 and 4.

### Oscillator — How It Works

The basic waveform generated by the oscillator is triangular. All other waveforms are generated by modification of this basic waveform.

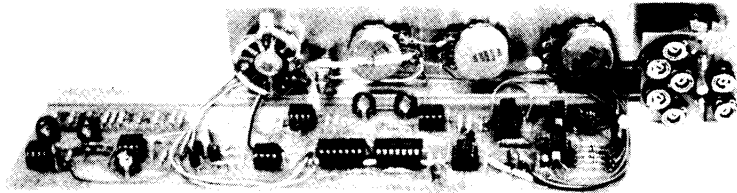
The input voltage, normally between 0 and +5V, is amplified in IC1. The tune control RV10, controls the gain and can vary the output by a 2 to 1 ratio. With this control set at mid position, the output of IC1 is about equal to, but in antiphase with, the input voltage. That is, the stage has a gain of -1. Individual potentiometers on each switch position allow the ranges to be adjusted an exact number of octaves apart. Control RV9 adjusts the offset of IC7 and RV8 is the free run control. The output of IC1 is therefore normally in the range 0 to -5V, but can range up to -12V if the 'modulated' output from the keyboard is being used.

The output of IC1 is inverted by IC2 to provide an identical voltage of opposite polarity, the offset of IC2 being adjusted by RV11.

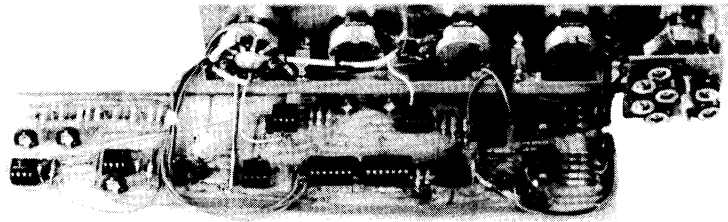
IC3 is a solid state, dual double throw switch. If the input at A is high (+7V) IC3/1 will be on and IC3/2 will be off and vice versa if the input at A is low (-7V). The on resistance is between 200 and 500 $\Omega$  and the off resistance is around 10<sup>12</sup> $\Omega$ . Diodes D1 and D2 protect the switch input against excessive voltages.

An integrator is constructed with IC4 and an integrating capacitor selected by SW1. If IC3/1 is on, the output of the integrator will be a linearly increasing voltage. Hence if 3/1, 2 are switched alternately on and off the output of IC4 will be a triangular waveform.

Transistor array IC5 when connected to Q1 and IC6 acts as a Schmitt trigger, where



Oscillator 1



Oscillator 2,3,4

IC6 is simply a CMOS inverter with IC6/1 and IC6/2 connected to +7V and -7V and IC6/3 connected to 0 and +5V. The output of IC6/3 provides feedback to the comparator section of the Schmitt trigger, and being a 0 to +5V level, makes the Schmitt points 0 and +5V. The output of IC6/1 controls the CMOS switches IC3/1 and IC3/2 which hence derive a triangular wave from the integrator of 0 to +5V amplitude.

To generate a square wave of variable mark/space ratio, the triangular wave is simply compared to a dc level as set by the shape potentiometer (RV17) by IC11, the output of which is buffered by Q2 and Q3 which ensure that the output has the correct levels of 0 and +5V.

The mark/space ratio of the square waveform may be altered by a voltage applied through R49 to pin 3 of IC11 and SW4 may be switched to one of two lines from the patchboard.

The sawtooth waveform is generated by inverting the triangular waveform in IC7 and level shifting to produce a waveform 180° out of phase having 0 to -5V levels. The output of these two waveforms is selected in turn by IC3/3 and IC3/4. These switches are controlled by either IC6/1 or IC6/2 dependent on the position of SW2 (reverse or normal sawtooth). The correct level and amplitude of the sawtooth is maintained by IC8.

The sinewave output is generated by amplifying the triangular wave in IC9 to about 15V peak-to-peak, symmetrically about 0V. This signal is then clipped by the diode-resistor matrix to approximate a sinewave. This is then level shifted and amplitude controlled by IC10.

Oscillator 1 has R47 and C25, but not D9 and SW3 and oscillators 2 to 4 have D9 and SW3, but not R47 and C25. If SW3 is switched to 'sync', the pulses from oscillator 1 pin 19 which are at the fundamental frequency of oscillator 1 pass through D9 and retrigger IC6/1 thus forcing oscillator 2 to have an overall repetition rate equivalent to oscillator 1.

### 2 Setting-up Oscillators for 5600S

This procedure will require the use of an oscilloscope and a digital frequency counter. Start with oscillator 1.

1. Ensure there are no plugs in the patchboard.
2. Select the 8 foot range, turn the free run control fully clockwise and the tune control to mid-point.
3. Select triangular waveform and observe the output waveform. This should be as per Fig. 58a (on page 40) and go from 0 to +5V.
4. Select sawtooth waveform and observe the output. It will probably be similar to either Fig. 58b or 58c. Adjust RV12 to obtain a straight line as in Fig. 58d.
5. Adjust RV13 to set the lowest edge of the waveform at zero volts.
6. Select the  $\frac{1}{2}$  foot range and turn the free run control anti-clockwise until the oscillator is just running. The waveform will appear as in Fig. 58e or 58f. Adjust RV11 to obtain a straight line as in Fig. 58d.
7. Adjust RV9 so that the oscillator is just running when the free run control is at zero.
8. Select 32 foot, maximum free run and sinewave output. Adjust RV14 for best waveform as per Fig. 58h. Incorrect waveforms are shown in Fig. 58g and 58j.
9. Adjust RV15 such that the waveform is 5V peak-to-peak.
10. Adjust RV16 such that the lowest edge of the waveform is at 0V.
11. Check that all waveforms are selectable by SW2 and that the squarewave output is correct as per Fig. 58k.
12. Connect pin 16 of oscillator to +5V supply, set tune control to mid-point and free run control to zero. Adjust RV1 to RV7 to obtain the frequency shown in Table 3 for each range. Remove +5V from pin 16.
13. With sync off set up oscillators 2, 3 and 4 as above.

