Specification of 5600S Synthesiser

Keyboard

48-note F to E monophonic (could use a keyboard of up to 63 notes, but not in our cabinets). Each note generates its own specific 6-bit digital code which is decoded in the keyboard controller. Thus notes may be generated directly by a microprocessor, sequencer or other digital input. The code being used is displayed by six LED's.

Outputs to patchboard

Trigger: —7V to +7V transition at each new key press. A new trigger pulse is initiated every time a new key is pressed and that key will sound whether or not any other keys are pressed.

Analogue (direct): 0 to +5V

Analogue (modulated): 0 to +12V

Output to microprocessor: 6 data lines plus strobe

Inputs: Low oscillator
Patchboard
Computer/Sequencer

Controls:

Glide: Adjustable rate 0 to 10 seconds. With on/off switch.

Modulation selection: Selects direct modulation on keyboard by low oscillator or from patchboard.

Modulation: Allows input to modulate keyboard to a maximum of ±1 octave.

Tune: Tunes keyboard ±2 semitones.

Pitch bend: See Joystick.

Computer: Switches data socket from input to output. Keyboard is operative in both positions. A microprocessor could be used directly as a sequencer giving up to 62 notes or rests of any length up to 8½ seconds based on approx. 1/60th second intervals, for each kilobit of random access memory or other digital memory. (Notes or rests use 16 bits of memory per 8½ seconds and notes or rests of any length in 1/60th second multiples can be generated). The sequence recorded in the RAM can be edited from the keyboard. A complete design for a sequencer will be available before the end of 1979.

Oscillators

Four voltage controlled oscillators plus one low oscillator (described separately). Overall range: 0.1Hz to >20kHz per oscillator.

Output to mixers 1, 2 and 3.

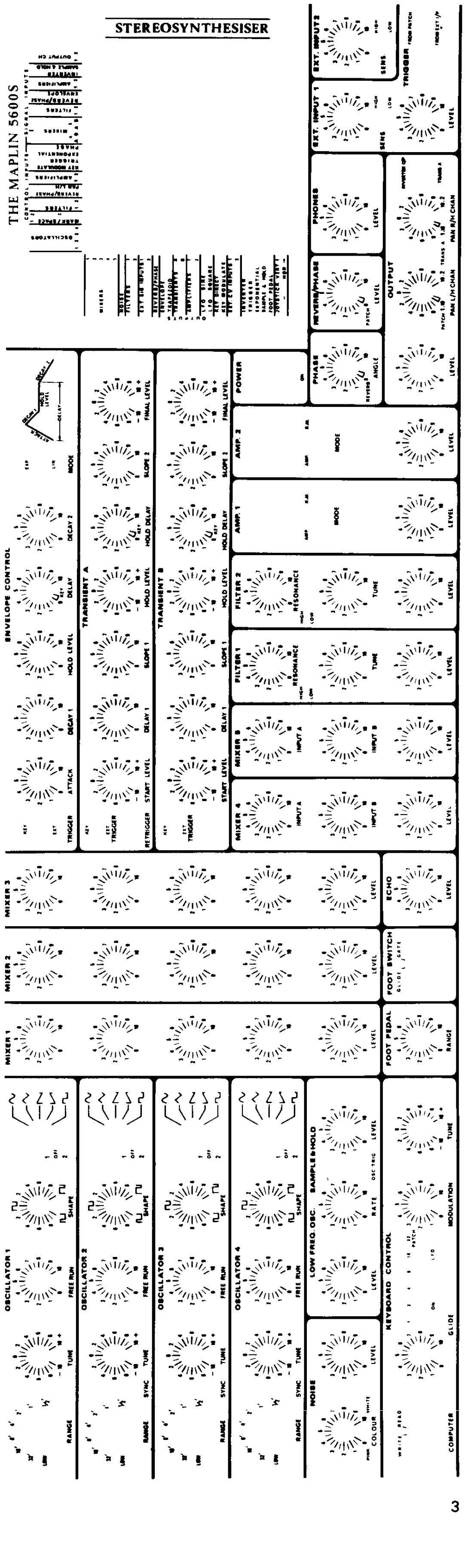
Controls

Range: Switchable in seven ranges from ½' to 32' plus low frequency (0.1Hz) special effects source.

Tune: Tuning range of ±½ octave.

Free run: Internal voltage source manually adjusts oscillator over full range. Oscillators 2, 3 and 4 can be synchronised with oscillator 1 i.e. every time oscillator 1 starts a new cycle so does any other oscillator with sync. operative.

Shape: Varies mark/space ratio of square wave



	output, plus switch to enable shape to be voltage controlled from either of two control lines on patchboard or off.
Waveform:	Selects sine, triangular, sawtooth, inverted sawtooth or square wave as output.
Stability:	Frequency change with change in temperature: <0.015%/°C typical. Frequency change with constant temperature over one week: <±0.05% typical.

Low Oscillator

Range:	0.2Hz to 20Hz
Outputs:	Sine wave to patchboard via level control, and square wave at fixed 5V to patchboard simultaneously.

Noise

A pseudo-random noise generator with colour control to allow noise spectrum to be continuously variable between white and pink. Output to patchboard via level control.

Sample And Hold

Samples incoming waveforms and stores the voltage.
Controls:

Sample rate input:	Switchable between low oscillator and external input module.
Level:	Sets the range of output voltage.
Input:	From patchboard
Output:	To patchboard.

Mixers 1, 2 and 3

Inputs:	Four (one from each oscillator) each with independent level controls.
Level:	Adjusts level of output from each mixer.
Overload:	LED lights to indicate overload.
Output:	To patchboard.

Mixers 4 and 5

Inputs:	Two each, from patchboard with level individually adjustable.
Level:	Adjusts level of output from each mixer.
Overload:	LED lights to indicate overload.
Output:	To patchboard.

Filters 1 and 2

Two active voltage controlled filters (VCF).

Inputs:	From patchboard.
Cut-off rate:	24dB per octave.
Control range:	>2 decades.

Controls

Tune:	Tunes filter to control source
High/Low:	Selects tuning range.
Resonance:	Adjusts Q of filter.
Level:	Adjusts level of output to patchboard.

Amplifiers 1 and 2

Two voltage controlled amplifiers (VCA) which may be AC or DC coupled.
Input signal: Via patchboard. Input control: Via patchboard.
Mode switch

Amp:	In this position VCA is DC coupled and functions as a voltage controlled amplifier.
RM:	In this position VCA is AC coupled and functions as a ring modulator.
Output:	To patchboard via level control.

Envelope

Input trigger:	From keyboard or external input.
Attack, Decay 1 and Decay 2:	All adjustable from 5m sec to 5 sec.
Hold level:	Adjustable 0 to 5 volts.
Delay:	Adjustable 5m sec to 5 sec or duration of key contact closure as selected by switch.
Control Mode:	Linear or exponential voltage controlled amplifier with a range of 60dB.
Signal input:	From patchboard.
Signal output:	To patchboard.
Control output:	Trapezoid output to patchboard.

Transient 'A'

Trigger input:	From keyboard or external input.
Levels:	Start, hold and final adjustable from 0 to 5V.
Delay 1, Slopes 1 and 2:	Adjustable 5m sec to 5 sec.
Hold delay:	Adjustable 5m sec to 5 sec or for duration of key contact closure.
Re-trigger:	Allows transient to re-trigger itself at the end of each sequence, but this can be interrupted from the keyboard, then restarted again by a momentary tap on any key.
LED indicators:	LED 1 lights when trigger pulse occurs and extinguishes at the end of Delay 1; LED 2 then lights and extinguishes at the end of Hold delay; then LED 3 lights and extinguishes at the end of Slope 2.
Output:	To patchboard.

Transient 'B'

Identical to Transient 'A' except it has no internal re-trigger facility. However, it can be independently triggered from a push switch on the front panel.

Exponential Converter

Converts a linear input to an exponential output.
Input: From patchboard. Output: To patchboard.

Joystick

Gives 2-axis control of any two functions.
Range: Variable range on horizontal axis.
Switch to select patchboard or pitch bend.

External Signals

Inputs:	Two inputs having a sensitivity of 50mV to 2V at 10kΩ.
Sensitivity:	Input level control with high/low switch making it suitable for most signal sources.

External input 1 only, also has a trigger level control. This trigger pulse may be switched to patchboard or (in external input position) to any module switched to external.

Foot Pedal

A control voltage to patchboard may be generated by an external swell pedal. Range is controlled from front panel.

Foot Switch

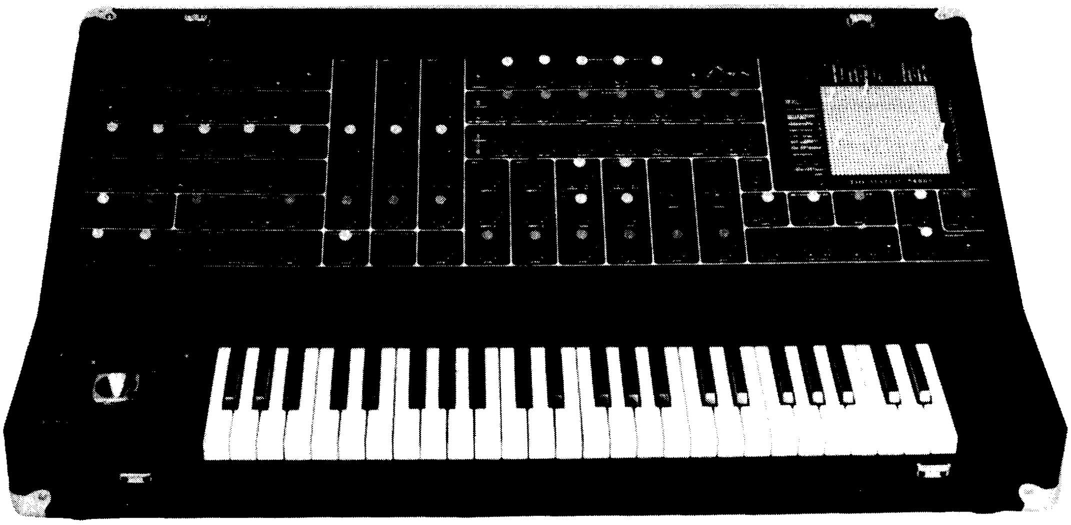
Glide may be switched on and off or a gate trigger pulse may be generated from an external foot switch. Switched on front panel.

Echo

An external echo chamber may be connected and control on front panel adjusts balance between straight through and returned signal. Output to output channel 1.

External Control Voltage Inputs 1 and 2

Up to two control voltages from external sources (e.g. another synthesiser) may be connected and the voltages will appear separately on two patchboard lines. The inputs are protected against overload and should the voltage go more negative than 0V the voltage at the patchboard will remain at 0V. Similarly, if the voltage greatly exceeds 5V, the patchboard voltage will not go above 9V.



Inverter
When input is at 5V, output will be at OV and vice versa. Intermediate voltages are similarly reversed.
Input: From patchboard. Output: To patchboard.

Reverberation
Not available when switched to Phase. Multi-spring system. (See note below.) Level control adjusts between no reverb and full reverb, or when switched to patch, may be voltage controlled from patchboard.
Input: From patchboard. Output: To patchboard.

Phase
Not available when switched to Reverb. The control angle is fully variable through 360°, and more to give a delay to the signal, the length of which depends on the frequency. This control may be used in conjunction with the voltage controlled input from the patchboard, to set the maximum delay.
Input: From patchboard. Output: To patchboard.

Output Stages
There are two separate output channels: 1 and 2 and two separate outputs: left and right. Both channels are fed from the patchboard (or echo chamber: channel 1 only). Both left and right output can be fed from either or both output channel, or any mixture of the two. This panning facility may be controlled manually or by voltage control from

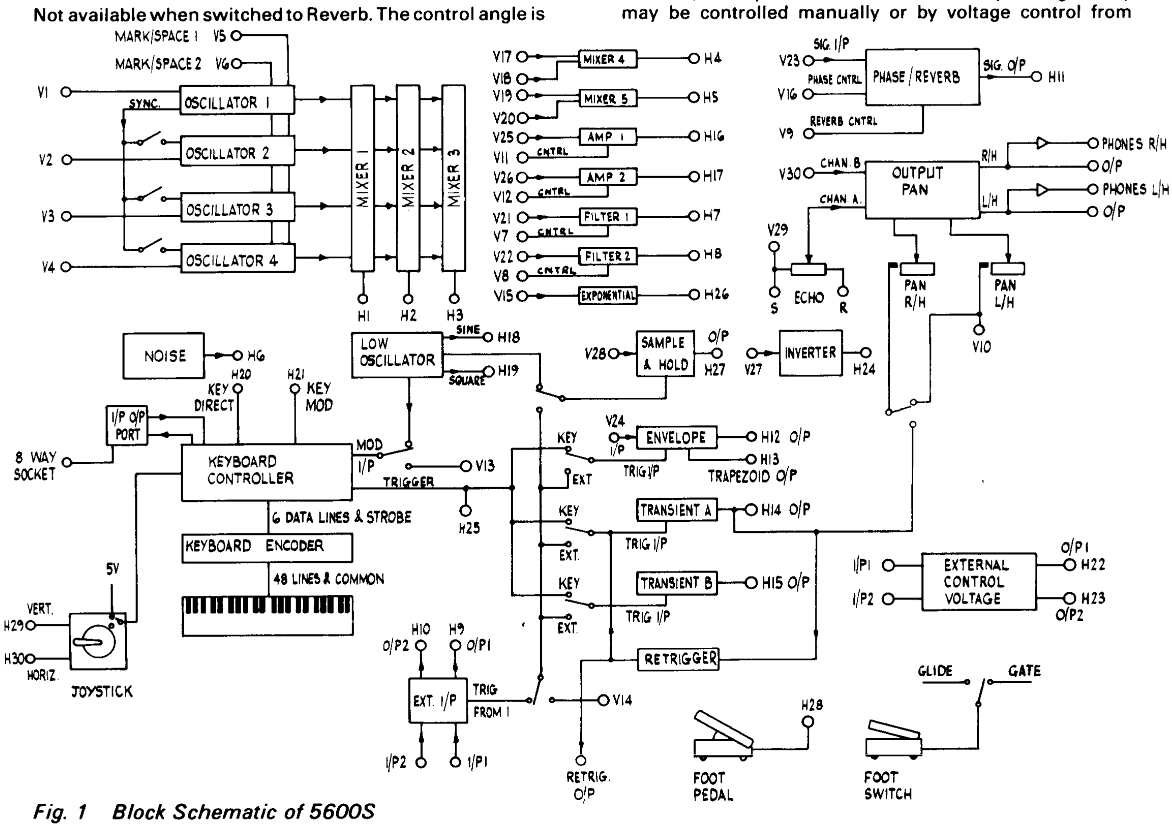


Fig. 1 Block Schematic of 5600S

Transient 'A' for right output and patchboard for left output. Also control inputs may be coupled together so that a voltage from the patchboard may be used to control simultaneously the panning of left output from channel 1 to 2, and right output from channel 2 to 1. Note that it is the outputs that are panned between the two channels and not vice versa.
Output level: 0 to 1V rms approx.
Load impedance: 2k Ω

Phones Output

A stereo output for stereo headphones. This output is linked to the main output and therefore pans with it.
Power output: >2W rms
Load impedance: 8 Ω
Output level control provided

Additional Outputs

Retrigger pulse available from jack socket on rear panel. Trigger pulse from keyboard controller available from jack socket on rear panel.

NOTE

In some early specifications and in our 1979/80 catalogue a solid state reverberation system was specified, but although we tried many different designs, it was our opinion that no design ever began to approach the realism of a spring-line system. The only serious disadvantage with a spring-line is that it is subject to mechanical noise if the synthesiser is knocked or moved. However, with our design the synthesiser requires a considerable blow before the slightest mechanical noise is heard from the output.

Specification of 3800 Synthesiser

Keyboard

48-note F to E monophonic. (Could use a keyboard of up to 63 notes, but not in our cabinets.) Each note generates its own specific 6-bit digital code which is decoded in the keyboard controller. Thus notes may be generated directly by a microprocessor or other digital input. The code being used is displayed on the front panel.
Controls:
Tune: Tunes keyboard ±2 semitones.
Glide: Adjustable rate 0 to 10 secs with on/off switch.
Computer Switches data socket from input to output (see 5600S for details).

Modulation

Provides a source of modulation for oscillators other than from the keyboard.
Controls:
Low oscillator: Selects low oscillator as source.
Transient: Selects transient as source.
Sample and Hold: Selects held voltage.