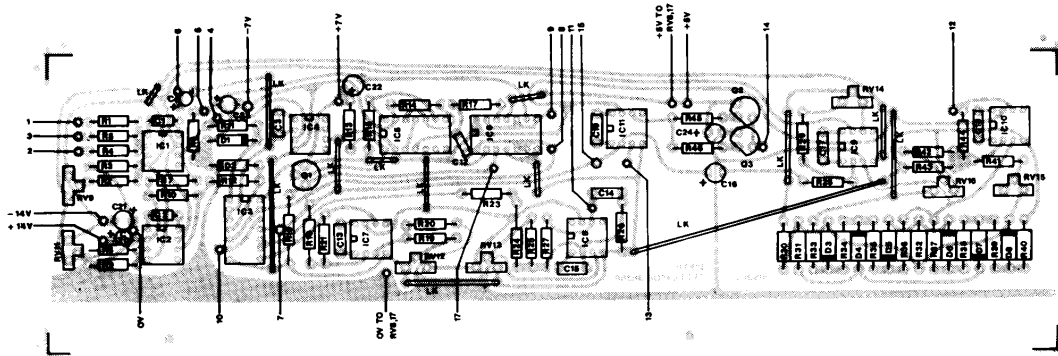


Fig. 9 Component Overlay for Oscillator

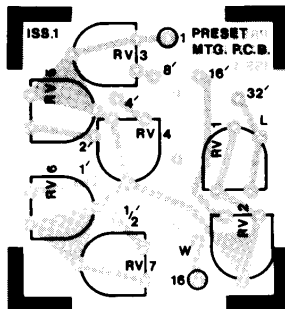


Fig. 10 Component Overlay for Preset Mounting pcb

**General Note: Tuning by Zero-Beat Method for 5600S**

If two sine waves of approximately equal volume, but different frequencies, are listened to together, the ear will hear a third frequency equal to the difference between the two actual frequencies. For instance, if the two frequencies were, say, 1000Hz and 1100Hz then as well as these two frequencies a third frequency of 100Hz will be heard. If the upper frequency (1100Hz) were now gradually reduced, as this frequency approached the lower frequency the third frequency (100Hz) would reduce in frequency, disappearing as such and reappearing as a pulsating volume change in the basic frequencies. As the frequencies get very close the volume rise and fall will become slower and slower until when the two frequencies are the same, the volume will remain constant. The ear is very sensitive to these changes and thus this 'zero-beat' method is a very simple and accurate method of tuning.

**Setting-up Oscillator 2, 3 & 4 for 5600S Continued**

14. Patch 'key direct' to oscillator 1 and oscillator 2 with their tune controls at zero, free run fully anticlockwise, sync off, wave form at sine wave and range at 2 foot. Mix oscillator 1 with oscillator 2 in mixer 1, patch mixer 1 to output and listen. Depress top C and adjust RV5 on oscillator 2 for zero beats. Depress lowest G and adjust RV9 on oscillator 2 for zero beat. Depress top C and readjust RV5 for zero beats. It may be necessary to repeat the procedure several times to obtain zero beat at both ends of the keyboard. Repeat above for oscillators 3 and 4.

15. Depress top C and set oscillators 1 and 2 to 32 foot range and adjust RV1 on oscillator 2 for zero beats. Set both oscillators in turn to the ranges shown below and adjust the preset shown, on oscillator 2 for zero beats.

16 foot range: adjust RV2  
 8 foot range: adjust RV3  
 4 foot range: adjust RV4  
 1 foot range: adjust RV6  
 1/2 foot range: adjust RV7  
 When setting up 1 foot and 1/2 foot ranges it will be necessary to depress a lower note so that the beat is clearly audible. Repeat above for oscillators 3 and 4.

**Parts List for Oscillator (4 required for 5600S; 2 required for 3800)**

R1,6,28	Min Res 56k
R2,4,5,19,25,	41,45,46,49 Min Res 100k
R3,9,17	Min Res 1k
R7,10,11,12,	18,21 Oxide 33k
R8,22,42	Min Res 1M
R13	Min Res 680Ω
R14	Min Res 470Ω
R15,31	Min Res 8k2
R16,23,24,27,	30 Min Res 10k
R20	Min Res 4k7
R26,32	Min Res 27k
R29	Min Res 120k
R33,40	Min Res 270Ω
R34,39	Min Res 56Ω
R35,38	Min Res 120Ω
R36,37	Min Res 220Ω
R43	Min Res 180k
R44	Min Res 68k
R47 (required	for oscillator
1 only)	Min Res 100k
R48	Min Res 47k
RV1,2,3,4,5,6,7	Hor S-Min Preset 47k
RV9,11,12,13,	15,16 Vert S-Min Preset 47k
RV8	Pot Log 22k
RV10	Pot Lin 47k
RV14	Vert S-Min Preset 100k
RV17	Pot Lin 22k

C1,2,13,17,18	Ceramic 33pF
C3,15	Ceramic 150pF
C4	Tant 1μF 35V
C5,6	Carbonate 0.047μF
C7	Carbonate 0.022μF
C8	Carbonate 0.012μF
C9	Carbonate 0.0047μF
C10	Carbonate 0.0022μF
C11	Carbonate 0.0015μF
C12	Ceramic 100pF
C14	Ceramic 10pF
C16	PC Elect 100μF 10V
C19	Ceramic 3.3pF
C20,21,22,23,	24 Tant 10μF 25V
C25 (required	for oscillator
1 only)	Ceramic 220pF

Q1,2	MPS3638A
Q3	PN3643
IC1,2,4,7,8,9,	10,11 LM301A
IC3	4416BE
IC5	CA3046
IC6	4007UBE
D1 to 8	1N4148
D9 (required	for oscillators
2,3 and 4	only)
SW1	1N4148
	Maka Shaft with two
	Maka Wafer 1p 12w
	Maka Shaft with one
	Maka Wafer 2p 6w MB
SW2	
SW3 (required	for oscillators
2,3 and 4	only)
SW4	Sub Min Toggle A
	Sub Min Toggle B

**Also required**

- 1 Oscillator PCB
- 1 Preset Mtg PCB
- 1 Oscillator Mtg Bkt
- 5 15mm Collet Knob Black
- 2 15mm Collet Indicator
- 3 15mm Collet Nut Cover
- 3 DIL Skt 14-pin
- 8 DIL Skt 8-pin
- 1 Wafercon Socket 8-way
- 8 Wafercon Terminals
- 34 Veropin 2141
- 2 Bolt 6BA 1/4in.
- 2 Nut 6BA
- 2 Shake 6BA

**Also required for 5600S only**

- 5 15mm Collet Cap Red (for osc. 1 only)
- 5 15mm Collet Cap Black (for osc. 2 only)
- 5 15mm Collet Cap Yellow (for osc. 3 only)
- 5 15mm Collet Cap Green (for osc. 4 only)

**Also required for 3800 only**

- 5 15mm Collet Cap Blue (for osc. 1 only)
- 5 15mm Collet Cap Green (for osc. 2 only)

**Setting-up Oscillators for 3800**

This procedure will require the use of an oscilloscope and a digital frequency counter. Start with oscillator 1.