Oscillators

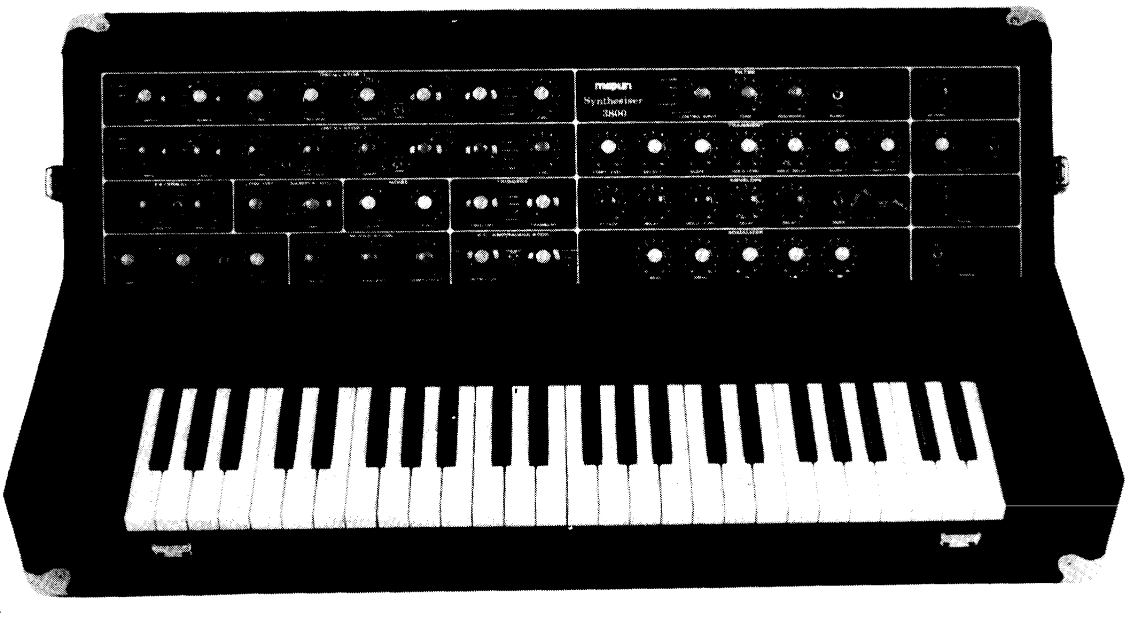
Two voltage controlled oscillators plus one low oscillator (described separately). Overall range: 0.1 Hz to >20k Hz per oscillator.
Controls:
Input: Selects keyboard or modulation unit as source of control. Off position provided.
Range: Switchable in seven ranges from ½' to 32' plus low frequency (0.1 Hz) special effects source.
Tune: Tuning range of ±½ octave.
Free run: Internal voltage source manually adjusts oscillator over full range. Oscillator 2 can be synchronised with oscillator 1, i.e. every time oscillator 1 starts a new cycle so does oscillator 2 with sync. operative.
Shape: Varies mark/space ratio of square wave output plus switch to enable shape to be voltage controlled from either low oscillator or transient or off.
Waveform Selects sine, triangular, sawtooth, inverted sawtooth or square wave as output.
Output switch: Routes signal to filter, envelope, signal input of VCA or direct to output stage.
Output level: Adjusts level of output.
Stability: Frequency change with change in temperature: <0.015%/°C typical. Frequency change with constant temperature over one week: < ±0.05% typical.

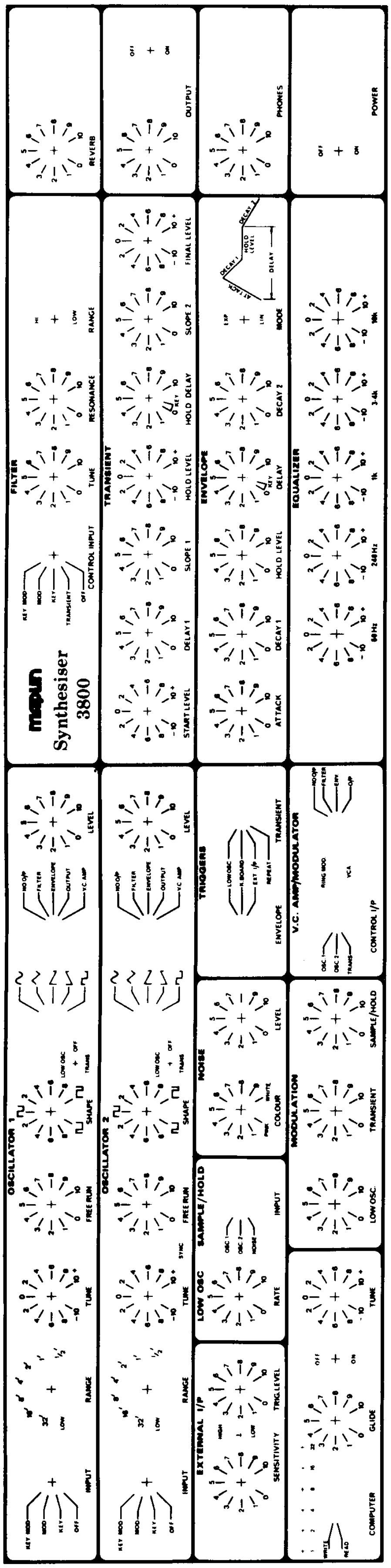
Low Oscillator

Range: 0.2Hz to 20Hz. Outputs: Sine wave.

Noise

A pseudo-random noise generator with colour control to





allow spectrum to be continuously variable between white and pink. Level control adjusts level fed to VCF.

Sample And Hold

Samples incoming waveforms and stores the voltage.
Input switch: Switches between oscillator 1, oscillator 2 and noise.

Filter

An active voltage controlled filter (VCF).
Inputs: Mixed signals from oscillators, noise and external inputs.
Cut-off rate: 24dB per octave.
Control range: >2 decades.
Controls:
Control source: Keyboard, modulation, transient, modulated keyboard or off by front panel switch.
Tune: Tunes filter to control source.
High/low: Selects tuning range.
Resonance: Adjusts Q of filter.

VCA

A voltage controlled amplifier (VCA) in addition to the envelope. Allows ring modulation.
Controls:
Control input: From oscillator 1, oscillator 2 or transient.
Function switch: VCA or Ring modulation.
Output: Switches output between filter, envelope or output direct.

Envelope

Input trigger: See "Triggers".
Attack, Decay 1 and Decay 2: All adjustable from 5m sec to 5 sec.
Hold level: Adjustable 0 to 5 volts.
Delay: Adjustable 5m sec to 5 sec or duration of key contact closure as selected by switch.
Control mode: Linear or exponential voltage controlled amp with range of 60dB.
Signal input: From oscillator 1, oscillator 2 or VCA.
Output: Direct to output stage.

Transient

Trigger input: See "Triggers".
Levels: Start, hold and final adjustable 0 to 5 volts.
Delay 1, Slopes 1 and 2: Adjustable 5m sec to 5 sec.
Hold delay: Adjustable 5m sec to 5 sec or for duration of key contact closure.
Output: Direct to filter input switch, modulation input and VCA control input switch.

External Input

Allows external signals to be matched to the synthesiser and also generates a trigger pulse.
Sensitivity: 50mV to 2V at 10k Ω. Variable from front panel.
Trigger level: Decides at what voltage amplitude, trigger pulse occurs. Variable from front panel.

Triggers

Switches trigger pulses to envelope and transient.
Envelope: Selects trigger to control envelope from low oscillator, keyboard or external input.
Transient: Selects trigger to control transient from low oscillator, keyboard, external input or repeat.

Foot Switch

Glide may be switched on and off or a gate/trigger pulse may be generated from an external foot switch. Selection is made from jack sockets on the rear panel.

Output Equaliser

Number of stages:	Five.
Centre frequencies:	60Hz, 240Hz, 1kHz, 3.4kHz and 10kHz.
Type:	Active filter.
Range of adjustment:	>±10dB.

Reverberation

Type:	Multi-spring.
Output:	Adjustable mix-fader from full reverb to original sound with no reverb.

Signal Output

Level control:	0 to 1V rms approx.
Load impedance:	1kΩ

Phones Output

Power output:	1W rms (mono)
Load impedance:	8Ω Output level control provided.

Additional Outputs

Retrigger pulse available from jack socket on rear panel. Trigger pulse from keyboard controller available from jack socket on rear panel.

IMPORTANT NOTE

Each section of this book describes the construction, setting-up and principles of operation of each stage separately. The construction should be carried out in the order it appears in the book. When all the construction is complete, work through the setting-up instructions in the sequence designated by the numbers in square boxes for the 5600S and in circles for the 3800. Note that the 3800 construction details begin on page 40. Also see page 46 before starting any construction.

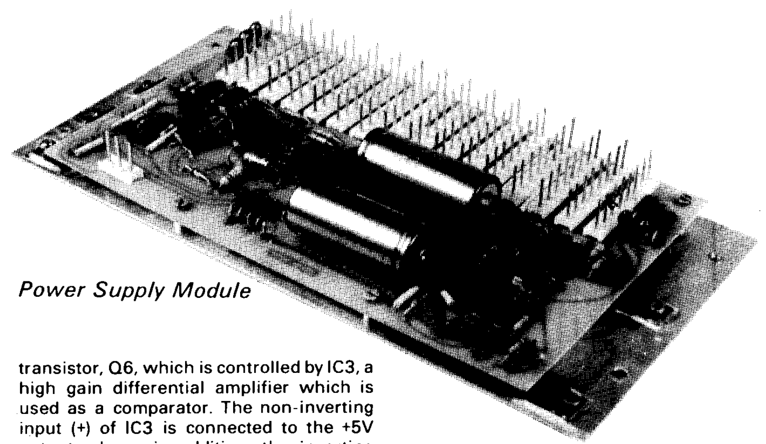
CONSTRUCTION 5600S

Power Supply Construction

Assemble the pcb with the aid of the component overlay Fig. 2. Do not mount the power transistors yet. Double check that all the polarised components are correctly orientated. The pcb is mounted by ¼in. spacers onto an aluminium panel which is also the heatsink for the power transistors. The power transistor leads must be bent apart and up at right angles to pass through the pcb from the underside.

The heatsink should be used as a guide to determine the bending points. Since the transistors are on the underside of the pcb there must be no strain on the joints otherwise the pcb track may be broken. Mount the transistors, using mica insulators, in position on the heatsink. The transistors can then be soldered to the pcb through the access holes provided. If required the heatsink may then be removed for other work to be carried out. Fix the heatsink and pcb to the base of the cabinet in the position shown in the internal layout photograph, using spacers and self-tapping screws.

Each of the other pcb's to be constructed will be plugged onto this board, and any board may be connected to any position. There are insufficient plugs for every board so the wires from the reverb and phase pcb and the vc pan and anc pcb are wired separately to one socket. The binary encoder pcb is powered from the keyboard controller and the joy lever pcb is powered from the vc pan and anc pcb.



Power Supply Module

Power Supply — How It Works

The power supply provides regulated outputs of +14V, +7V, +5V, -7V and -14V. The 5V supply can deliver 60mA and all other outputs 300mA. An additional output of +13.4V is provided to supply the high current requirement of the headphone output amplifier. The bridge rectifier and smoothing capacitors are a conventional system supplying ±20V. The 5V output is derived from a μA78L05AWC voltage regulator (IC1). The +5 volts is used as the main reference for the other supplies. Current limit is provided by R9 which limits the current to about 85mA.

The +7V output is via a series pass transistor, Q6, which is controlled by IC3, a high gain differential amplifier which is used as a comparator. The non-inverting input (+) of IC3 is connected to the +5V output where, in addition, the inverting input (-) is connected via a 5/7 divider R21/24. The result of this connection is that the output will stabilise at +7V. The high gain of IC3 will keep this voltage constant with nominal load and supply voltage changes.

A current sensing resistor, R8, is in series with the collector of Q6. If the voltage across the resistor exceeds 0.6V, the base/emitter junction of Q2 will become forward biased, turning it on. This causes Q10 to turn on and the 5V reference to IC3 is switched to 0V and all the supply voltages except +5V are switched off and the output current limited to about 500mA. To prevent overvoltage from the +7V supply on switch on, the output is limited by ZD3 to about 8.5V.

The -7V supply is similar to the +7V supply, except that the reference voltage is now zero volts (pin 3) and this is compared to a voltage at the junction of R26 and R22. The voltage will be zero when the output of the -7V is identical to the +7V, but of opposite polarity. Diode D6 is used to protect the input of IC4. Overload on this output turns on Q3 which applies a negative voltage to Q2 closing down the supplies as before.

The ±14V supplies are identical to the ±7V supplies except for the sensing resistors R20/25 on the +14V supply. The +13.4V output is simply an emitter follower on the +14V rail. This supply should not, however, be shorted since no protection is provided. Zeners ZD5, 6 and 7 protect the +5V, +7V and -7V rails against accidental short circuit with a 14V rail.

[1] Setting-up Power Supply for 5600S

First remove any wafercon sockets previously plugged in and with the mains connected, switch on. The power on LED will not light. Check all voltages as per overlay Fig. 2. There are six to check: +14V, +13.4V, +7V, +5V, -7V and -14V. If all are correct switch off and put in all the plugs making sure they are the right way round. Switch on again, power on LED should light.

(1) Setting-up Power Supply for 3800

First remove any wafercon sockets previously plugged in and with the mains connected, switch on. The power on LED will not light. Check all voltages as per overlay Fig. 2. There are six to check: +14V, +13.4V, +7V, +5V, -7V and -14V. If all are correct switch off and put in all the plugs making sure they are the right way round. Switch on again, power on LED should light.

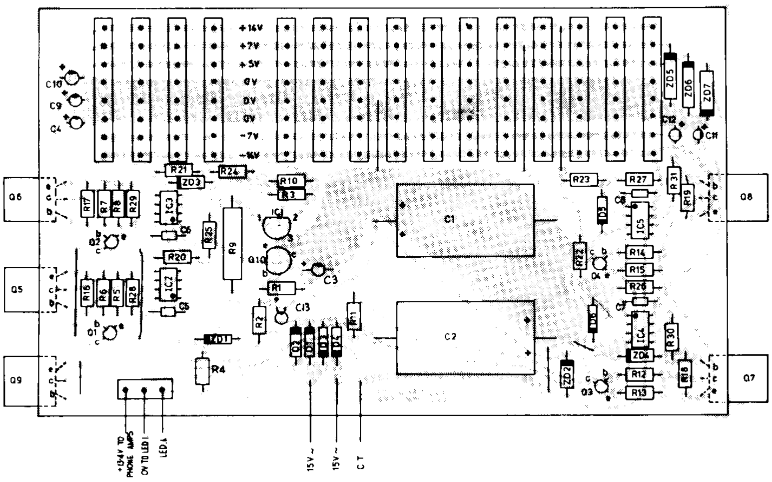


Fig. 2 Component Overlay for Power Supply

Parts List for Power Supply
(1 required for 5600S; 1 required for 3800)

R1	Min Res 22k
R2,3,22,23,24, 25,26,27	Min Res 10k
R4	Std Res 1k
R5,8,13,15	Std Res 1.2Ω
R6,7,12,14	Min Res 100Ω
R9	7W W/W 220Ω
R10	Min Res 220Ω
R11	Min Res 4k7
R16,17,18,19	Min Res 1k
R20	Min Res 18k
R21	Min Res 3k9
R28,29,30,31	Min Res 470Ω
C1,2	Axial 2200 μF 25V
C3,4,9,10,11,12	Tant 10 μF 25V
C5,6,7,8	Ceramic 33pF
C13	Tant 33 μF 10V
Q1,2	MPS3638
Q3,4	PN3643
Q5,6,9	TIP31A
Q7,8	TIP32A
Q10	2N3704
IC1	μ A78L05AWC
IC2,3,4,5	LM301A
D1,2,3,4	1N4002
D5,6	1N4148
LED1	LED Red
ZD1,2	BZY88C12
ZD3,4	BZY88C9V1
ZD5,7	5W Zener 8V2
ZD6	5W Zener 5V6
T1	Tr 20V 1A
SW1	Sub-Min Toggle E
SK1	Mains Plug P429
FS1	Fuse 20mm 1A

Also required

1 Synth Power Supply PCB
1 Synth Power Supply Heatsink
4 DIL Socket 8-pin
1 Safuseholder 20
1 Mains Socket P430SE
2 Boot 9455
1 Wafercon Plug 3-way
1 Wafercon Socket 3-way
3 Wafercon Terminals
1 Cliplite Red
5 Bolt 6BA ¼in.
4 Bolt 6BA ½in.
9 Nut 6BA
9 Shake 6BA
1 Tag 6BA
4 Self-tapper No. 4 ½in.
4 6BA Spacer ¼in.
4 6BA Spacer ⅛in.
2 Self-Tapper No. 8 ⅜in. (to fix transformer)
1 Tag 2BA
5 Kit P Plas
2m Min Mains
1 13 Amp Plug Nylon

Also required for 5600S only

16 Wafercon Plug 8-way

Also required for 3800 only

11 Wafercon Plug 8-way

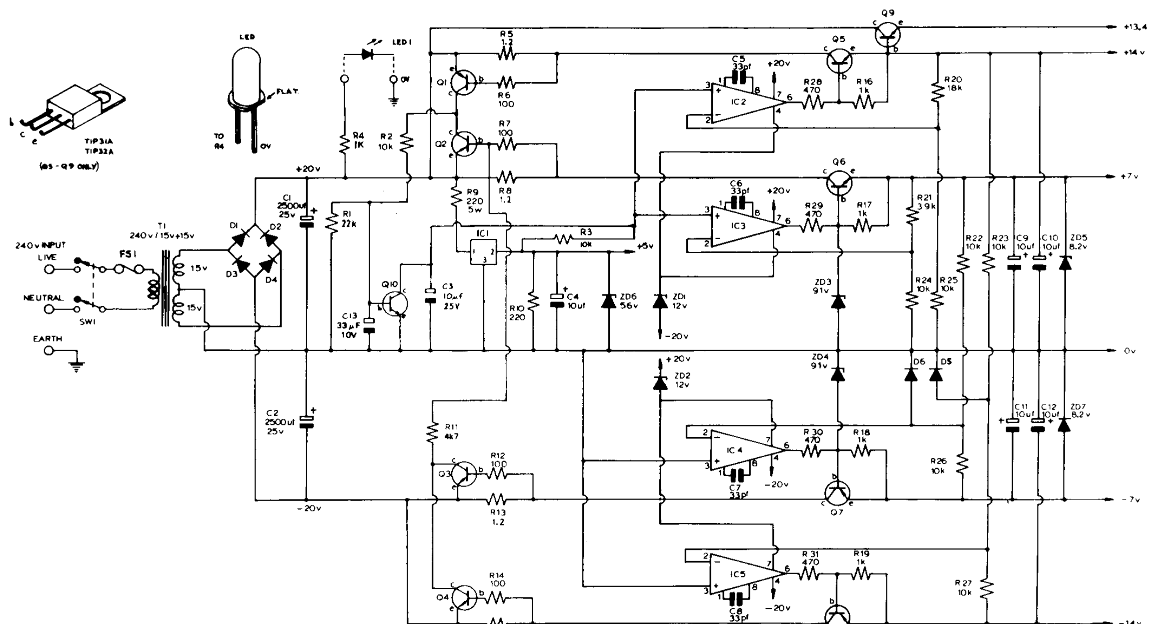


Fig. 3 Circuit Diagram of Power Supply

Keyboard and Binary Encoder Construction

Glue the KB mounting strips to the keyboard using an epoxy resin glue (e.g. Araldite). Take twelve contact blocks and put one piece of earth bar through each of the two holes. Repeat with the other 36 contacts, then glue the contact blocks to the mounting strips so that each gold wire contact is beneath a plunger for each key (see photographs). Align the octaves of contact blocks so that the earth bars may be soldered together. After soldering, anchor the ends of the bars by applying a blob of glue at both ends of each of the two earth bars, but take care to ensure that the glue does not run inside the blocks.