1. Remove the wire from pin 16 on the preset mounting board.
2. Select the 8 foot range, turn the free run control fully clockwise and the tune control to mid-point.
3. Select triangular waveform and observe the output waveform by connecting the 'scope to point 28 on oscillator 1 (see Fig. 12). This should be as per Fig. 58a (on page 40) and go from 0 to +5V.
4. Select sawtooth waveform and observe the output. It will probably be similar to either Fig. 58b or Fig. 58c. Adjust RV12 to obtain a straight line as in Fig. 58d.

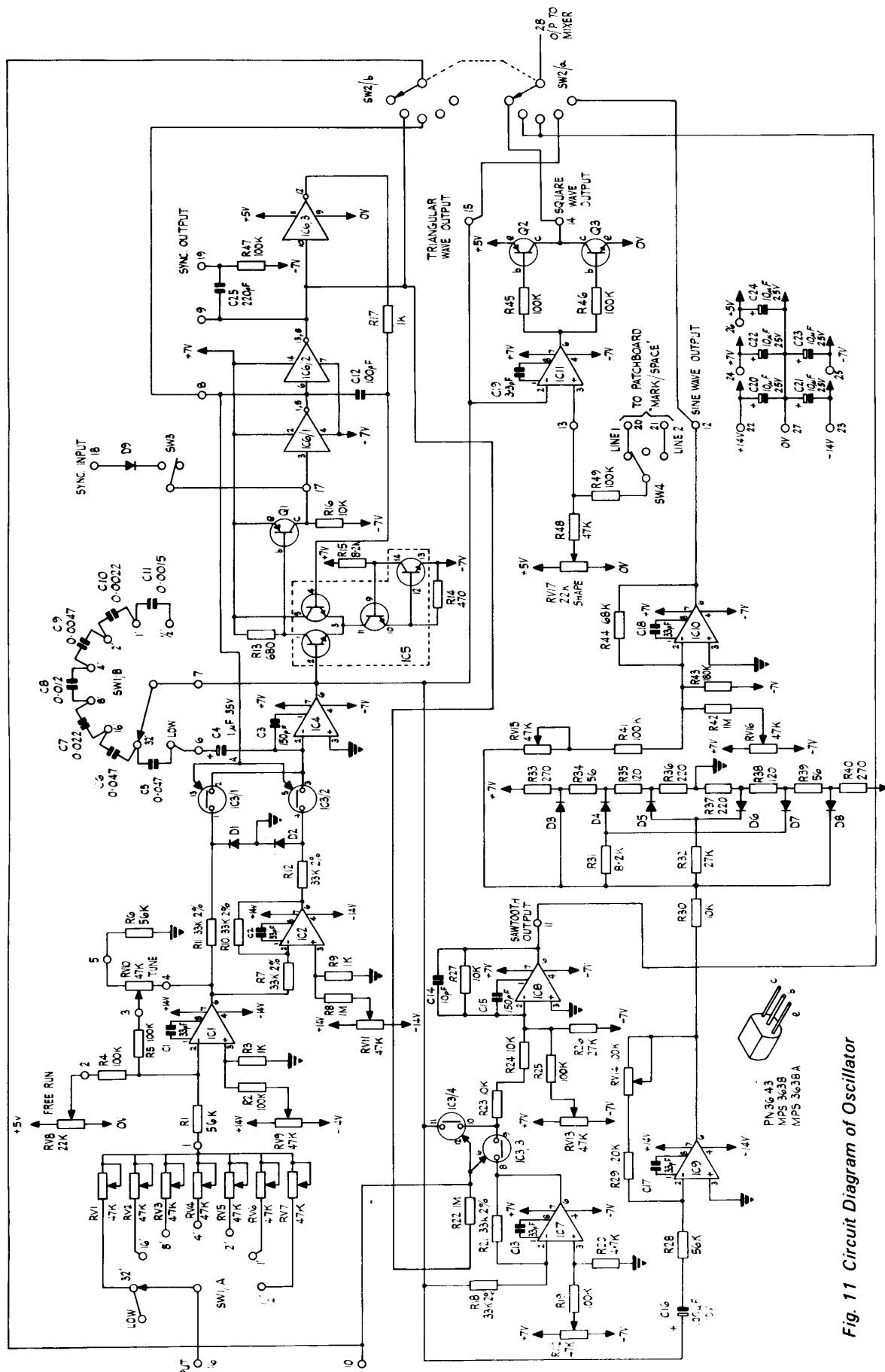


Fig. 11 Circuit Diagram of Oscillator

5. Adjust RV13 to set the lowest edge of the waveform at zero volts.
6. Select the 1/2 foot range and turn the free run control anticlockwise until the oscillator is just running. The waveform will appear as in Fig. 58e or Fig. 58f. Adjust RV11 to obtain a straight line as in Fig. 58d.
7. Adjust RV9 so that the oscillator is just running when the free run control is at zero.
8. Select 32 foot, maximum free run and sine wave output. Adjust RV14 for best waveform as per Fig. 58h. Incorrect waveforms are shown in Fig. 58g and Fig. 58j.
9. Adjust RV15 such that the waveform is 5V peak-to-peak.
10. Adjust RV16 such that the lowest edge of the waveform is at 0V.
11. Check that all waveforms are selectable by SW2 and that the squarewave output is correct as per Fig. 58k.
12. Connect pin 16 of oscillator to +5V supply, set tune control to mid-point and free run control to zero. Adjust RV1 to RV7 to obtain the frequency shown in Table 3 for each range. Remove +5V from pin 16.
13. With sync. off set up oscillator 2 as above.

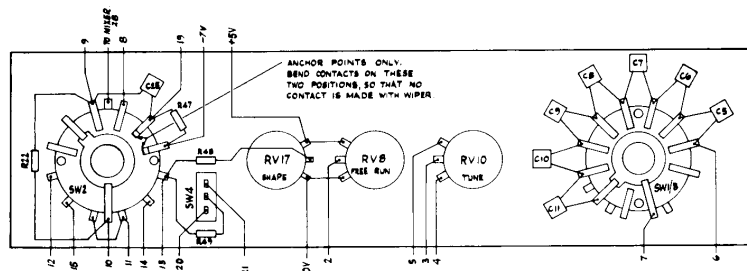


Fig. 12 Front Panel Wiring for Oscillator 1

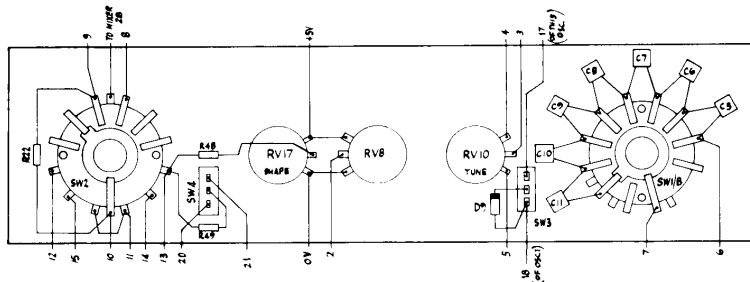


Fig. 13 Front Panel Wiring for Oscillators 2, 3 & 4

**⑤ General Note: Tuning by Zero-Beat Method for 3800**

If two sine waves of approximately equal volume, but different frequencies, are listened to together, the ear will hear a third frequency equal to the difference between the two actual frequencies. For instance if the two frequencies were, say, 1000Hz and 1100Hz then as well as these two frequencies a third frequency of 100Hz will be heard. If the upper frequency (1100Hz) were now gradually reduced, as this frequency approached the lower frequency the third frequency (100Hz) would reduce in frequency, disappearing as such and reappearing as a pulsating volume change in the basic frequencies.