Assemble the binary encoder pcb. Fit the track pins, then the pins 2141, then all the other components taking care with the orientation of the polarised components. Solder both sides of the pcb and finally plug the IC's into their holders. Fix the pcb to the base of the cabinet under the keyboard as shown in the internal layout photograph using spacers and self-tapping screws. Cut two 1½ metre lengths of 25-way multi-

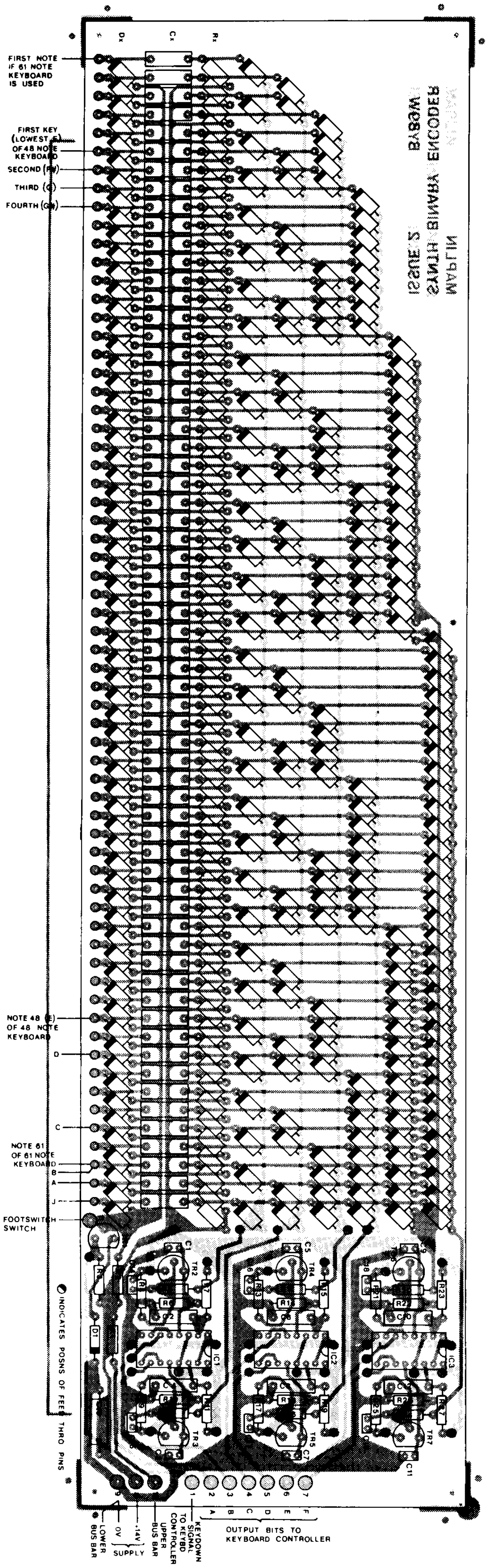
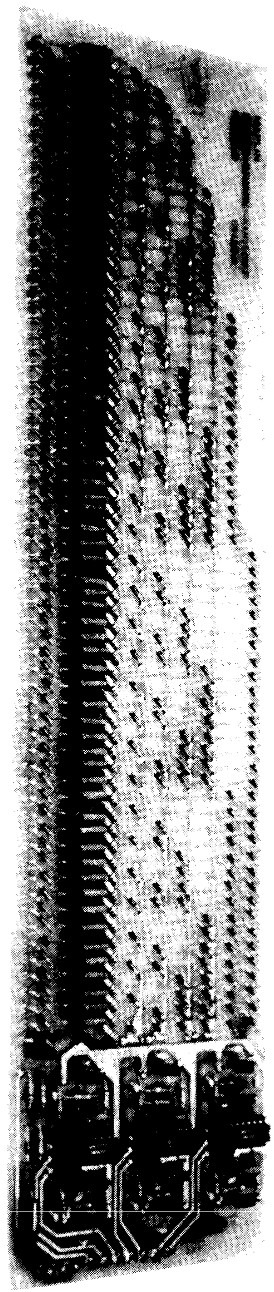


Fig. 4 Component Overlay for Binary Encoder

core. Connect one wire to the gold wire at the rear of each contact block in turn and the other two wires, one to each earth bar. Then connect the 50 wires to the pcb as shown in Fig. 4 connecting the wire from the bar closest to the keyboard to pin 10 and the other to pin 9.

Binary Encoder — How It Works

When all keys are normal +14V is applied to both sides of Cx. When a key is pressed a -14V short duration pulse is applied to each of the lines A to F, where there is a diode. If there is a diode in line A then TR2 is momentarily turned on and the +14V pulse at its collector triggers the monostable which then produces a 300 microsecond pulse set by R7 and C2. The same applies for any line and the code selected by the key appears on data lines 2 to 7. The 1.3V at pin 11 is reduced to 0.6V when any key is pressed and thus TR1 is turned off and pin 1 goes up to +14V.



Binary Encoder

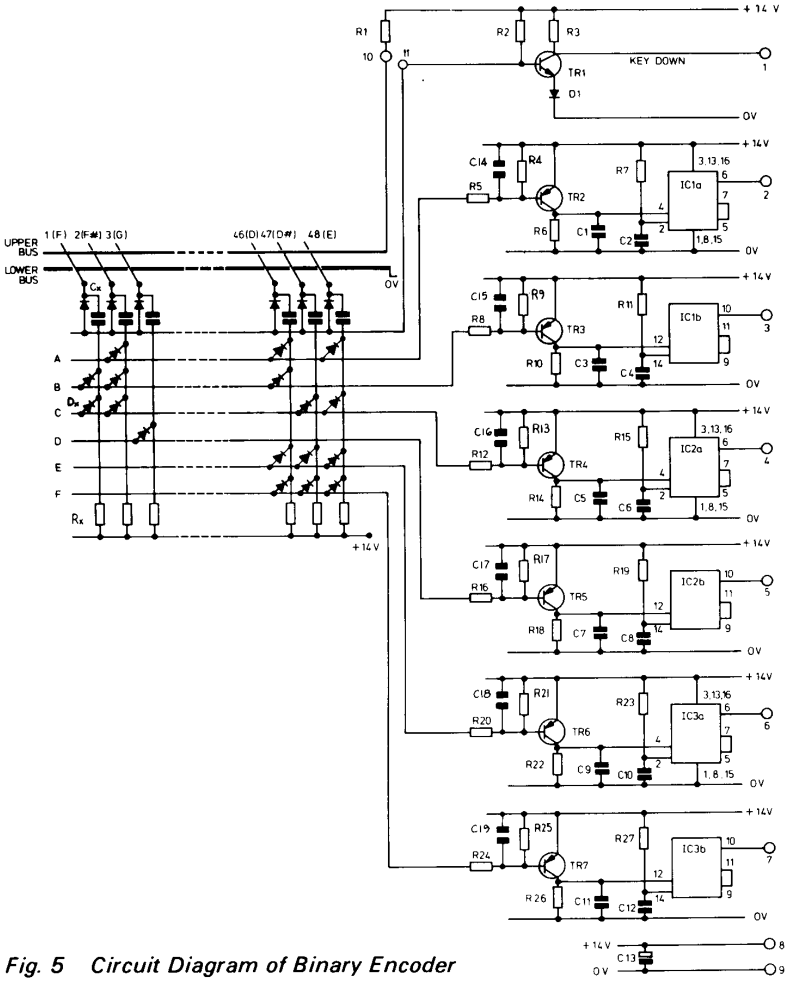


Fig. 5 Circuit Diagram of Binary Encoder

Parts List for Binary Encoder

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

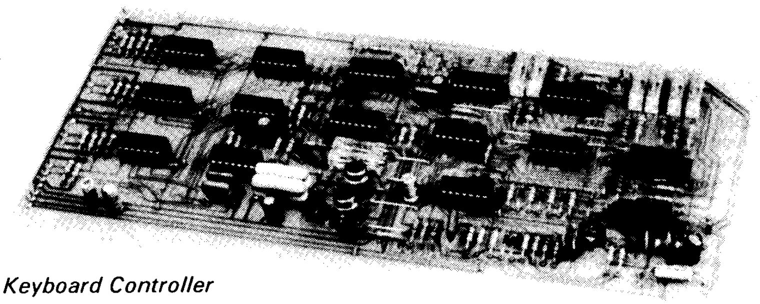
R1,5,8,12,16, 20,24	Min Res 2k2
R2	Min Res 47k
R3	Min Res 10k
R4,9,13,17,21, 25	Min Res 1k
R6,10,14,18, 22,26	Min Res 27k
R7,11,15,19, 23,27	Min Res 68k
Rx (63 required)	Min Res 100k
C1,3,5,7,9,11, 14,15,16,17, 18,19	Ceramic 470pF
C2,4,6,8,10,12	Polyester 0.01 μ F
C13	Axial 10 μ F 25V
Cx (63 required)	Polyester 0.01 μ F
TR1	BC548
TR2,3,4,5,6,7	2N3905
IC1,2,3	4098BE
D1	1N4148
Dx (255 req.)	1N4148

Also required

1 Binary Encoder PCB
3 DIL Socket 16-pin
72 Veropin 2141
36 Track Pins
5 6BA Spacer ⅛in.
5 Self-Tapper No. 4 ½in.

Keyboard Controller Construction

Assemble the pcb. Fit the pins and wire links then all the other components taking care with the orientation of the polarised components. Take extra care with the soldering as many of the tracks are very close. Finally plug the IC's into their holders except IC's 16 and 17 which cannot use a socket as pin 3 has to be offset. Connect wires to the power rails using a piece of ribbon cable and at the other end connect a wafercon socket ready to plug on to the power supply pcb. Fix the pcb to the base of the cabinet in the position shown in the internal layout photograph, using spacers and self-tapping screws.



Keyboard Controller

Keyboard Controller — How It Works

The code arrives from the binary encoder pcb on pins 1 to 6 in the form of 300 microsecond long positive pulses which are then inverted by NAND gates and applied to more NAND gates used as OR gates and finally the code is offered to six latches in IC7 and IC8. A '1' on any of these six lines will be detected by D1 to 6 and used to turn on TR1 whose collector goes to 0V. A very short duration negative going pulse appears on IC5 pins 5 and 6 which gives a positive pulse on pin 4. This is used in IC7 and IC8 to strobe the code into the latches. The code is then displayed on LED 1 to 6.

The positive level from the encoder on pin 14 is inverted twice and appears after a short delay as a positive level on IC5 pin 1. The resulting 0V at pin 3 turns off TR2 and the gate output pin 15 goes from -7V to +7V. If another key is pressed before the first is released, a new code will be detected by D1 to 6 which immediately causes C2 to discharge to 0V and the gate reverts to -7V for a period of 20 milliseconds set by the charging rate of C2 through R19. The gate returning to +7V produces a new trigger pulse. Provision is made for inputs from a computer or sequencer.

The code is now presented to a voltage divider chain and a voltage derived that gives the correct frequency when used to control an oscillator. The same divider chain is used for both the key direct and modulated outputs. IC11 produces a square wave at approximately 1kHz and after passing through shaping circuits the waveform is used to switch IC15a and IC15c on and IC15b and IC15d off simultaneously for 500 microseconds whilst in the following 500 μ s IC15a and IC15c are switched off and IC15b and IC15d are switched on. This results in the 'key direct' voltage being stored in C11 and the 'modulated' voltage being stored in C12. With SW2a open and the glide control VR11 advanced, capacitors C11 and C12 will reach their respective voltages after some delays. VR12 and VR13 are used to compensate for any offset voltage introduced by the op-amps.

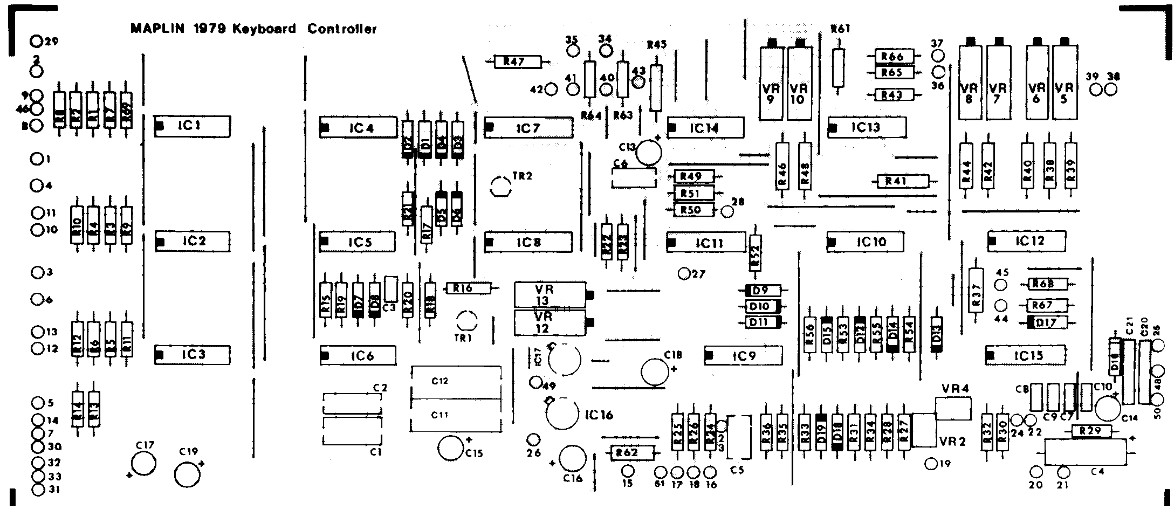


Fig. 6 Component Overlay for Keyboard Controller

If in the divider chain a code is set up with all six data lines at '1' (equivalent to key 63 pressed), IC12a, 12c, 13a, 13c, 14a and 14c will be turned on and IC12b, 12d, 13b, 13d, 14b and 14d will be turned off. Thus the 5V applied to IC9c appears at IC14 pin 10. A code equivalent to key 62 would give a '0' on 'bit 1' and IC14c will be off and IC14d on. VR10 is adjusted to produce a voltage which will reduce the frequency of an oscillator by one semitone. If 'bit 2' was '0', IC14a would be off and IC14b would be on. VR9 is adjusted to produce a voltage which will reduce the frequency of an oscillator by two semitones. VR8 is adjusted to produce a voltage which will reduce the frequency of an oscillator by four semitones and so on: VR7 — eight semitones; VR6 — sixteen semitones; and VR5 — thirty-two semitones. Thus the binary combination on the data lines synthesises a voltage which will make an oscillator run at the frequency of the key generating that binary code.

If VR3 is turned fully anticlockwise the 'modulated' output will be the same voltage as the 'key direct' voltage. With VR3 turned fully clockwise the 'modulated' output voltage will be dependent on the voltage appearing at pin 3 of IC9. This is arranged such that when 2.5V is applied to point 47 (and SW1 switch to patchboard), IC9 pin 3 is at 5V giving no modulation. With 0V on point 47, IC9 pin 3 is at 2.5V and with +5V on point 47, IC9 pin 3 is at +10V. This means that the voltage on the 'modulated' output increases roughly logarithmically for a linear increase in input voltage.

Parts List for Keyboard Controller

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

R1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,22,26,69	Min Res 47k
R16,18,52	Min Res 10k
R17,20,31,33,35	Min Res 33k
R19	Min Res 470k
R21,28,34,36,53,54,55,56	Min Res 100k
R23,24	Min Res 4k7
R25	Min Res 18k
R27,49	Min Res 180k
R29 for 5600S only	Min Res 1M
R29 for 3800 only	Min Res 100k
R30	Min Res 6k8
R32	Min Res 2k2
R37,46	Oxide 8k2
R38	Oxide 1k2
R39,42	Oxide 5k6
R40	Oxide 3k6
R41	Oxide 3k3
R43	Oxide 1k8
R44	Oxide 7k5
R45	Oxide 820Ω
R47	Oxide 330Ω
R48	Oxide 9k1
R50,51	Min Res 27k
R57,58,59,60	Not used
R61	Min Res 100Ω
R62	Min Res 3k3
R63,64,65,66,67,68	Min Res 2k7
C1	Polyester 0.1μF
C2	Polyester 0.068μF
C3	Ceramic 2200pF
C4	Axial 1μF 63V
C5,6	Polyester 0.01μF
C7,8	Ceramic 100pF
C9,10	Ceramic 470pF
C11,12	Polyester 0.47μF
C13,14,15,16,17,18	PC Elect 10μF 35V
C19	PC Elect 4.7μF 63V
C20,21	Disc 0.1μF
VR1	Pot Lin 47k
VR2	Vert S-Min Preset 47k
VR3 (5600S only)	Pot Lin 10k
VR4	Vert S-Min Preset 1k
VR5,6,7,8,9,10	15-Turn Cermet 500Ω
VR11	Pot Dual Log 1M
VR12,13	15-Turn Cermet 10k
TR1,2	BC548
IC1,2,3,4,5,6	4011BE
IC7,8	4042BE
IC9,10,11	4136
IC12,13,14,15	4416BE
IC16,17	LH0042C
D1 to 19	1N4148
LED1 to 6	TIL209 Red
SW1 (5600S only)	Sub-Min Toggle A
SW2	Sub-Min Toggle E
SW3 (wiring not shown in this book)	Rotary SW3

Also required

1 1979 Keyboard Controller PCB
1 DIL Socket 14-pin
2 DIL Socket 16-pin
50 Veropins 2145
1 Wafercon Socket 8-way
8 Wafercon Terminals
4 Self-Tapper No. 4 ½in.
4 6BA Spacer ⅛in.

Also required for 5600S only

4 15mm Collet Knob Black
4 15mm Collet Nut Cover
2 15mm Collet Cap Black
1 15mm Collet Cap Green
1 15mm Collet Cap Yellow

Also required for 3800 only

3 15mm Collet Knob Black
3 15mm Collet Nut Cover
3 15mm Collet Cap Blue

[3] Setting-up Keyboard Controller for 5600S

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 and remove any pins in the patchboard. 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. On the patchboard patch 'key direct' to 'oscillator 1'. 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.

NOTE: *When used in 3800 the keyboard controller does not have SW1 or VR3 fitted and the wiring to pins 19 to 25 is shown in Fig. 59.*

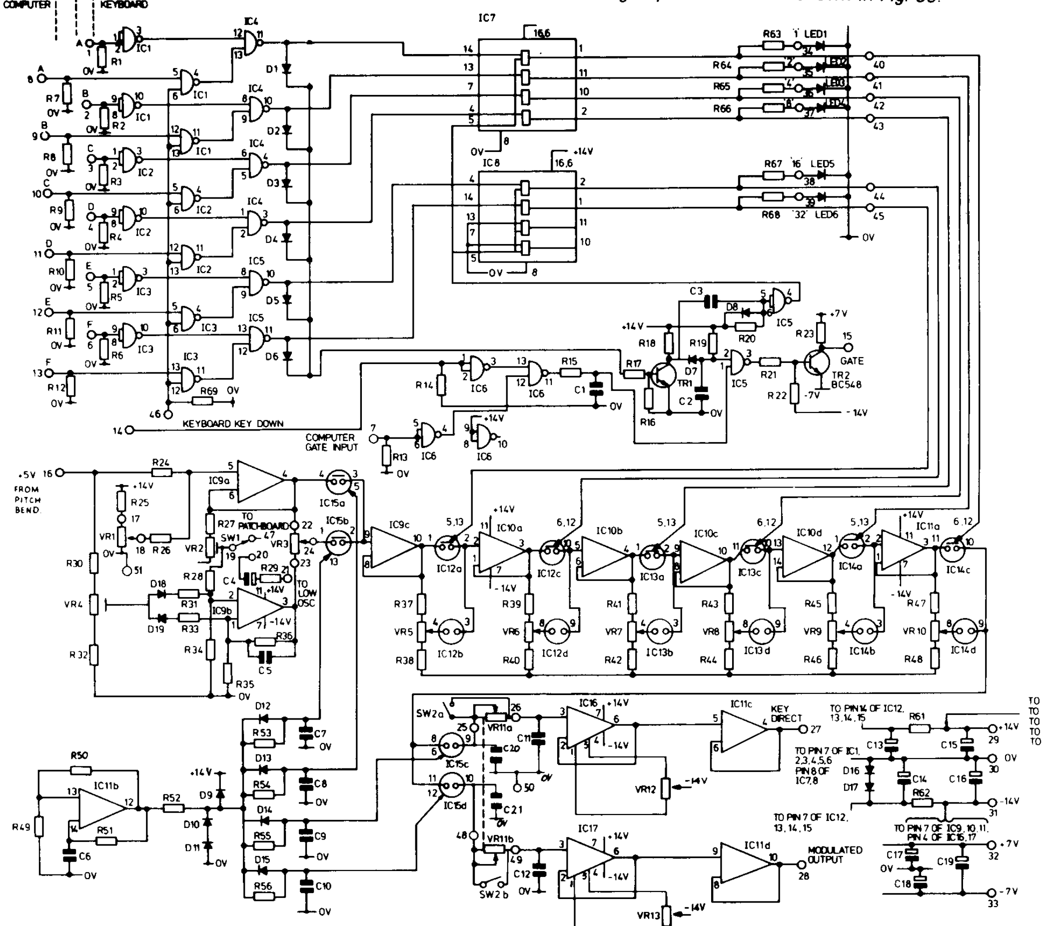


Fig. 7 Circuit Diagram of Keyboard Controller

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 and clear the patchboard.

Note

We recommend using one of our Preset Trimmer tools for adjusting the presets. The easiest way to adjust the 15-turn cermets is to cut the recessed end off about 35mm (1½in.) long and use that piece.

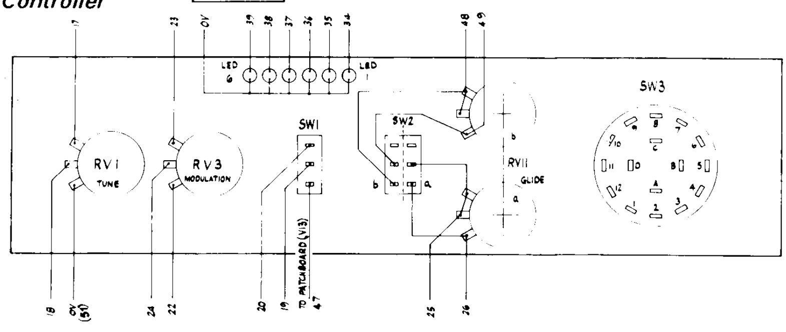


Fig. 8 Front Panel Wiring for Keyboard Controller

10 Setting-up Keyboard Controller for 5600S Continued

Patch oscillator 1 and oscillator 2 to 'key direct', mix the outputs together and listen. Set both oscillators to 2 foot, free run to zero, tune to centre (zero) and waveform to sine wave. Set the modulation control on the keyboard controller to zero and to be certain, strap pin 22 to pin 24 on the keyboard controller pcb. Depress top C and adjust oscillator 2 tune control to give as near to zero beat as possible.

Remove the patch pin from oscillator 2/key direct and replace in oscillator 2/key modulate. Adjust VR13 in the keyboard controller for zero beat. Remove the strap from pin 22 to pin 24.

Turn the modulation control fully anticlockwise. As a convenient source of 0 to 5V, patch transient A to 'key modulate' input. Switch modulation to patch and depress the second D down on the keyboard. Remove the patch pin from oscillator 2 input and advance the free run control on oscillator 2 for zero beats. Move patch pin from Osc 1/key direct to Osc 1/key modulate.

Turn the modulation control fully clockwise and depress top D. Adjust transient A final level fully anticlockwise (OV output) and adjust VR4 on the keyboard controller for zero beats. Depress the second D down again and remove the patch pin from the 'key modulate' input. Adjust VR2 on the keyboard controller for zero beats.

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

32 foot
16 foot
8 foot
4 foot
2 foot
1 foot
½ foot

Half tone factor is $\sqrt[12]{2}$
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					2†																		HW
Foot Sw Control					4†																		HW
Glide Control					20	26																	HW
Glide Control					21	25																	HW
Glide Control					22	48																	HW
Glide Control					23	49																	HW
Retrigger					24					5	5												MS
O/P Retrigger					25													SK11					MS
Sine Modulation					27	21																	HW
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

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
I/P from Computer						7-13	Computer inputs not used in this book																
Key Down						14	1																HW
Gate						15			17	27		27						SK12				H25	MS
5V from Pitch Bend						16														4			HW
Key Direct						27																H20	MS
Key Modulated						28																H21	MS
Computer						40-45	Computer Outputs not used in this book																
Computer						46	Computer Strobe not used in this book																
I/P for Foot Sw to Gate							11†																HW
O/P Mixer 1								11														H1	MS
O/P Mixer 2								31														H2	MS
O/P Mixer 3								51														H3	MS
I/P A Mixer 4								61														V17	MS
I/P B Mixer 4								62														V18	MS
O/P Mixer 4								71														H4	MS
I/P A Mixer 5								81														V19	MS
I/P B Mixer 5								82														V20	MS
O/P Mixer 5								91														H5	MS
Trapezoid O/P									8-VCA Pcb 8													H13	MS
I/P Envelope Signal									22													V24	MS
O/P Envelope Signal									23													H12	MS
Trigger OR Gate										16	6												HW
Period 'C' End Signal										17	1												HW
Retrigger Enable										22	4												HW
Retrigger Timing										23	2												HW
Retrigger Timing										24	3								47				HW
O/P Transient 'A'										25												H14	MS
Trigger I/P											7	16											HW
Trigger											8	5											HW
Manual Trigger I/P											9	18											HW
+7V Supply										13	10												HW
-7V Supply										15	11												HW
O/P Transient 'B'												25										H15	MS
I/P Filter 1 Control													A									V7	MS
I/P Filter 1 Signal													E									V21	MS
O/P Filter 1													W									H7	MS
I/P Filter 2 Control														A								V8	MS
I/P Filter 2 Signal														E								V22	MS
O/P Filter 2														W								H8	MS
I/P VCA 1 Signal															1							V25	MS
O/P VCA 1															6							H16	MS
I/P VCA 1 Control															7							V11	MS
I/P VCA 2 Signal																1						V26	MS
O/P VCA 2																6						H17	MS
I/P VCA 2 Control																7						V12	MS
I/P Signal																	1					V23	MS
I/P Reverb Control																	2					V9	MS
O/P Reverb/Phase																	16					H11	MS
I/P Phase Control																	9					V16	MS
I/P Control Voltage 2																		SK1	43				MS
I/P Control Voltage 1																		SK2	40				MS
Return Echo																		SK3	VR13†				MS
Send Echo																		SK4	VR13†			V29	MS
I/P External 2																		SK5			13		MS
I/P External 1																		SK6			12		MS
O/P Stereo																		SK7	VR15				2MS
Foot Switch																		SK8†					MS
Foot Pedal																		SK9	20,21				MS
I/P/O/P Computer Data																		SK10	Not used in this book				
Pan L/H																			2			V10	MS
Channel 1																			5,VR13†				MS
Channel 2																			14			V30	MS
Foot Pedal Range																			22,23†				HW
Foot Pedal O/P																			24			H28	MS
Inverter I/P																			25			V27	MS
Inverter O/P																			27			H24	MS
Joy Lever Horizontal																			31	JPA2			HW
Joy Lever Horizontal																			33			H30	MS
Joy Lever Horizontal																			34	JPB2			HW
Joy Lever Horizontal																			36			H29	MS
Exp. Converter I/P																			37			V15	MS
Exp. Converter O/P																			39			H26	MS
Ext. I/P 1 to Patch																			42			H22	MS
Ext. I/P 2 to Patch																			45			H23	MS
+14V Supply																			28	1			HW
0V																			35	2			HW
+7.5V Supply																			46	5			HW
Ext. I/P 1 O/P																					5	H9	MS
Ext. I/P 2 O/P																					6	H10	MS
Trigger from Patch																					11	V14	MS
Key Mod from Patch						47																V13	MS
+14V Supply						29	8																HW
0V to Encoder						30	9																HW

Note 1

All screens of screened wires to patchboard are earthed at the patchboard only.

Key

HW Hook-up Wire

MS Cable Twin split in half and each side used individually.

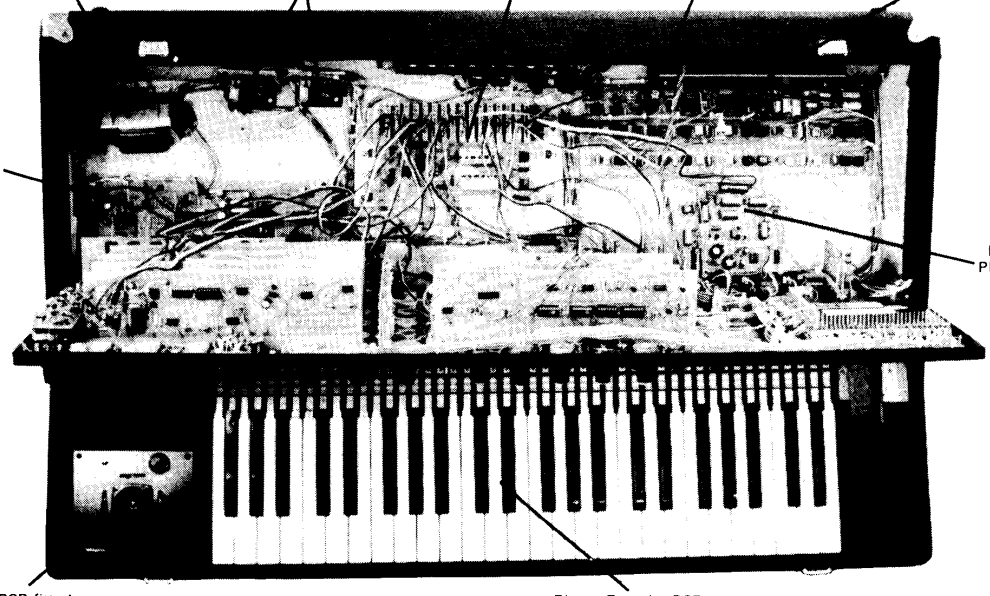
Note 2

The patchboard tags are numbered H1 to H30 down the side and V1 to V30 across the top with V1 adjacent to H1. Thus hole H10/V3 is the tenth socket down in the third vertical row across.

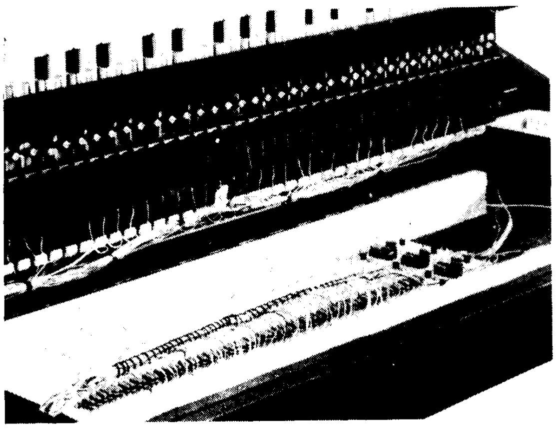
† See Fig. 56.

TABLE 3

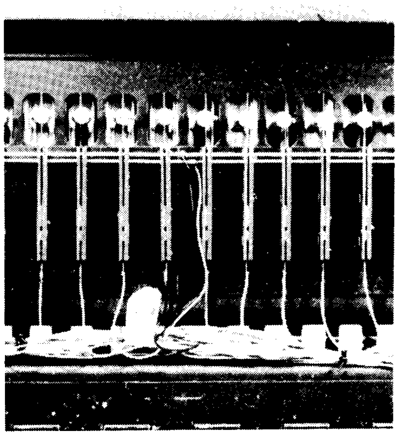
Adjust	RV1	RV2	RV3	RV4	RV5	RV6	RV7
Range	32ft	16ft	8ft	4ft	2ft	1ft	½ft
Frequency	587.3	1174.7	2349.3	4698.6	9397.3	18974	37948



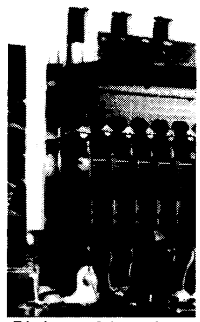
5600S Internal Layout



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.

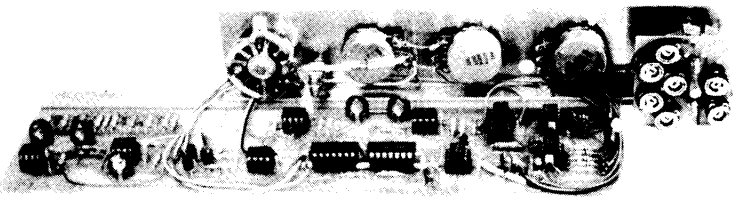
Switch oscillator 2 to 'key mod' and adjust VR13 in the keyboard controller for zero beat. Remove the strap from pin 22 to pin 24 and reconnect the wire from pin 23 to pin 24. Turn the three modulation controls fully anticlockwise. Adjust VR4 on the keyboard controller for zero beats. Set VR2 to centre position (this preset has no effect in the 3800 synthesiser).

Oscillator Construction

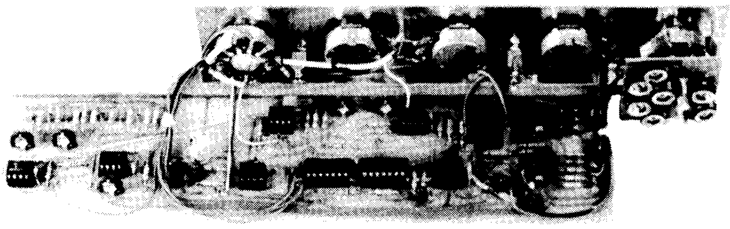
Assemble the four identical oscillator pcb's. Fit the pins and wire links, then all the other components taking care with the orientation of the polarised components. Solder the components then plug in all the IC's. Note that the bracket mounted components of oscillator 1 are wired slightly differently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

Prepare the maka shaft for SW1. Remove the ⅜in. 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 1



Oscillator 2,3,4

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 500Ω and the off resistance is around $10^{12}\Omega$. 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 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 ½ 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.

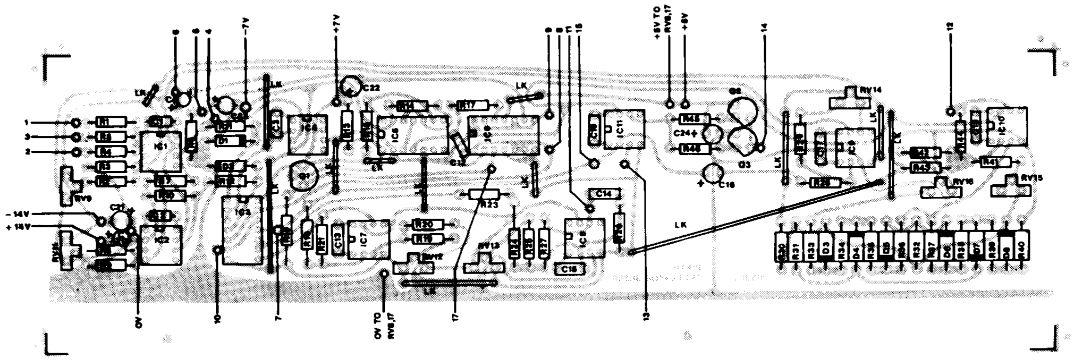


Fig. 9 Component Overlay for Oscillator

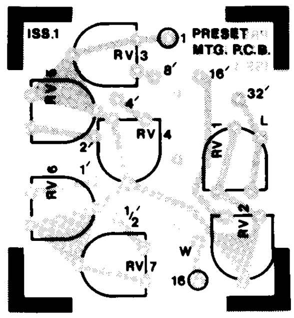


Fig. 10 Component Overlay for Preset Mounting pcb

[8] 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.