As the frequencies get very close the volume rise and fall will become slower

and slower until when the two frequencies are the same, the volume will remain constant. The ear is very sensitive to these changes and thus this 'zero-beat' method is a very simple and accurate method of tuning.

**⑥ Setting-up Oscillator 2 for 3800 Continued**

14. Switch oscillators 1 and 2 to 'key' with tune controls at zero, free run fully anticlockwise, sync. off, waveform at sine wave, range at 2 foot and switch to output. Depress top C and adjust RV5 on oscillator 2 for zero beats. Depress lowest G and adjust RV9 on oscillator 2 for zero. Depress top C and readjust RV5 for zero

beats. It may be necessary to repeat the procedure several times to obtain zero beat at both ends of the keyboard.

15. Depress top C and set oscillators 1 and 2 to 32 foot range and adjust RV1 on oscillator 2 for zero beats. Set both oscillators in turn to the ranges shown below and adjust the preset shown, on oscillator 2 for zero beats.

- 16 foot range: adjust RV2
- 8 foot range: adjust RV3
- 4 foot range: adjust RV4
- 1 foot range: adjust RV6
- 1/2 foot range: adjust RV7

When setting up 1 foot and 1/2 foot ranges it will be necessary to depress a lower note so that the beat is clearly audible.

**Mixer Construction**

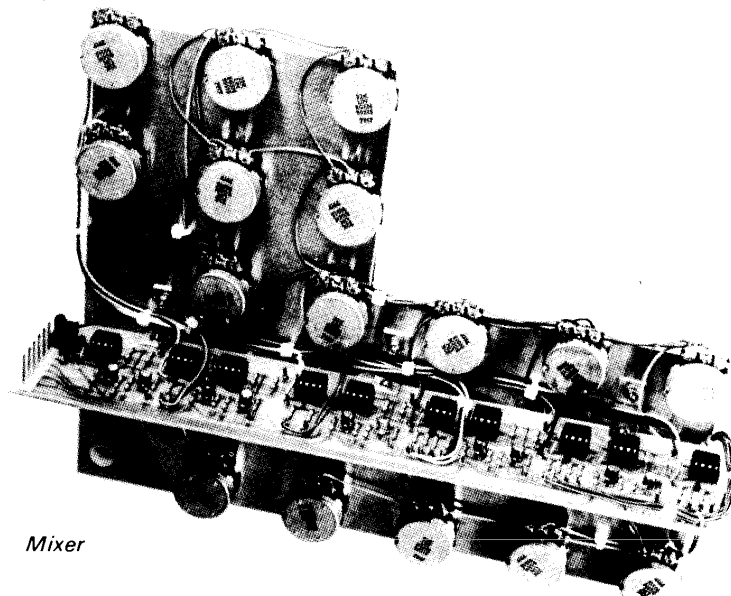
Assemble the pcb as shown in the component overlay Fig. 14. Insert the pins then all the other components taking care with the orientation of the polarised components. Finally plug the IC's into their holders. Bolt all the potentiometers to the mixer chassis and interwire them as shown in Fig. 16. Mount the pcb to the chassis using the mounting brackets and wire the pcb to the potentiometers. Mount the chassis to the front panel by means of the pot bushes which pass through the 10mm holes.

The four oscillators may now be mounted on the front panel in the same way. Ensure that the oscillator wired as 'oscillator 1' is in the top position.

The circuit diagram of the mixer Fig. 15 shows mixer 1 only. Mixers 2 and 3 are identical except that the component designations are numbered as mixer 1 plus 20 (i.e. R1 becomes R21 etc.) for mixer 2 and as mixer 1 plus 40 (i.e. R1 becomes R41 etc.) for mixer 3. Mixers 4 and 5 are also the same, but have only two inputs each. Mixer 4 components are designated R61 etc. and mixer 5, R81 etc.

**Mixer — How It Works**

A conventional mixer is used where IC1 adds together the input currents. Individual



Mixer

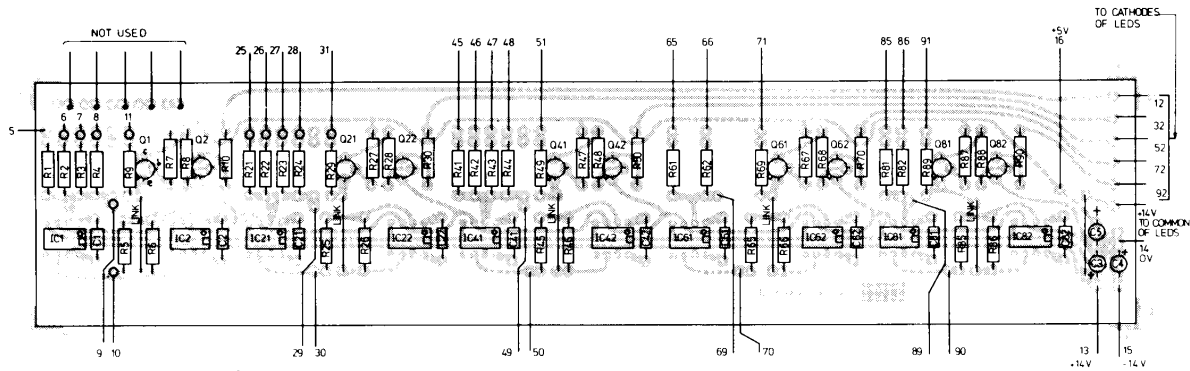


Fig. 14 Component Overlay for Mixer

gain control is provided by RV1 to 4 and overall gain by RV5. Since the output of this type of mixer is inverted an additional IC is provided to reinvert the signal.

Overload indication is provided by Q1, Q2 and LED 1. If the output voltage exceeds 5.6V, Q1 becomes forward biased and Q1 and Q2 turn on illuminating the LED indicator. The base resistor R8 prevents damage to Q1 should the output swing negative. The overload point as indicated by the LED is chosen to protect the inputs of following stages from being overloaded. The mixer itself has an overload point of about 12V.