[9] 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
½ foot range: adjust RV7

When setting up 1 foot and ½ 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)	1N4148
SW1	Maka Shaft with two Maka Wafer 1p 12w
SW2	Maka Shaft with one Maka Wafer 2p 6w MB
SW3 (required for oscillators 2,3 and 4 only)	Sub Min Toggle A
SW4	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 ¼in.
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)

(2) 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.

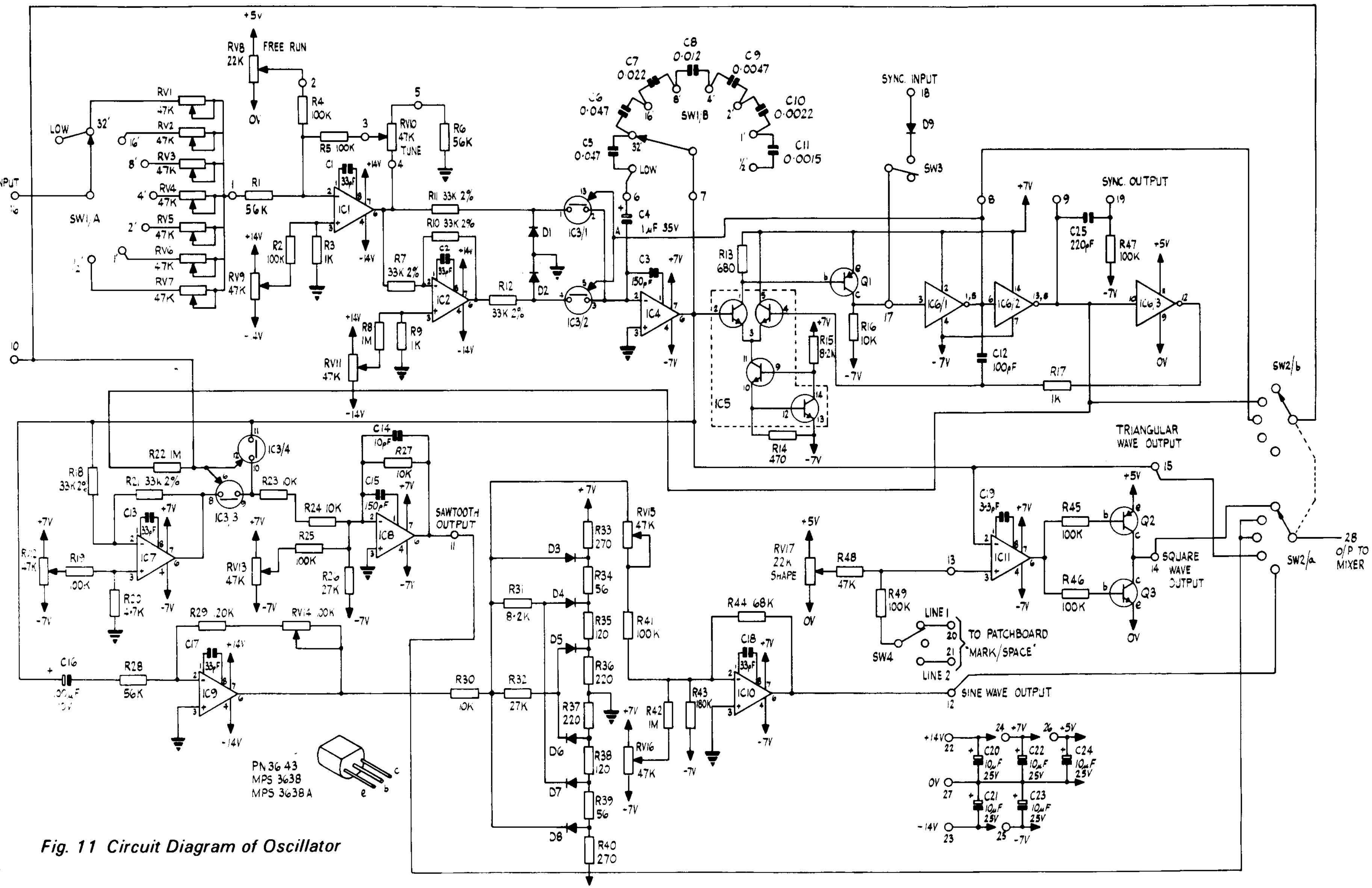


Fig. 11 Circuit Diagram of Oscillator

5. Adjust RV13 to set the lowest edge of the waveform at zero volts.
6. Select the ½ 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.

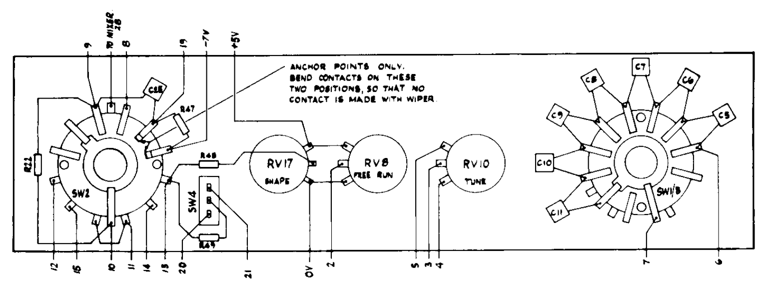


Fig. 12 Front Panel Wiring for Oscillator 1

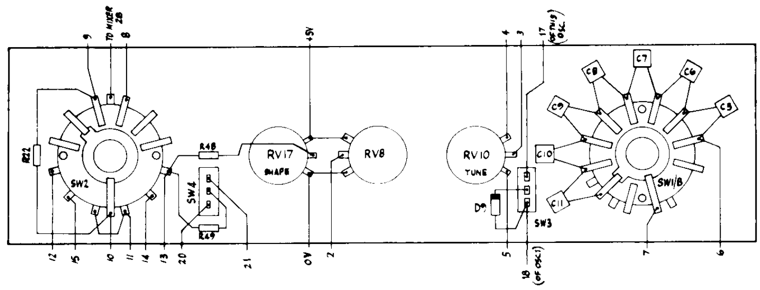


Fig. 13 Front Panel Wiring for Oscillators 2, 3 & 4

(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 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.

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
½ foot range: adjust RV7

When setting up 1 foot and ½ foot ranges it will be necessary to depress a lower note so that the beat is clearly audible.

Mixer Construction

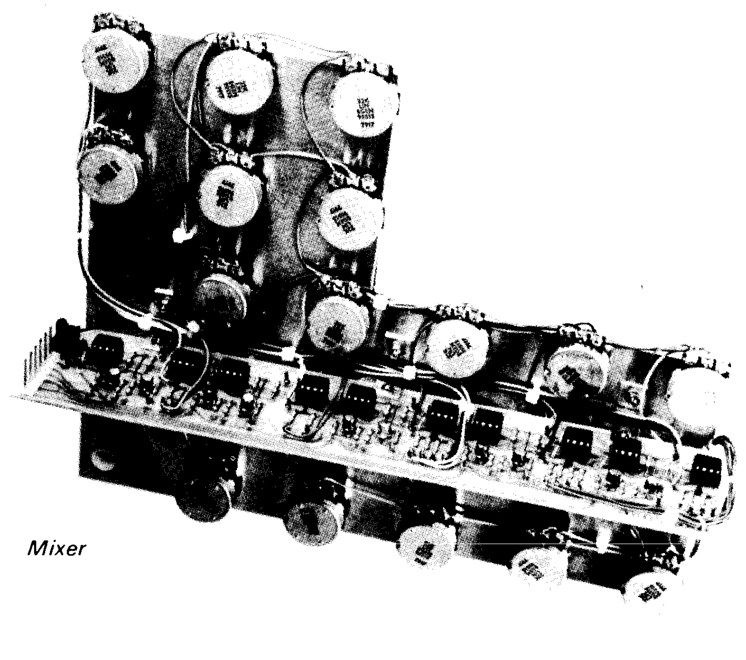
Assemble the pcb as shown in the component overlay Fig. 14. Insert the pins then all the other components taking care with the orientation of the polarised components. Finally plug the IC's into their holders. Bolt all the potentiometers to the mixer chassis and interwire them as shown in Fig. 16. Mount 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

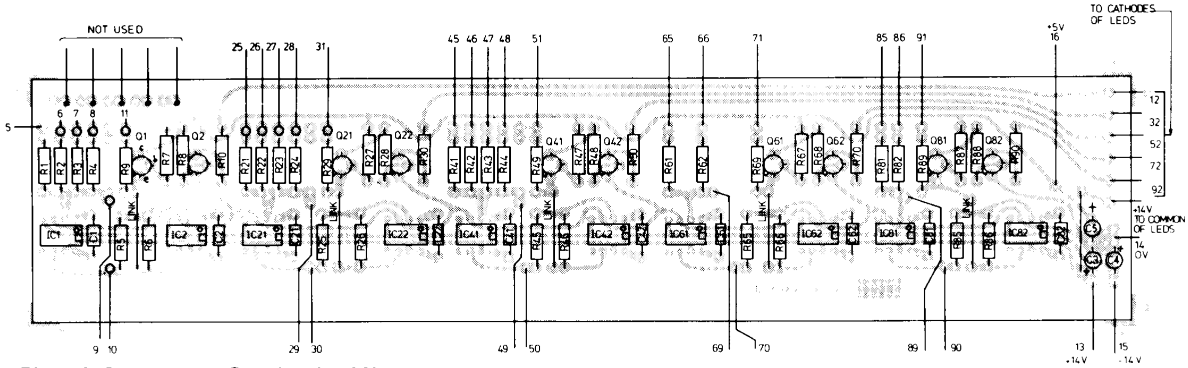


Fig. 14 Component Overlay for Mixer

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.

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 470Ω

C1,2,21,22,41,
42,61,62,81,
82 Ceramic 33pF
C3,4,5 Tant 10μF25V

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

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 ¼in.
3 C/S Screw 6BA ½in.
6 Nut 6BA
6 Shake 6BA

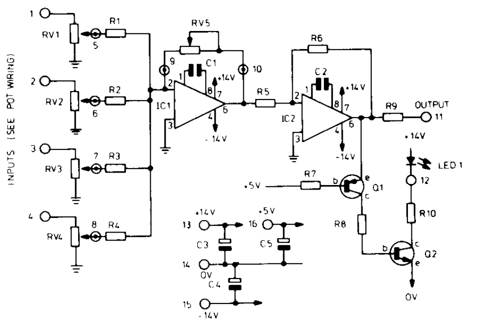


Fig. 15 Circuit Diagram of Mixer

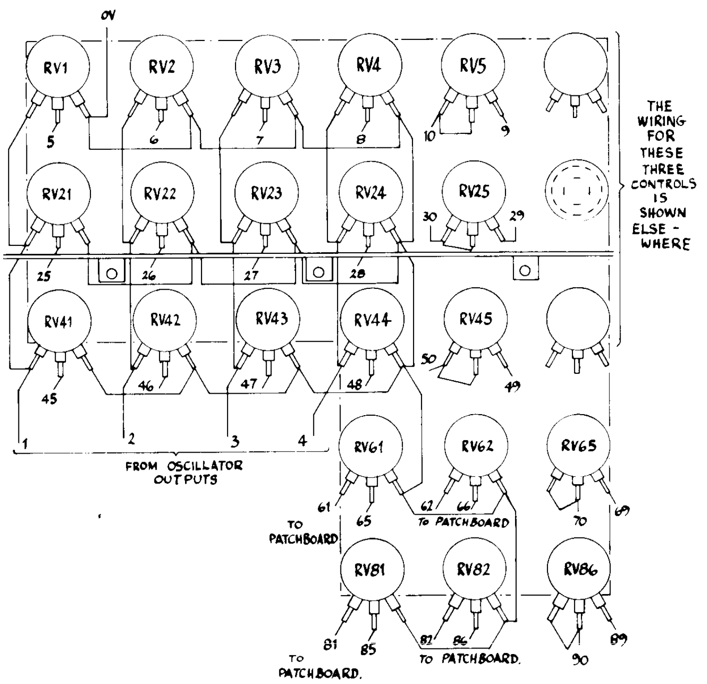


Fig. 16 Front Panel Wiring for Mixer

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

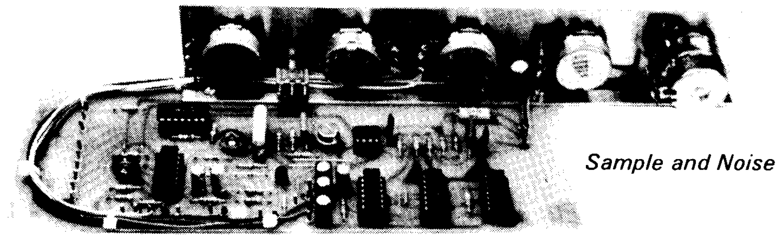
White noise is generated digitally by an 18-bit shift register which is clocked at about 35kHz. Several feedback loops around the shift register cause it to generate a pseudo-random bit pattern which closely approximates white noise.

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 sinewave. 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 μF 100V
C2	Ceramic 100pF
C3	Mylar 0.002 μF
C4	Mylar 0.001 μF
C5	Polyester 0.015 μF
C6,7	PC Elect 2.2 μF 63V
C8	Polyester 0.022 μF
C9	Polyester 0.47μ F
C10,11,12	PC Elect 10μ F 35V
C13	Axial 1 μ 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	μA741C 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 ¼in.
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.

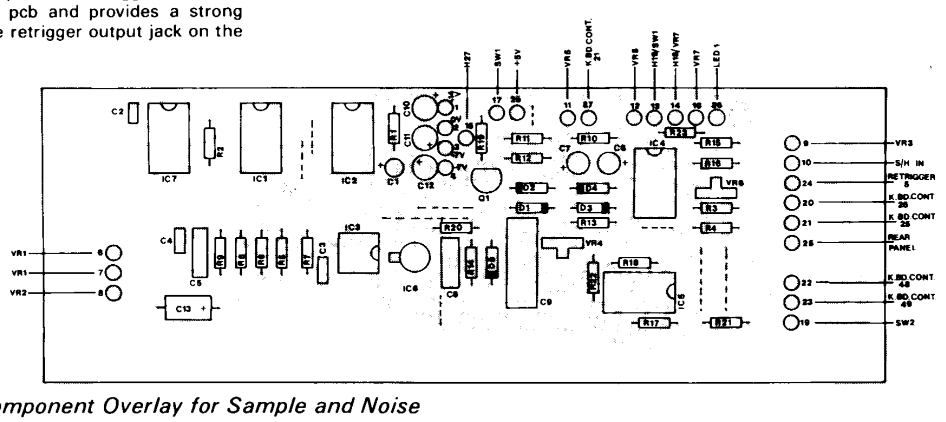


Fig. 17 Component Overlay for Sample and Noise

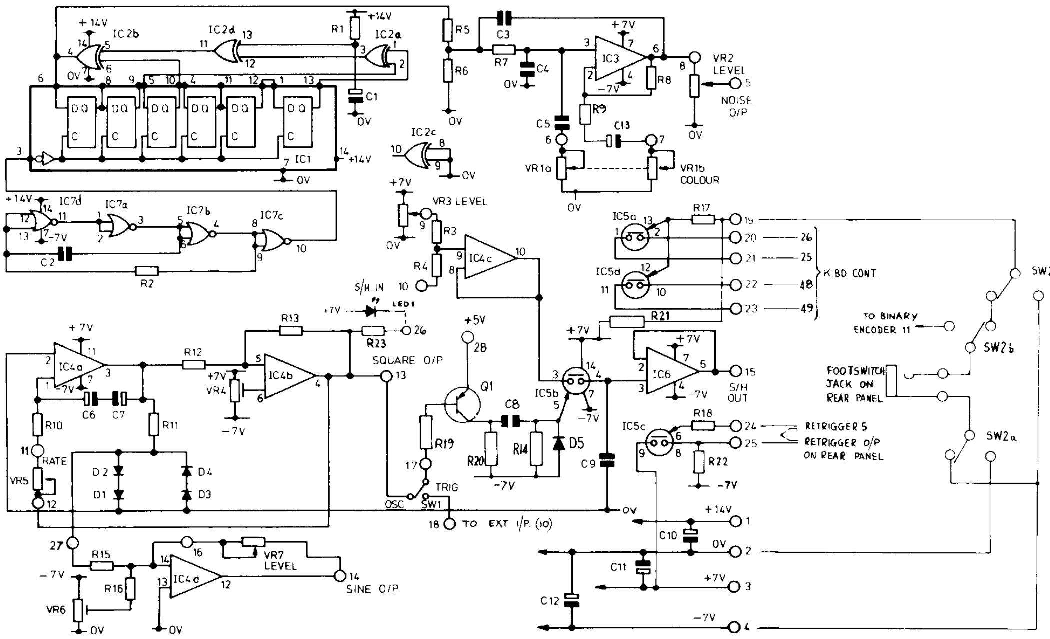


Fig. 18 Circuit Diagram of Sample and Noise (5600S only)

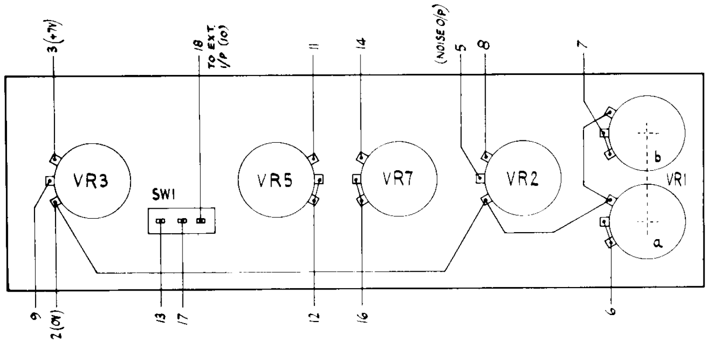


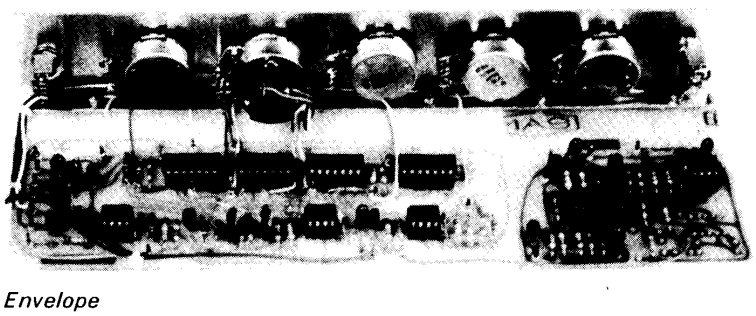
Fig. 19 Front Panel Wiring for Sample and Noise (5600S only)

(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 OV.