- C1,2,21,22,41, 42,61,62,81, 82 Ceramic 33pF
- C3,4,5 Tant 10  $\mu$ F25V
- RV1,2,3,4,5,21, 22,23,24,25, 41,42,43,44, 45, 61,62,65, 81,82,86 Pot Lin 22k
- Q1,21,41,61,81 BC178
- Q2,22,42,62,82 BC108C
- IC1,2,21,22,41, 42,61,62,81, 82 LM301A
- LED1,21,41,61, 81 LED Red

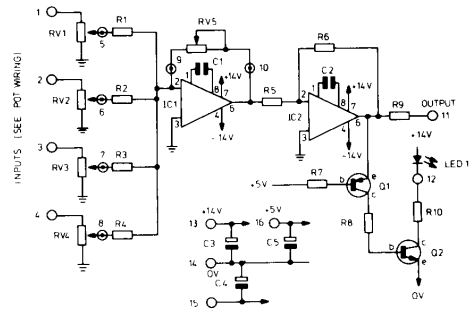


Fig. 15 Circuit Diagram of Mixer

**6 Setting-up Mixer**

Look with a 'scope on patchboard row H1. Set all mixer controls to fully anticlockwise. Set the 'scope to 1V/cm and 1ms. No signal should be seen. Put four patchpins in the patchboard between 'key direct' and each of the oscillators. Set oscillator 1 to 4 foot, tune to zero, free run fully anticlockwise and waveform to sine wave. Press middle C. Set mixer 1 level to 10 and advance mixer 1/oscillator 1 to 10. A sine wave of approximately 5V peak-to-peak should be seen. Repeat for each oscillator in turn. Then with oscillator 1 at 10 gradually add another oscillator and check that the overload lamp lights. Move the scope probe to H2 and repeat all above, then H3.

Restore all knobs to their anticlockwise position, then set mixer 1 level to 10 and mixer 2 level to 10. Adjust mixer 1/oscillator 1 level to number 2. Patch mixer 1 to mixer 4A input and put the 'scope probe on H4. Turn mixer 4 level to 10 and advance input A. Approximately 1V peak-to-peak level should be seen. Now patch mixer 2 to mixer 4B input. Set mixer 2 level to 10 and mixer 2/oscillator 2 level to 2. Turn mixer 4 input B fully clockwise and the mixture of oscillator 1 and 2 will be seen (usually a pulsating waveform). Advance both oscillator levels and check that overload lamp lights. Repeat above for mixer 5.

**Parts List for Mixer**  
(1 required for 5600S only)

- R1,2,3,4,6,21, 22,23,24,26, 41,42,43,44, 46,61,62,66, 81,82,86 Min Res 33k
- R5,8,25,28,45, 48,65,68,85, 88 Min Res 22k
- R7,27,47,67,87 Min Res 100k
- R9,29,49,69,89 Min Res 3k3
- R10,30,50,70, 90 Min Res 470 $\Omega$

**Also required**

- 1 Synth Mixer PCB
- 1 Mixer Chassis
- 3 Mixer Mtg Bracket
- 1 Wafercon Socket 8-way
- 8 Wafercon Terminals
- 10 DIL Socket 8-pin
- 41 Veropin 2141
- 21 15mm Collet Knob Black
- 21 15mm Collet Nut Covers
- 3 15mm Collet Cap Red
- 5 15mm Collet Cap Black
- 3 15mm Collet Cap Yellow
- 5 15mm Collet Cap Green
- 5 15mm Collet Cap Blue
- 3 Bolt 6BA 1/4in.
- 3 C/S Screw 6BA 1/2in.
- 6 Nut 6BA
- 6 Shake 6BA

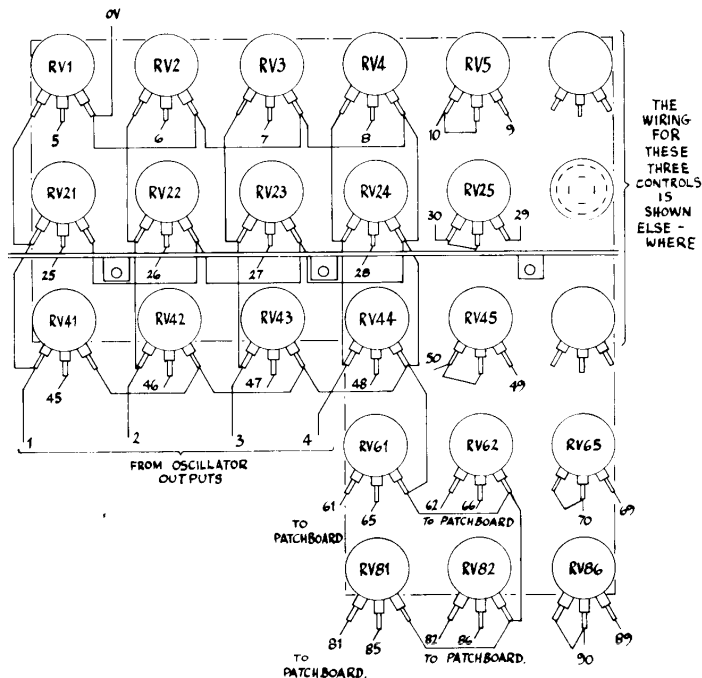


Fig. 16 Front Panel Wiring for Mixer



### Sample and Noise Construction

Assemble the pcb with the aid of the component overlay Fig. 17 taking care to ensure that the polarised components are correctly orientated. Plug the IC's into their holders noting that IC6 is mounted directly to the pcb, not in a socket. Mount the front panel controls and the pcb to the bracket, then wire the controls to the pcb as shown in Fig. 19. This module uses an oscillator bracket for its front panel controls. Finally fix the module to the front panel, then fix the LED's to the front panel and wire that to the pcb.

### Sample and Noise — How It Works

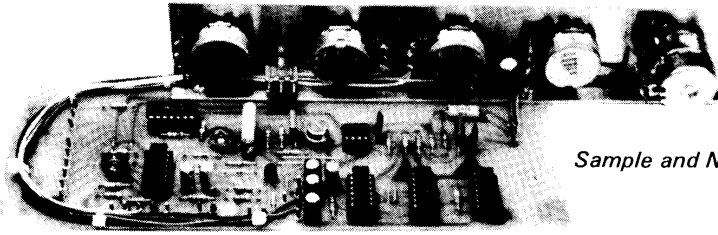
White noise is generated digitally by an 18-bit shift register which is clocked at about 35kHz. Several feedback loops around the shift register cause it to generate a pseudo-random bit pattern which closely approximates white noise.

The oscillator uses a quad, dual-input NOR gate IC7. Feedback is taken from the 5th, 9th and 18th stage in the shift register and these outputs are 'mixed' by IC2 which is an exclusive-OR gate, the output of which controls the 'D' input of the shift register. R1 and C1 ensure that the system will start.

The output of IC2b, as well as being the control for the shift register, is the white noise we require. However, due to some unwanted components above 15kHz, a low pass filter is used with a 15kHz cut-off. To give an alternate 'PINK' noise output, the filter is changed to cut frequencies above 500Hz with an up to 6dB per octave slope dependent on the position of VR1a. Since the output voltage will fall if some of the spectrum is removed, additional gain is also provided when pink noise is selected. The level can be adjusted by VR2.

The low oscillator formed by IC4a and 4b is a conventional square wave circuit providing a square wave output to the patchboard. The triangular wave present at IC4 pin 3 is applied to D1 to 4 through R11 and these components form a limiting circuit producing an approximate sine-wave. This is amplified and level changed by IC4d to provide a controllable 0 to +5V sine wave. The square wave is used to drive LED 1 which indicates the repetition rate.

A voltage applied to pin 10 may be sampled and stored in C9 at a rate dependent on the low oscillator or under the control of the external trigger circuit that originates at the patchboard or in the external input module. IC5a and 5d are used to switch on and off the glide circuit in the keyboard controller when under the control of the footswitch switched to 'glide'. IC5c repeats the retrigger level from the retrigger pcb and provides a strong signal for the retrigger output jack on the rear panel.



Sample and Noise

### Parts List for Sample and Noise (1 required for 5600S; 1 required for 3800)

R1	Min Res 1M
R2	Min Res 150k
R3 for 5600S only	Min Res 220k
R4,13,14,17,18	Min Res 100k
R5,19,21	Min Res 33k
R6	Min Res 18k
R7,8,9,20	Min Res 10k
R10	Min Res 22k
R11,22	Min Res 4k7
R12,15	Min Res 47k
R16	Min Res 220k
R23	Min Res 1k2
C1	PC Elect 0.47 $\mu$ F 100V
C2	Ceramic 100pF
C3	Mylar 0.002 $\mu$ F
C4	Mylar 0.001 $\mu$ F
C5	Polyester 0.015 $\mu$ F
C6,7	PC Elect 2.2 $\mu$ F 63V
C8	Polyester 0.022 $\mu$ F
C9	Polyester 0.47 $\mu$ F
C10,11,12	PC Elect 10 $\mu$ F 35V
C13	Axial 1 $\mu$ F 63V
VR1	Dual Pot Log 100k
VR2	Pot Log 10k
VR3 for 5600S only	Pot Lin 100k
VR4,6	Vert S-Min Preset 47k
VR5	Pot Lin 2M2
VR7	Pot Log 100k
Q1	MPS3638
D1 to 5	1N4148
LED1	LED Red
IC1	4006BE
IC2	4070BE
IC3	$\mu$ A741C 8-pin DIL
IC4	4136
IC5	4016BE
IC6	CA3140
IC7	4001BE

SW1 for 5600S only	Sub Min Toggle A
SW2 for 5600S only	Rotary Sw 3B

### Also required

- 1 Sample and Noise PCB
- 1 Oscillator Mtg Bkt
- 5 DIL Socket 14-pin
- 1 DIL Socket 8-pin
- 1 Wafercon Socket 8-way
- 8 Wafercon Terminal
- 26 Veropin 2141
- 2 Bolt 6BA  $\frac{1}{4}$ in.
- 2 Nut 6BA
- 2 Shake 6BA

### Also required for 5600S only

- 5 15mm Collet Knob Black
- 5 15mm Collet Nut Cover
- 3 15mm Collet Cap Blue
- 1 15mm Collet Cap Red
- 1 15mm Collet Cap Grey

### Also required for 3800 only

- 4 15mm Collet Knob Black
- 4 15mm Collet Nut Cover
- 2 15mm Collet Cap Blue
- 1 15mm Collet Cap Green
- 1 15mm Collet Cap Grey

### 18 Setting-up Noise Generator for 5600S

Connect a 'scope to H6 and patch H6/V29 and H6/V30. Check that the noise varies as the colour control is turned.

### 19 Setting-up Low Oscillator for 5600S

On the sample and noise pcb connect a 'scope to pin 27. Turn the rate control fully clockwise and adjust VR4 for the best sine wave on the 'scope. Connect 'scope to H18 on the patchboard and with level control at 10, adjust VR6 until the bottom edge of the waveform just touches 0V.

### 13 Setting-up Noise Generator for 3800

Set filter to 'transient', 'tune' fully clockwise and 'resonance' fully anticlockwise and on transient, set final level fully clockwise. Advance noise level until it is clearly audible. Check that the noise varies as the colour control is turned.