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

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 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 OV 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 transistion 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

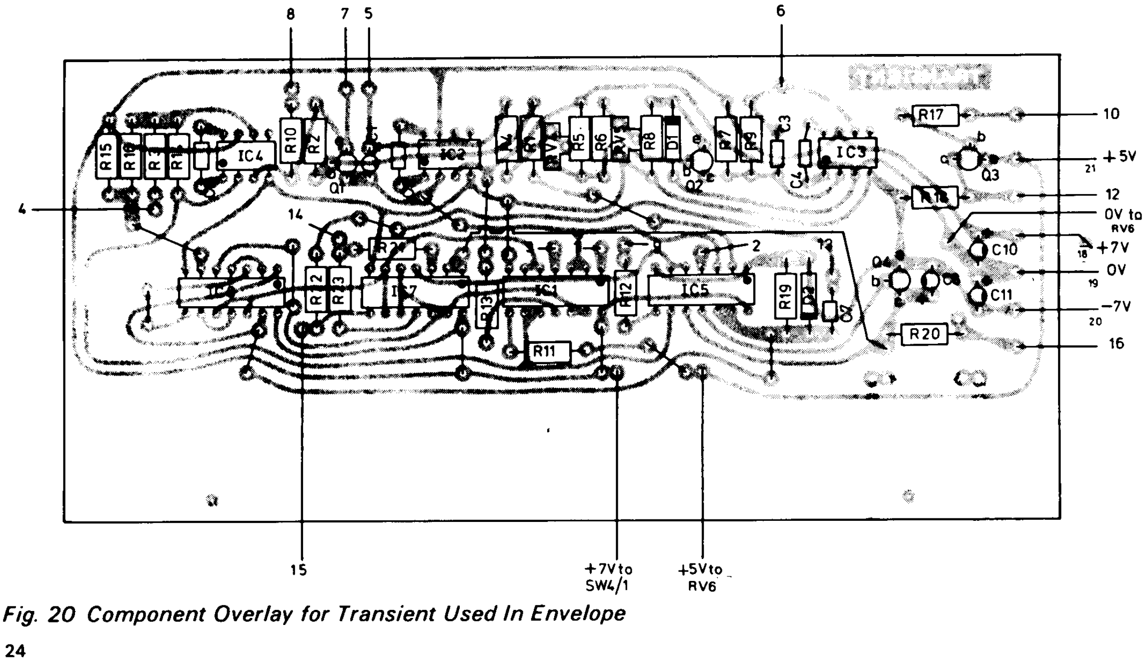


Fig. 20 Component Overlay for Transient Used In Envelope

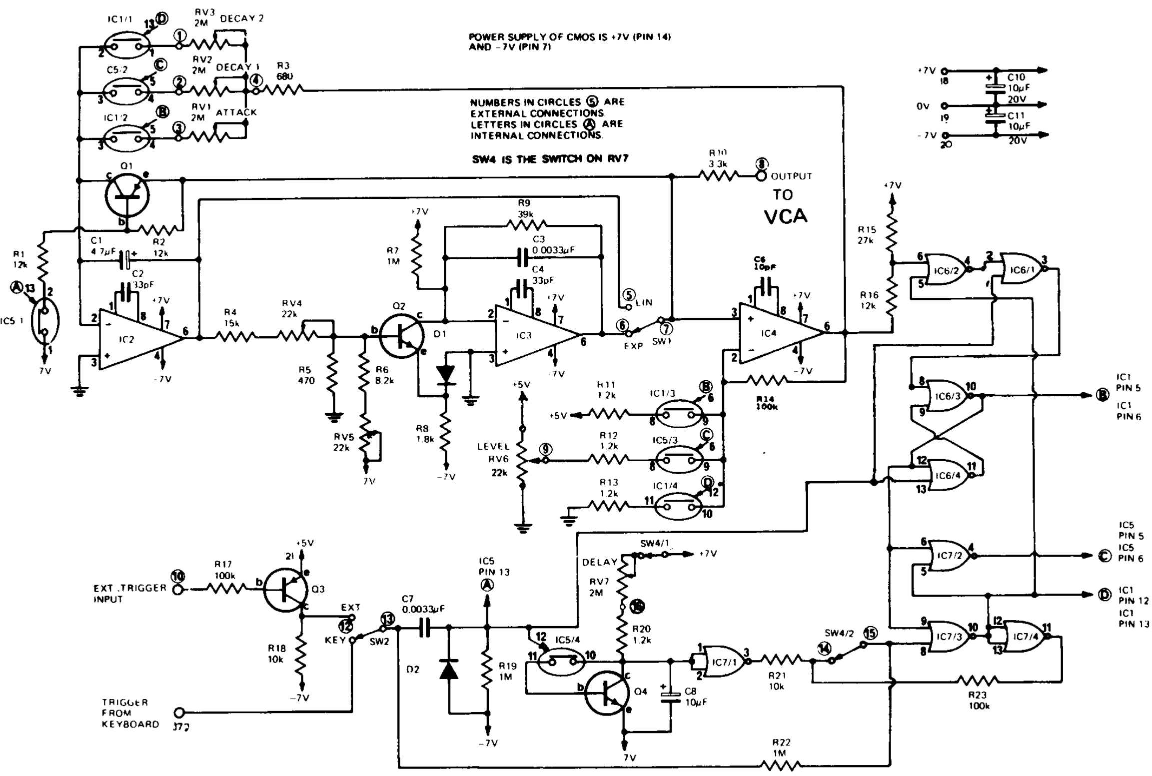


Fig. 21 Circuit Diagram of Transient Used In Envelope

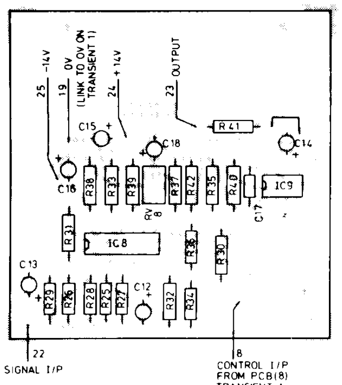


Fig. 22 Component Overlay for VCA Used In Envelope

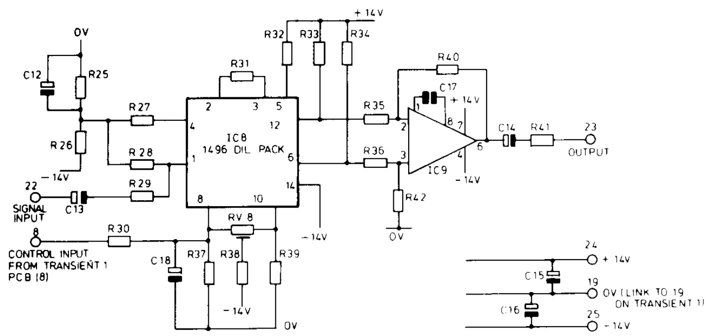


Fig. 23 Circuit Diagram of VCA Used In Envelope

SW1	Sub-Min Toggle A
SW2 (for 5600S only)	Sub-Min Toggle A

Also required

1 Synth Trans Gen 1 PCB
1 Synth VCA PCB
1 Trans Gen 1/Env Bkt
1 Wafercon Skt 8-way
8 Wafercon Terminals
28 Veropin 2141
5 DIL Socket 14-pin
4 DIL Socket 8-pin
4 Bolt 6BA ¼in.
4 Nut 6BA
4 Shake 6BA
5 15mm Collet Knob Black
5 15mm Collet Nut Cover
5 15mm Collet Cap Grey (for 5600S only)
5 15mm Collet Cap Red (for 3800 only)

16 Setting-up Envelope for 5600S

Turn all envelope front panel controls anticlockwise. Switch to linear and trigger to external and check that output of Trans board (pin 8) is at 0V. Adjust RV5 until the output of IC3 is at 0V. Turn 'delay' and 'hold level' to maximum, switch trigger to key and depress a key on the keyboard. The output should go to about +5V and stay there for about 10 seconds. Whilst the output is at +5V adjust RV4 so that the output of IC3 is also at +5V. Recheck the 0V level and readjust if required. Repeat the procedure until both levels are correct.

Switch to exponential and check that the output of IC3 never goes negative during an envelope cycle. Turn all the controls fully anticlockwise except 'hold level' which should be turned fully clockwise. Patch a signal to the input of the envelope and patch H12/V30. Now adjust RV8 on the VCA pcb on the envelope bracket for minimum output.

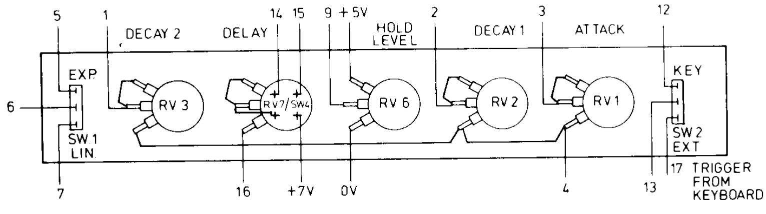


Fig. 24 Front Panel Wiring for Envelope

⑩ Setting-up Envelope for 3800

Turn all envelope front panel controls anticlockwise, but do not switch delay to 'key'. Switch to linear and switch envelope on the 'triggers' switches to 'external input.' Check that output of trans board (pin 8) is at 0V. Adjust RV5 until the output of IC3 is at 0V. Turn 'delay' and 'hold level' to maximum, switch envelope on 'triggers' switches to 'keyboard' and depress a key on the keyboard. The output should go to about +5V and stay there for about 10 seconds. Whilst the output is at +5V adjust RV4 so that the output of IC3 is also at +5V. Recheck the 0V level and readjust if required. Repeat the procedure until both levels are correct.

Switch to exponential and check that the output of IC3 never goes negative during an envelope cycle. Turn all the controls fully anticlockwise except 'hold level' which should be turned fully clockwise. Turn oscillator 1 to off, advance free run control, and switch to output. Check that a strong signal can be heard. Switch oscillator 1 to envelope. Adjust RV8 on the VCA pcb on the envelope bracket for minimum output.

VCA Construction

Assemble two VCA pcb's using the component overlay Fig. 25 taking care with the orientation of the polarised components. Mount the front panel components and the pcb on the bracket and interwire the components as shown in Fig. 27. Finally mount the two identical modules to the front panel.

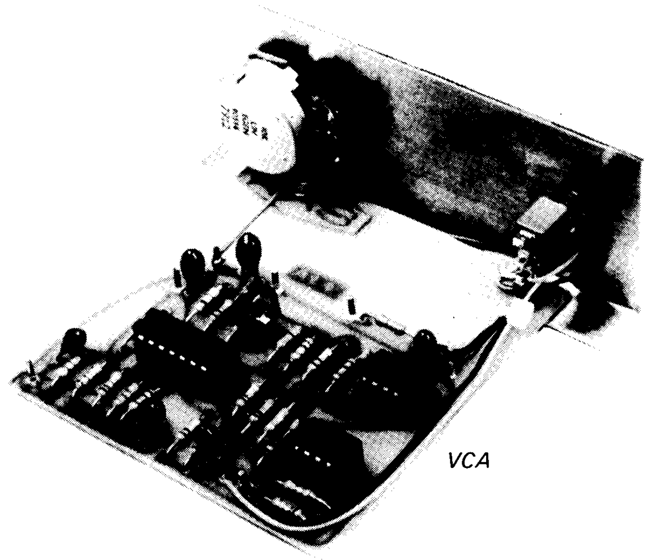
VCA — How It Works

The voltage controlled amplifier is constructed around an MC1496 integrated circuit. This is a balanced modulator/demodulator, the internal circuitry of which is shown in Fig. 28. The MC1496 has differential outputs, i.e. two outputs in antiphase, which are not referred accurately to the 0V line. A buffer amp IC3, having differential inputs is therefore used to provide a single ended output.

The MC1496 has two sets of differential inputs, one set biased at about 0V and another set biased at approximately -3V. The input signal is injected into one of the -3V biased inputs (pin 1), whereas the control signal is fed to the other input, pin 8.

When using the circuit as a VCA, the maximum possible attenuation is required when the input is 0V. However, due to tolerance variations, the 0V from other modules may be up to 20mV in error. Hence a rectifier, IC1, is used so that any voltage less than +50mV is regarded as 0V. The maximum attenuation at 0V control is adjustable by RV1.

When the module is used as a ring modulator the control signal is ac coupled and the output will be the product of the two inputs.



VCA

17 Setting-up VCA for 5600S

Apply a signal to the input of each VCA in turn. Switch to amp and level to maximum. Patch H13/V11 (then H13/V12) and H16/V30 (then H17/V30) and adjust VR1 for minimum output.

⑪ Setting-up VCA for 3800

Switch oscillator 1 to VC Amp. Switch VC Amp control input to transient and the function switch to VCA and switch to output. Adjust slope 2 to minimum and final level fully anticlockwise on transient and adjust VR1 for minimum output.

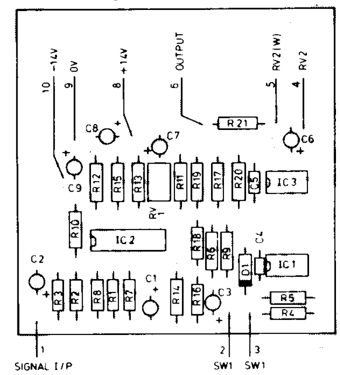


Fig. 25 Component Overlay for VCA

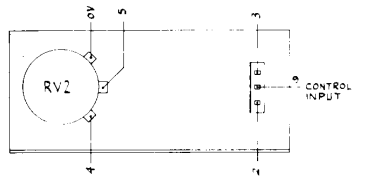


Fig. 27 Front Panel Wiring for VCA

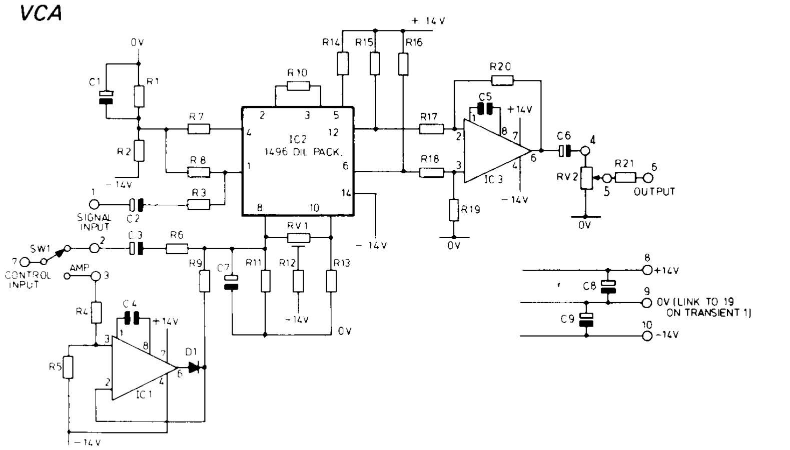


Fig. 26 Circuit Diagram of VCA

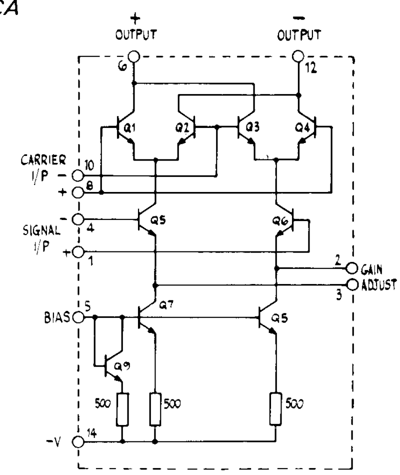


Fig. 28 Internal Circuit of MC1496

Parts List for VCA

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

R1	Min Res 8k2
R2,15,16	Min Res 22k
R3	Min Res 4k7
R4,7,8,10	Min Res 12k
R5	Min Res 3M3
R6	Min Res 10k
R9	Min Res 39k
R11,13	Min Res 330Ω
R12	Min Res 470k
R14,17,18,19, 20	Min Res 100k
R21	Min Res 3k3
RV1	Vert S-Min Preset 10k
RV2 for 5600S only	Pot Log 10k
C1	Tant 33 μF 10V
C2,3,6	Tant 4.7 μF 35V
C4,5	Ceramic 33pF
C7	Tant 0.47 μF 35V
C8,9	Tant 10 μF 25V
IC1,3	LM301A
IC2	MC1496
D1	1N4148
SW1	Sub-Min Toggle A

Also required

1 VCA PCB

1 DIL Socket 14-pin
2 DIL Socket 8-pin
9 Veropin 2141
1 Wafercon Socket 8-way
8 Wafercon Terminals
2 Bolt 6BA ¼in.
2 Nut 6BA
2 Shake 6BA

Also required for 5600S only

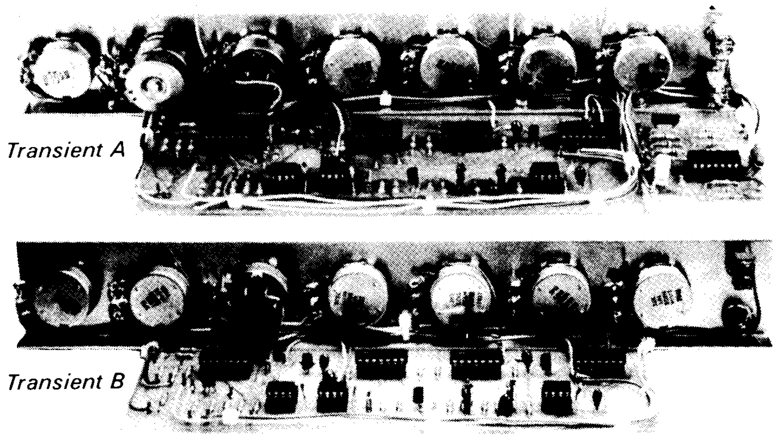
1 15mm Collet Knob Black
1 15mm Collet Nut Cover
1 15mm Collet Cap Blue
1 VCA Mtg Bkt

Also required for 3800 only

1 3800 VCA Bkt

Transient A and B Construction

The only difference between transient A and B is that transient A is constructed with a retrigger pcb and transient B has a retrigger pushbutton on the front panel. Assemble two transient 2 pcb's as shown in Fig. 29 and one transient retrigger pcb as shown in Fig. 33. Mount one transient 2 pcb and one retrigger pcb on one bracket and mount the front panel controls and interwire them as shown in Fig. 31. This module is transient A. Transient B simply uses one transient 2 pcb which should be fixed to the bracket along with the front panel controls and wired as shown in Fig. 32. Finally mount both modules to the front panel with transient A immediately below envelope and transient B below that.