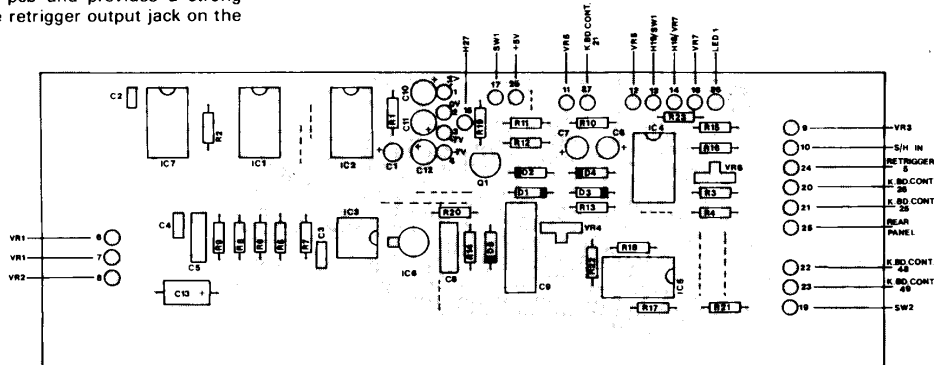


Fig. 17 Component Overlay for Sample and Noise

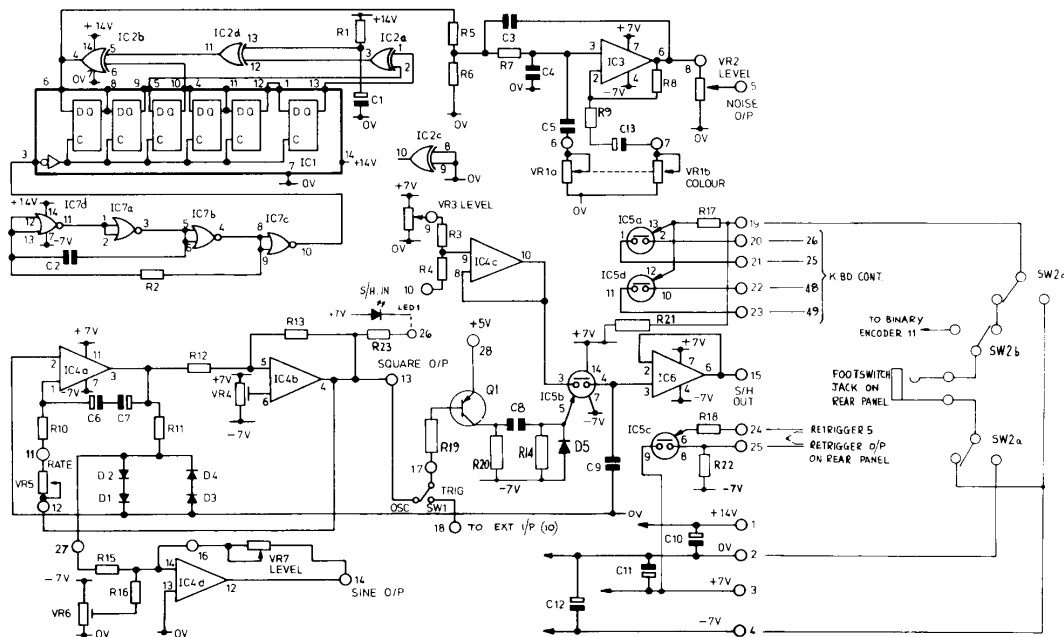


Fig. 18 Circuit Diagram of Sample and Noise (5600S only)

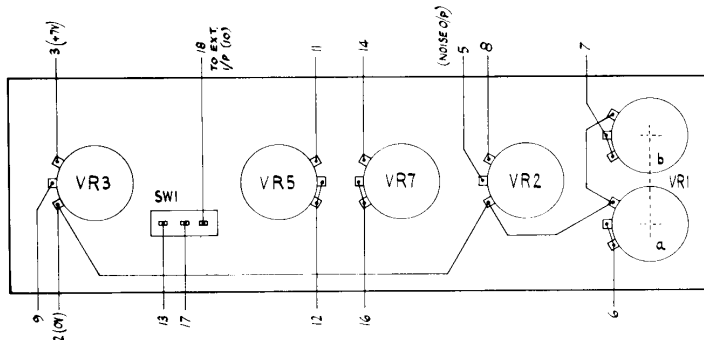


Fig. 19 Front Panel Wiring for Sample and Noise (5600S only)

#### 14 Setting-up Low Oscillator for 3800

On the sample and noise pcb connect a 'scope to pin 27. Turn the rate control fully clockwise and adjust VR4 for the best sine wave on the 'scope. Connect a 'scope to pin 14 of sample and noise pcb and with the low oscillator control on 'modulation' adjust VR6 until the bottom edge of the waveform just touches 0V.

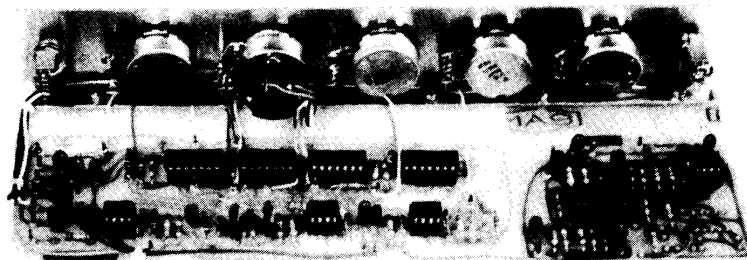
### Envelope Construction

This module is made up from a 'Transient' board (note that this is not Transient A or B) and a modified VCA board. Assemble the 'Transient' board as shown in Fig. 20 taking care with the orientation of the polarised components. Assemble a VCA board as shown in Fig. 22. Mount the front panel components on the bracket, then mount the two pcb's on the bracket and connect the wires between the front panel components and the pcb's as shown in Fig. 24. Finally, fix the module to the front panel.

### Envelope — How It Works

The transient generator consists, basically, of two sections.  
(a) The wave-shaping circuitry (analogue).  
(b) Control circuitry (digital).

The analogue section consists of integrator (IC2), exponential converter (Q2, IC3) and comparator (IC4). The comparator is a high gain differential amplifier whose output is normally either +6 volts or -6 volts. There is a small input region where the amplifier operates in the linear mode and the output voltage will then be somewhere between these two extremes. Negative feedback is applied by R14 so that



### Envelope

this linear input region is approximately 30 mV wide.

Solid state switches select one of three voltage sources as input to the comparator. IC1/3 selects +5 volts, IC1/4 selects 0V and IC5/3 selects the output of potentiometer RV6.

The output of the comparator is connected back to the input of IC2 by R3 and a slope potentiometer as selected by IC1/1, IC5/2 and IC1/2. If the output of the comparator goes to -6 volts, the output of the integrator, IC2, will be a voltage, linearly increasing at a rate set by the selected potentiometer (RV1, 2 or 3). Conversely if the comparator output is at +6

volts the integrator will produce a linearly decreasing voltage.

When the two inputs are within 30 mV of each other the slope of the integrator will decrease, and when they are equal (comparator output at zero) the system output will be stationary at the voltage selected by IC1/3, IC5/3 or IC1/4. This point will be stable as the comparator output is applied back to its input in a negative feedback loop, either directly, or via an exponential generator.

Generation of the exponential function is based on the collector-current to base-emitter-voltage relationship of a transistor, in this case Q2. The output of the

integrator, after attenuation by R4, RV4 and R5, and level shifting by R6 and RV5, is applied to the base of Q2. Diode D1 biases the emitter of Q2 about 0.6 volts below zero and also provides temperature compensation for Q2. Resistor R7 applies a small bias and helps compensate different offset voltages in IC3. Integrated circuit IC3 produces an output voltage proportional to the collector current of Q2. Hence a linearly changing voltage, at the output of integrator IC2, will result in an exponential output from IC3. The range of the exponential generator is adjusted by RV4 and RV5.

When a key is pressed, the keyboard controller provides a -7V to +7V change. The positive edge of this transition is differentiated by C7 and R19 (the negative edge pulse is clipped by D2) to provide an approximately 3m sec wide pulse which turns on IC5/5 and Q4 thus discharging C8. In addition, this pulse sets the flip flop formed by IC6/3 and IC6/4 so that the output at B is +7V, and turns on IC5/1 and Q1 thus clamping the output line at 0V.

At the end of the 3m sec pulse, C8 begins to charge from -7 volts at a rate determined by RV7. When it reaches 0V, approximately, the output of IC7 changes from +7V to -7V and thus an internal delay is generated which is adjustable by RV7. Also immediately following the 3m sec period, the output B is at +7V and hence IC1/2 is turned on selecting the attack potentiometer RV1, and IC1/3 is turned on, selecting +5V as an input to the comparator. Thus, as pin 2 of the comparator is higher than pin 3, the output will be low (-6V) and the integrator will start to rise. The voltage divider formed by R15 and R16 will apply -2V to the input of IC6/2.

Note for +7V and -7V supplies as used, '0' means less than -1V and '1' means greater than +1V when applied to inputs, and '0' means close to -7V '1' means close to +7V in the case of outputs.

The -2V input at IC6/2 is '0' and the output of IC6/2 will be high at +7V.

When the output of the integrator (or exponential generator) reaches +5V the comparator output will drop to zero volts causing an input of +2V to be applied to IC6/2. This is a '1' level and thus the output of IC6/2 will go to -7 volts. The output

swing of IC6/2 is inverted by IC6/1 and resets the flip flop (IC6/3 IC6/4).

When the flip flop is reset its output goes to -7V turning off IC1/2 and IC1/3 and a '0' is presented to IC7/2 and IC7/3 (pins 6 & 9).

If at this time the delay period has not expired (that generated by C8 & RV7) a '1' will still exist at the output of IC7/1. Thus IC7/3 has a '0' on pin 9 and '1' on pin 8 and its output will be a '0'. Hence both inputs of IC7/2 are '0' and its output will be a '1'. This turns on IC5/2 which selects DECAY 1 slope and IC5/3 which selects the output level set by RV6. The comparator now sees an error and drives the integrator to correct it. The output will stabilize again when the level set by RV6 has been reached. This output level will now be held until the 'C' control is removed.

When the delay period is completed the pin 8 input to IC7/3 goes to '0', and since the other input is '0', the output will be '1' and the output at 'C' will be turned off.

We now have the 'D' output at '1' and this selects the DECAY 2 potentiometer and 0V reference to the comparator. Again the integrator drives to correct the error. Positive feedback is provided around IC7/3 by IC7/4 so that the input may change much quicker.

When the delay potentiometer is switched off (SW4/1 and 2) trigger input will now be direct to IC7/3 pin 8 and the delay will be determined by the key-hold time only, and not by the internal generator.

If the DELAY time setting (either internal or external) is shorter than the time to complete DECAY 1, DECAY 2 will be initiated, provided the attack time is completed, immediately the delay expires.

If the DELAY setting is less than the ATTACK time setting, the ATTACK will be completed, DECAY 1 eliminated and DECAY 2 initiated.

The trigger input from the patchboard is buffered by Q3 to ensure correct operating levels for the logic. It also provides an inversion which means that the trigger will occur on the negative edge of the input trigger pulse.

The VCA is simplified by the omission of the rectifier IC1, as the input is coupled

directly from the output of the transient board and any zero error may be nulled out by RV1. In addition the output potentiometer is not required and is therefore deleted.

### Parts List for Envelope

(1 required for 5600S; 1 required for 3800)

R1,2,16,27,28,31	Min Res 12k
R3	Min Res 680Ω
R4	Min Res 15k
R5	Min Res 470Ω
R6,25	Min Res 8k2
R7,19,22	Min Res 1M
R8	Min Res 1k8
R9,30	Min Res 39k
R10,41	Min Res 3k3
R11,12,13,20	Min Res 1k2
R14,17,23,32,35,36,40,42	Min Res 100k
R15	Min Res 27k
R18,21	Min Res 10k
R24	Not used
R26,33,34	Min Res 22k
R29	Min Res 4k7
R37,39	Min Res 330Ω
R38	Min Res 470k
C1,13,14	Tant 4.7 μF 35V
C2,4,17	Ceramic 33pF
C3,7	Carbonate 0.0033 μF
C5,9	Not used
C6	Ceramic 10pF
C8,10,11,15,16	Tant 10 μF 25V
C12	Tant 33 μF 10V
C18	Tant 0.47 μF 35V
RV1,2,3	Pot Log 2M2
RV4,5	Vert S-Min Preset 22k
RV6	Pot Lin 22k
RV7	Sw Pot Log 2M2
RV8	Vert S-Min Preset 10k
Q1,3	MPS3638
Q2,4	PN3643
IC1,5	4016BE
IC2,3,4,9	LM301A
IC6,7	4001BE
IC8	MC1496
D1,2	1N4148

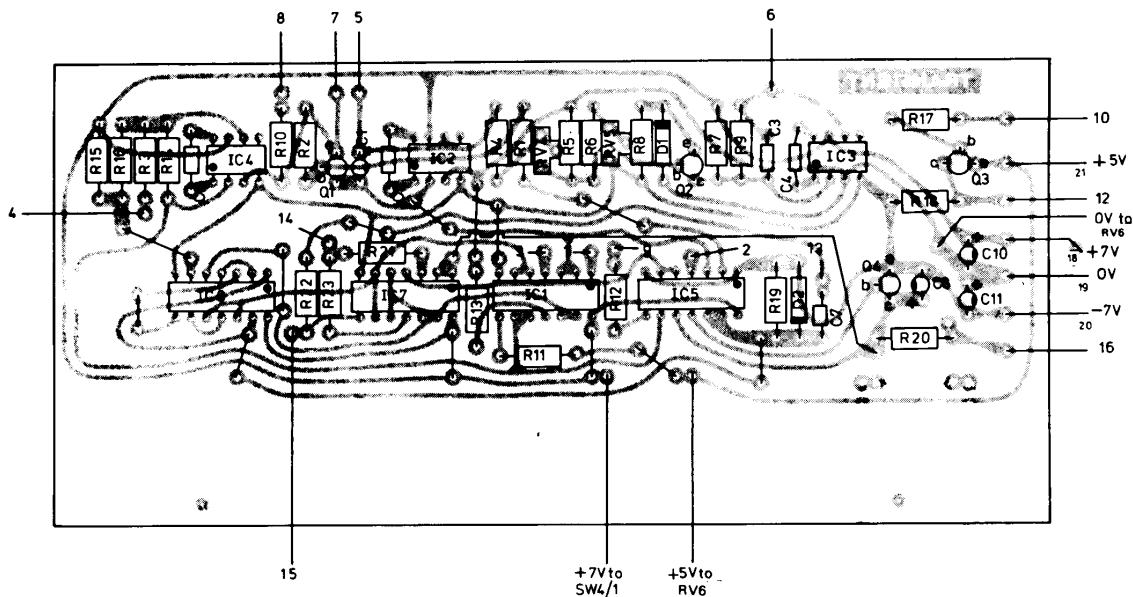


Fig. 20 Component Overlay for Transient Used In Envelope