Transient 2 — How It Works

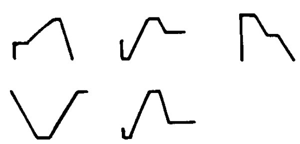
This pcb consists of two main sections.
(1) The analogue wave shaping circuitry.
(2) The digital control circuitry.

The analogue section is almost identical to the 'transient' part of the envelope and reference should be made to that. The main exception is the omission of the reset-transistor across the integrator IC. Additionally the three inputs to the comparator are all adjustable, the 'attack' potentiometer has been deleted and the 'attack time' is thus always at its maximum rate.

The digital section, however, is different and works as follows. When a trigger pulse is presented to gate IC5/4 it turns on for about 3 milliseconds. This discharges C7 via Q4. The resulting low level at the input of IC6/2 gives a 'high' output at (A) (IC6/4) and LED 1 lights. Whilst (A) is high, C4 will remain discharged.

A high output at (A) will select the maximum slope rate and the 'start level' potentiometer RV7. The output will go rapidly (within 5 milliseconds) to the level set by RV7. After the initial 3 millisecond period, C7 begins to charge at a rate selected by 'delay 1' control, RV6. When C7 charges to approximately 0V the output at (A) will go low allowing output (B) to go high selecting 'slope 1' and the 'hold level' as set by RV8. Also LED 1 is extinguished and LED 2 lights. The output will now charge towards this new level at the rate selected by 'slope 1'. At the same time C4 is also released and begins to charge. When about half charged (around 0V) the output (B) will go low and output (C) high. Thus 'slope 2' is selected and the 'final level' set by RV9. Also LED 2 is extinguished and LED 3 lights. The output cycle is now complete and the final level will be maintained until the unit is retriggered.

Note that the slopes can be in either direction depending only on the settings of the level potentiometers. Below are examples of output waveforms available.



If the 'hold delay' pot, RV5, is switched off, the 'key hold' time replaces the hold delay, and, if the 'key hold' time is less than 'delay 1', then at the completion of 'delay 1', 'slope 2', and 'final level' will be selected — thus eliminating 'slope 1' and 'hold level'.

Transient Retrigger — How It Works

C3, D5, D6, R6 and R7 are used with the push-button on transient B to provide a manual trigger pulse. The rest of the board is associated with transient A and works as follows. The normal trigger pulse from the keyboard or external input goes through D4. If it is desired to restart the transient cycle as soon as it ends then opening SW3 removes -7V from IC1d input. When the transient enters 'slope 2' and RV1 on transient A is selected, C1 starts to charge through the second gang of RV1. At the end of 'slope 2' period the voltage at the input to IC1d crosses the threshold voltage, the output goes negative and the output of IC1c goes positive. The change is speeded up by R3 which gives a positive feedback. A positive pulse appears at IC1a input 1 and IC1b inverts the pulse and further amplifies it and applies the positive pulse via D3 to the trigger input of transient A.

[4] Setting-up Transient A and B for 5600S

Connect a voltmeter between the output of Transient A (e.g. the lead of R20 closest

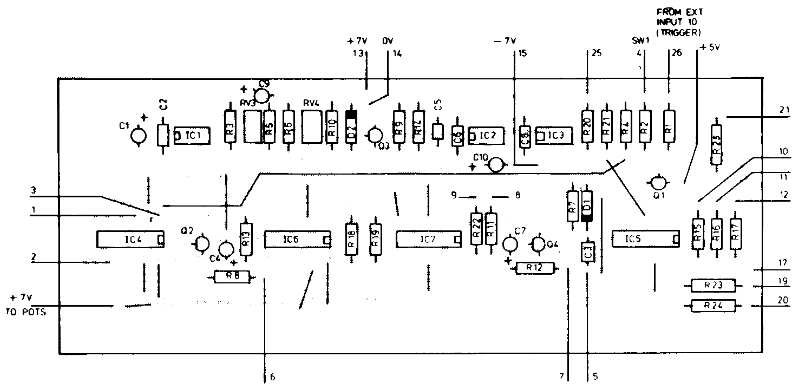


Fig. 29 Component Overlay for Transient 'A/B'

3800 & 5600S Synthesiser

The setting-up instructions for the Transient A & B in the 5600S and the Transient in the 3800 are incorrect. Setting-up should be carried out as follows. On the Transient pcb turn VR3 and VR4 fully clockwise. Turn the 'Final level' control to +10 and connect a ' scope to pin 25. Adjust VR4 until the maximum voltage is attained. Now turn VR3 fully anticlockwise and then turn it slowly clockwise until the maximum voltage is attained. If oscillation occurs turn VR4 slightly further anticlockwise and readjust VR3. In 5600S only, repeat For Transient B.

On the Transient, R2O should be removed and replaced by a wire strap. In the VCF, Rll should be a 390k.

In Fig. 69 there is a wire from FPC12 shown connected to OV. There should not be anything connected to this point. Also FPC2 has a wire shown connected to Keyboard Controller pin 23. This wire should, however, be connected to Interface pin 15.

On the Interface pcb connect a ceramic lOpF across R1 and another across R4.

In the 3800 only on the 'sample and noise' board link pins 13 and 17.

to the edge of the pcb) and 0V. Turn slope 2 to maximum and final level to -10 and adjust RV4 for 0V. Turn final level to +10 and adjust RV3 for +5V. Repeat with Transient B.

5 Setting-up Retrigger for 5600S

On Transient A, switch to 'key' and 'retrigger'. With no keys pressed and all slopes and delays at 3, check that the LED's light in rotation continuously. Now hold a key pressed and check that the rotation is arrested and LED 3 is lit permanently. Release the key and there should be no change. Quickly tap any key and the rotating sequence should restart.

8 Setting-up Transient for 3800

Connect a voltmeter between the output of the transient (e.g. the lead of R20 closest to the edge of the pcb) and 0V. Turn slope 2 to maximum and final level to -10 and adjust RV4 for 0V. Turn final level to +10 and adjust RV3 for +5V.

9 Setting-up Retrigger for 3800

Switch transient on 'triggers' switches to 'repeat'. With no keys pressed and all slopes and delays at 3, check that the LED's light in rotation continuously. Now hold a key pressed and check that the rotation is arrested and LED 3 is lit permanently. Release the key and there should be no change. Quickly tap any key and the rotating sequence should restart.

Parts List Transient A and B

(1 of each required for 5600S; 1 of 'A' only required for 3800)

R1,19,21,22	Min Res 100K
R2,13,18	Min Res 10k
R3	Min Res 15k
R4	Min Res 680Ω
R5	Min Res 470Ω
R6	Min Res 8k2
R7,9,11	Min Res 1M
R8,12,15,16,17	Min Res 1k2
R10	Min Res 1k8
R14	Min Res 39k
R20,23,24,25	Min Res 3k3
C1	Tant 4.7μF 35V
C2,6	Ceramic 33pF
C3,5	Carbonate 0.0033μF
C4,7	Tant 2.2μF 35V
C8	Ceramic 10pF
C9,10	Tant 10μF 25V
Q1	MPS3638
Q2,3,4	PN3643
IC1,2,3	LM301A
IC4,5	4016BE
IC6,7	4011BE
D1,2	1N4148
LED1,2,3	LED Red
RV1 a,b for Trans A only	Dual Pot Log 2M2
RV1 a for Trans B (5600S) only	Pot Log 2M2
RV2,6	Pot Log 2M2
RV3,4	Vert S-Min Preset 22k
RV5	Sw Pot Log 2M2
RV7,8,9	Pot Lin 22k
SW1 for 5600S only	Sub-Min Toggle A
SW3 for 5600S Trans A only	Sub-Min Toggle A
SW4 for 5600S Trans B only	Push Sw

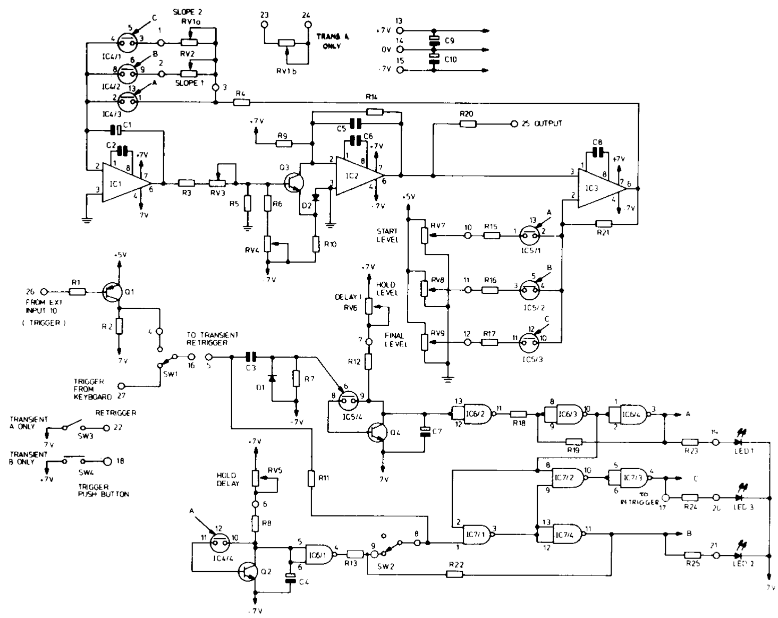


Fig. 30 Circuit Diagram of Transient 'A/B'

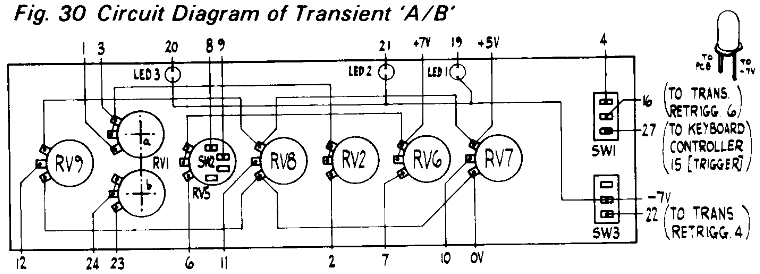


Fig. 31 Front Panel Wiring for Transient 'A'

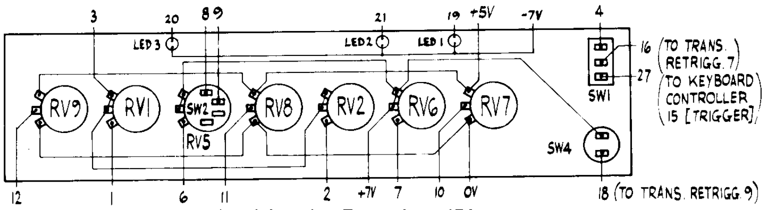


Fig. 32 Front Panel Wiring for Transient 'B'

Also required

1 Synth Trans 2 PCB
1 Trans 2 Mtg Bkt
4 DIL Socket 14-pin
3 DIL Socket 8-pin
1 Wafercon Skt 8-way
8 Wafercon Terminals
23 Veropin 2141
7 15mm Collet Knob Black
7 15mm Collet Nut Cover
2 Bolt 6BA ¼in.
2 Nut 6BA
2 Shake 6BA
7 15mm Collet Cap Blue (for Trans A in 5600S only)
7 15mm Collet Cap Red (for Trans B in 5600S only)
7 15mm Collet Cap Yellow (for 3800 only)

Parts List for Transient Retrigger

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

R1	Min Res 15k
R2	Min Res 4M7
R3	Min Res 10M

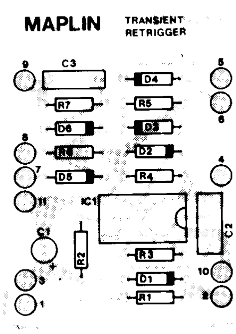


Fig. 33 Component Overlay for Transient Retrigger

R4	Min Res 220k
R5,6,7	Min Res 100k
C1	PC Elect 2.2 μF 63V
C2	Polyester 0.1μ F
C3	Polyester 0.01 μ F
D1 to 6	1N4148
IC1	4011BE

Also required

1 Trans Repeat PCB
1 DIL Socket 14-pin
11 Veropin 2141
2 Bolt 6BA ¼in.
2 Nut 6BA
2 Shake 6BA

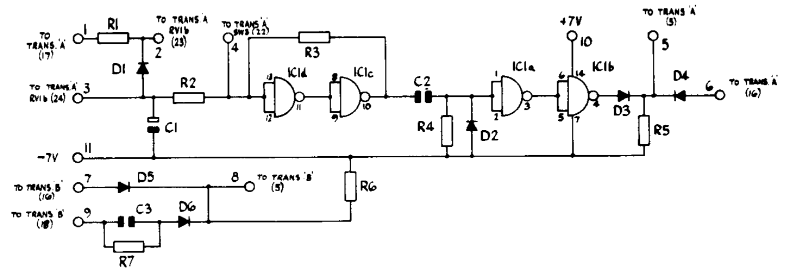


Fig. 34 Circuit Diagram of Transient Retrigger

Reverb and Phase Construction

Assemble the reverb and phase pcb using the component overlay Fig. 35. Fix the pcb to the base of the cabinet in the position shown in the internal layout photograph. Fix the spring line to the cabinet using rubber grommets. Wire the spring line to the pcb as shown in Fig. 35. Heatsinks should be clipped on to Q1 and Q2.

Reverb and Phase — How It Works

The input signal is buffered by IC1d and then split into three paths. One goes to the phasing circuitry via a low-pass filter formed around IC1a and IC1b. This filter gives a 24dB per octave cut above 10kHz to prevent high frequencies in the signal beating with the clock frequency in the bucket-brigade delay lines. The second path goes to the spring line drive circuits formed by IC2, Q1 and Q2. The push-pull transistor pair is provided to give a high current drive to the spring line which virtually eliminates mechanical noise due to the synthesiser being knocked in use. The third path goes directly to the output so that the phased or reverberated signals may be mixed with it.

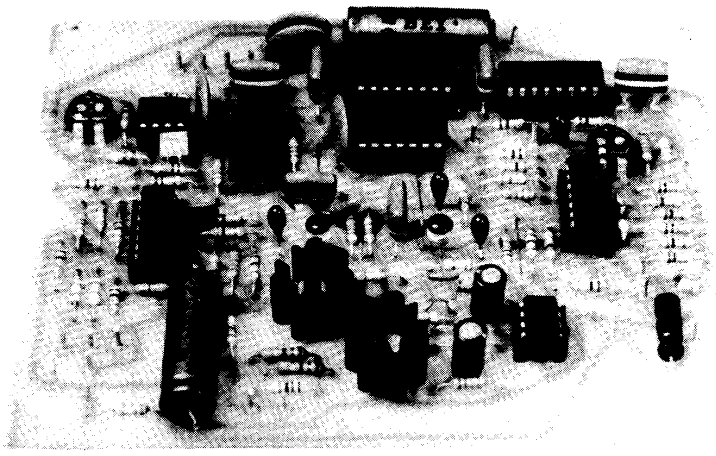
The amount of phased or reverberated signal compared to straight through signal in the output is controlled by the reverb/phase level control. This control sets the amount by which Q3 attenuates the straight through signal and also after inversion by IC1c, sets the amount by which Q4 attenuates the phased or reverberated signal such that as Q3 increases the attenuation of one signal, Q4 decreases the attenuation of the other signal.

The output from the low-pass filter is fed to IC4 whose output is fed both directly to IC3a and via IC5 to IC3a. IC4 and IC5 are 512-bit bucket brigade delay lines whose delays are set by the clock frequency which is adjustable between 25kHz and greater than 500kHz.

The clock frequency is controlled either by the phase angle control or 0 to +5V level from the patchboard. IC3c buffers the control voltage and sets its reference at 0V. The control voltage is linear but requires a different law to make the phasing effect linear. This is achieved by slowing the initial rate of change by clamping the voltage at the input of IC3d by D3 until the voltage exceeds the potential set by R50 and R51.

This voltage controls a voltage controlled oscillator IC6 whose frequency is set by C20 and VR2 which allows the minimum attainable frequency to be set. The output of the VCO goes to IC7 which produces two out of phase clock lines to drive IC4 and IC5.

Depending on the state of IC8 which is controlled by the switch on the phase angle control the reverberated or phased signal is fed to IC3a which amplifies the signal. It also incorporates a low-pass filter to reduce the level of any clock frequency present in the phased signal. IC3b mixes together and slightly amplifies the total output signal to give the correct levels at the output.



Reverb and Phase

21 Setting-up Reverb and Phase

Connect a voltmeter between TP2 on the reverb/phase pcb and 0V and adjust VR1 to give -5.5V. Set the phase angle control to fully anticlockwise, but not switched to reverb. Connect a frequency counter to TP1 and adjust VR2 for approximately 25kHz.

Parts List for Reverb and Phase

(1 required for 5600S only)

R1,2,12,17,24, 26,33,36,46, 47,53	Min Res 100k
R3,4,6,7,8,9, 10,11,22,23, 51	Min Res 10k
R5,43,44,56	Min Res 220k

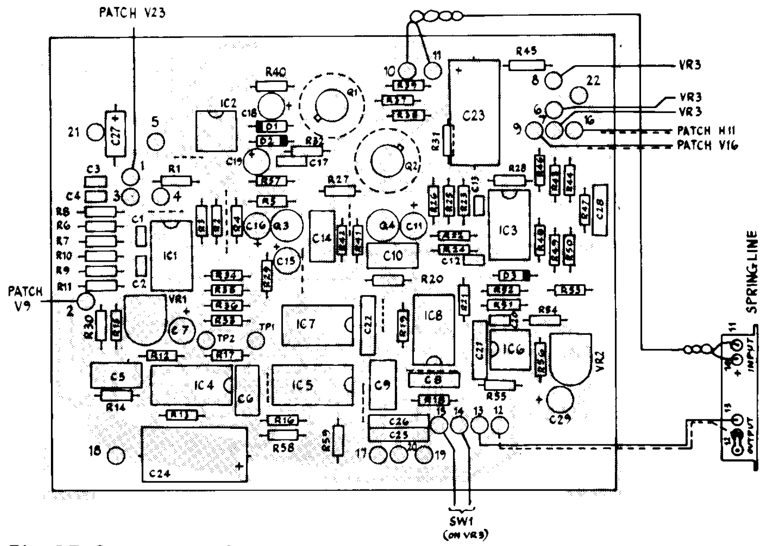


Fig. 35 Component Overlay for Reverb and Phase

R13,55	Min Res 1k
R14	Min Res 6k8
R15,25	Min Res 2k7
R16	Min Res 470k
R18,28	Min Res 330k
R19	Min Res 1M
R20,27,29,32, 58,59	Min Res 47k
R21,30,35,45	Min Res 22k
R31	Min Res 12Ω
R34	Min Res 5k6
R37,38	Min Res 15Ω
R39	Min Res 10Ω
R40,57	Min Res 15k
R41	Min Res 1k5
R42	Min Res 1k2
R48	Min Res 82k
R49	Min Res 390k
R50	Min Res 39k
R52	Min Res 560k
R54	Min Res 3k9
VR1	Hor S-Min Preset 4k7
VR2	Hor S-Min Preset 22k
VR3	Sw Pot Lin 25k
VR4	Sw Pot Lin 10k
C1	Ceramic 470pF
C2	Ceramic 1000pF
C3	Ceramic 10,000pF
C4	Ceramic 3300pF
C5,6,8,9,10,14	Polyester 0.1μF
C7,11,15,16	Tant 10μF 16V
C12,17	Ceramic 330pF
C13	Ceramic 10pF
C18,19	PC Elect 10μF 35V
C20	Ceramic 100pF
C21,22,25,26	Disc 0.1μF
C23,24	Axial 470μF 16V
C27	Axial 10μF 25V
C28	Polyester 0.022μF
C29	Tant 4.7μF 35V
D1,2,3	1N4148
Q1	BC441
Q2	BC461
Q3,4	2N3819
IC1,3	4136
IC2	741C 8-pin
IC4,5	TDA1022
IC6	NE566
IC7	4013BE
IC8	4416BE

Also required

1 Synth Reverb and Phase PCB
2 Heatsink Clip-On
1 Wafercon Socket 8-way
8 Wafercon Terminals
2 DIL Socket 16-pin
4 DIL Socket 14-pin
2 DIL Socket 8-pin
23 Veropin 2141
1 Short Spring-Line
2 Grommet Small
4 6BA Spacer ⅛in.
4 Self-Tapper No. 4 ½in.
2 Self-Tapper No. 6 ½in.
2 15mm Collet Knob Black
2 15mm Collet Nut Cover
1 15mm Collet Cap Blue
1 15mm Collet Cap Grey

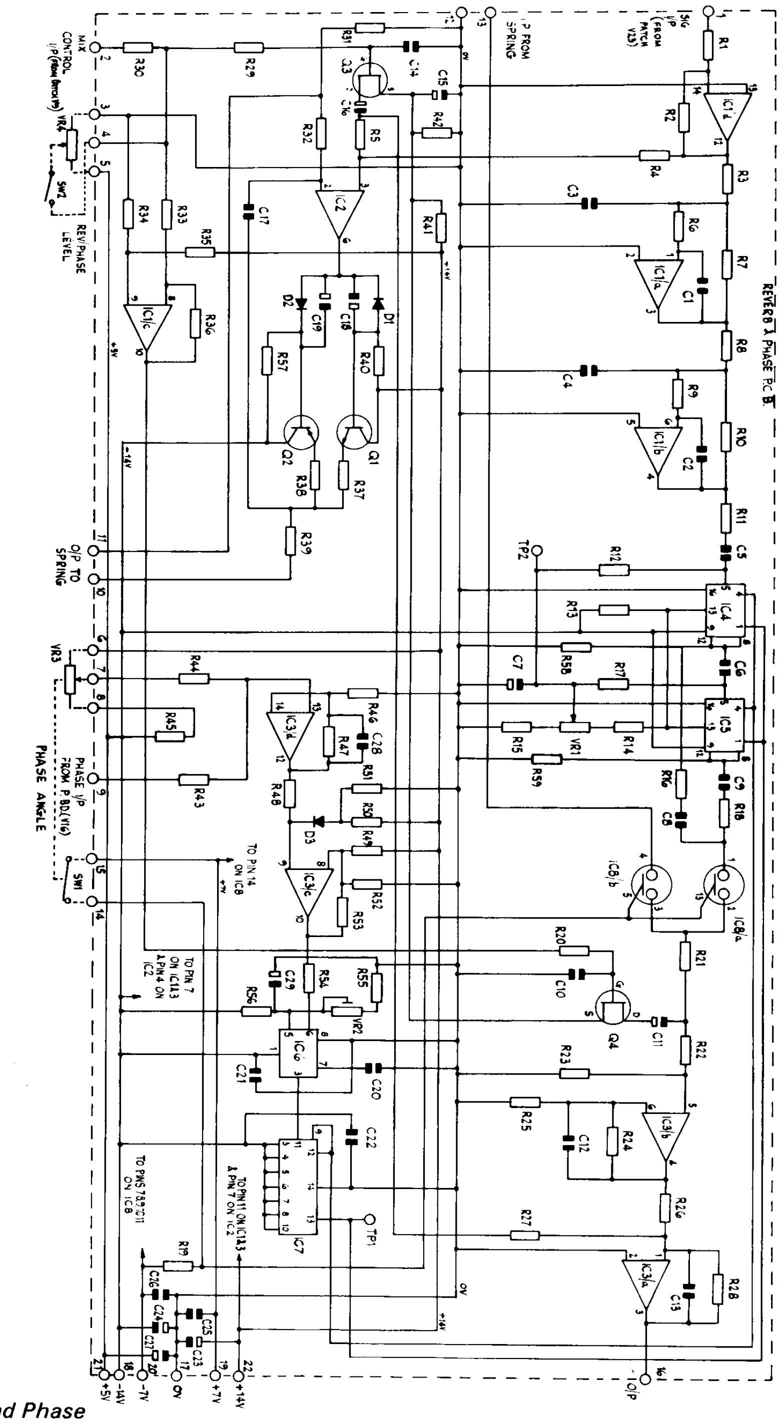
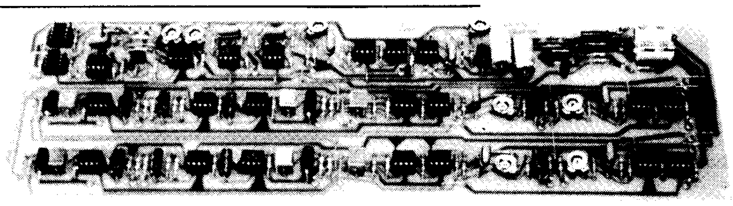


Fig. 36 Circuit Diagram of Reverb and Phase

Voltage Controlled Panning and Ancillaries (VC Pan & Anc.) Construction

Remove the 4 screws from the base and remove the base plate of the remote foot control. A resistor is soldered between one tag on the pot and the pot body. It is necessary to permanently short out this resistor. Refix the base.

Assemble the pcb as shown in Fig. 37 and when completed fix to the base of the cabinet in the position indicated in the internal layout photograph, using spacers



Voltage Controlled Panning and Ancillaries

Continued on page 33.

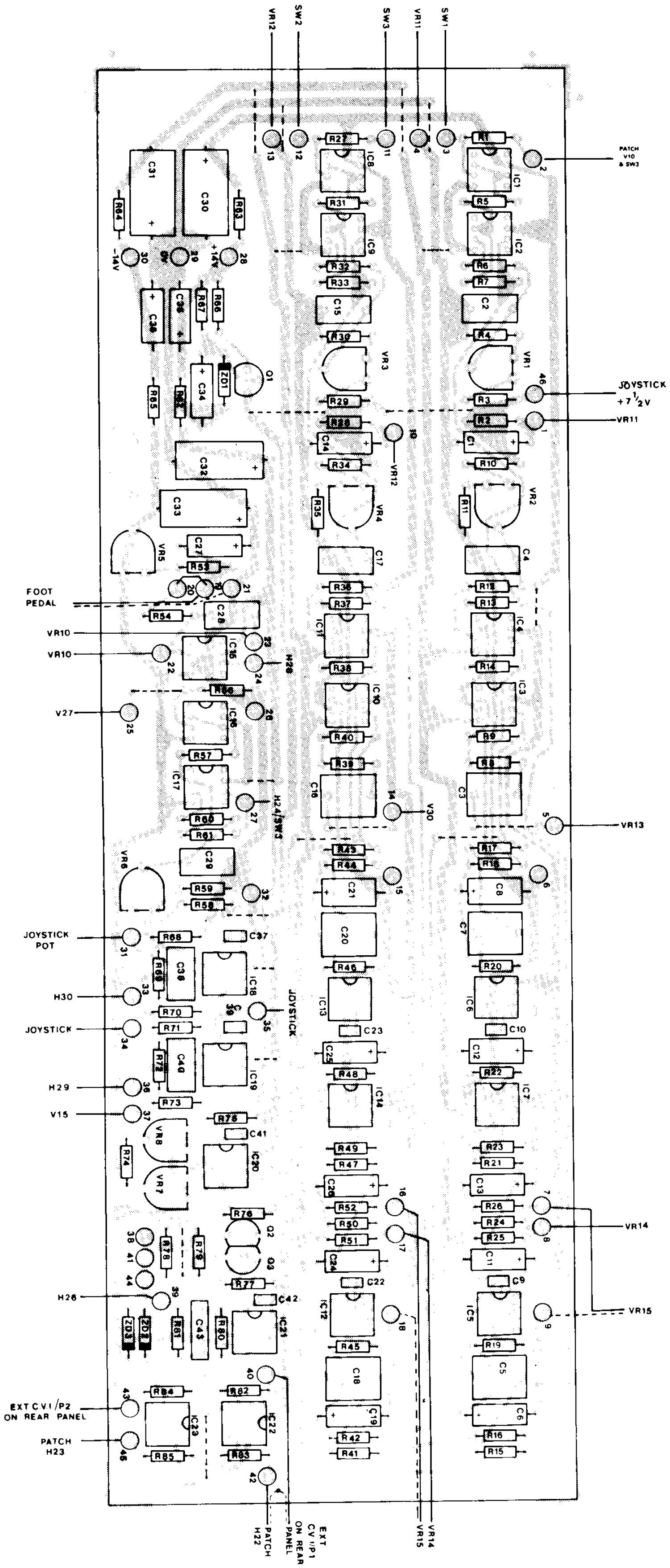


Fig. 37 Component Overlay for VC Pan and Anc.

Parts List for Voltage Controlled Panning and Ancillaries

(1 required for 5600S only)

R1,27,56	Min Res 220k
R2,28	Min Res 4k7
R3,4,10,11,29,30,34,35,59	Min Res 6k8
R5,8,13,14,24,31,37,38,39,50,57,61,82,84	Min Res 100k
R6,12,25,32,36,51,53,58,60,69,72	Min Res 10k
R7,21,22,23,33,47,48,49,80	Min Res 47k
R9,40	Min Res 33k
R15,17,41,43	Min Res 8k2
R16,18,42,44	Min Res 47Ω
R19,20,26,45,46,52,68,71,83,85	Min Res 2k2
R54,77,78	Min Res 22k
R55	Not used
R62,63,64,65	Min Res 10Ω
R66	Min Res 220Ω
R67	Min Res 3k9
R70,73,76,81	Min Res 3k3
R74	Min Res 150k
R75	Min Res 68k
R79	Min Res 1k2
C1,11,12,13,14,24,25,26,34,35,36	Axial 10 μF 25V
C2,4,15,17,28,29,38,40	Polyester 0.1 μF
C3,5,7,16,18,20	Carbonate 1 μF
C6,8,19,21	Axial 2.2 μF 63V
C9,10,22,23	Ceramic 680pF
C27	Disc 0.1 μF
C30,31	Axial 220 μF 16V
C32,33	Axial 100 μF 25V
C37,39,41,42	Ceramic 33pF
C43	Polyester 0.01 μF
VR1,2,3,4,6	Hor S-Min Preset 10k
VR5	Hor S-Min Preset 100k
VR7	Hor S-Min Preset 47k
VR8	Hor S-Min Preset 22k
VR9	Remote Foot Control
VR10	Pot Lin 22k
VR11,12	Sw Pot Lin 10k
VR13	Pot Lin 100k
VR14,15	Dual Pot Log 10k
SW3	Sub-Min Toggle A
Q1	BC548
Q2	PN3643
Q3	MPS3638
ZD1,2,3	BZY88C8V2
IC1,2,3,4,7,8,9,10,11,14,15,16,17,22,23	μA741C 8-pin DIL
IC5,6,12,13	MC3340
IC18,19,20,21	LM301A

Also required

1 VC Pan and Anc PCB
23 DIL Socket 8-pin
46 Veropin 2141
6 6BA Spacer ⅛in.
6 Self-Tapper No. 4 ½in.
1 Foot Switch
1 Adaptor A (for Foot Switch)
7 15mm Collet Knob Black
7 15mm Collet Nut Cover
3 15mm Collet Cap Red
1 15mm Collet Cap Blue
2 15mm Collet Cap Green
1 15mm Collet Cap Grey

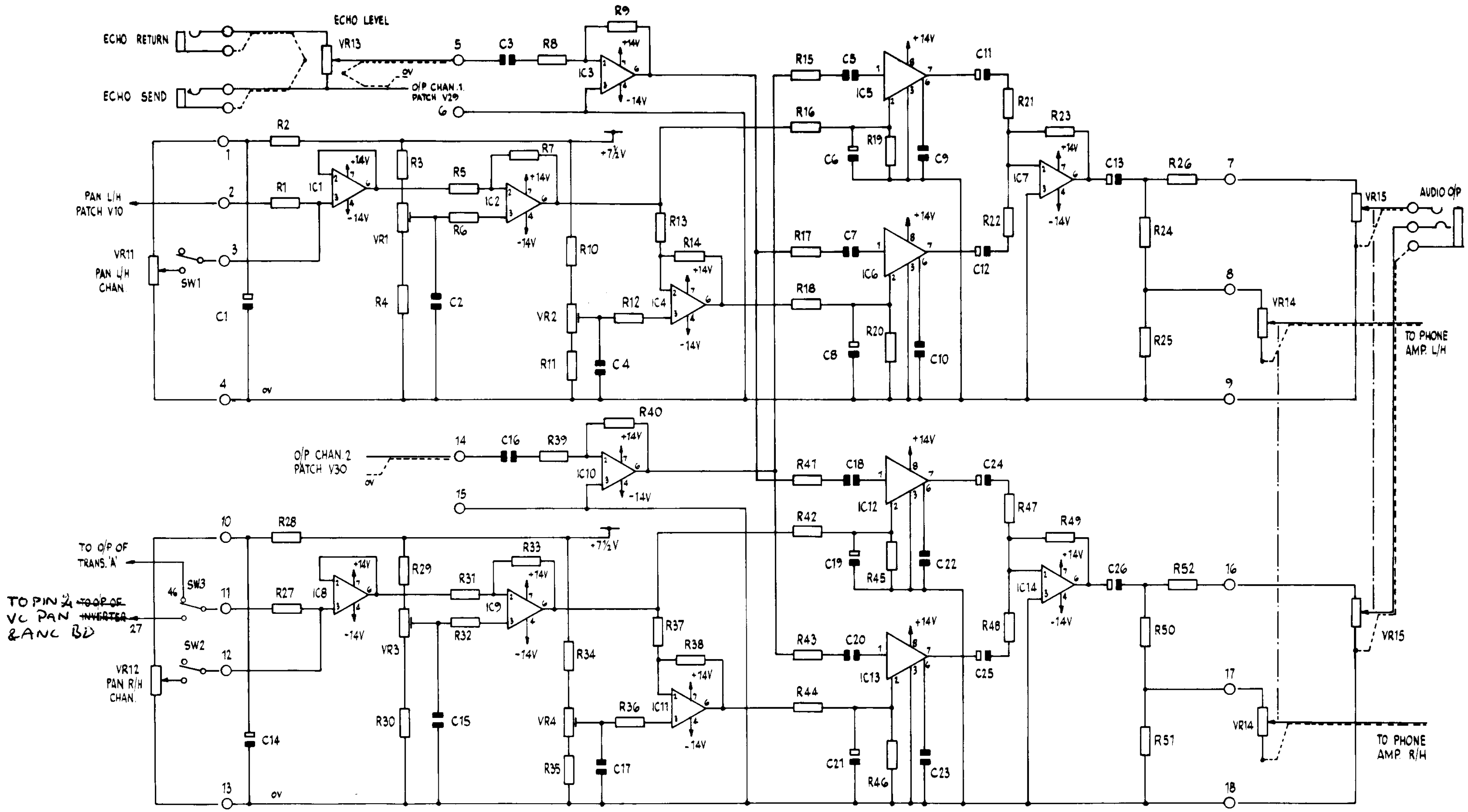


Fig. 38 Circuit Diagram of VC Panning

and self-tapping screws. Note that the flat faces of Q2 and Q3 should be smeared with Thermpath, then the two transistors pressed together and held tight by surrounding with an epoxy resin glue.

Voltage Controlled Panning — How It Works

Output channel 1 from the patchboard goes to VR13 the echo level, where echo may be added from an external echo chamber. The signal is fed via IC3 to the voltage controlled amplifiers IC6 and IC12 whose gain is controlled from pin 2, such that it decreases as the voltage becomes more positive than 0V. Output channel 2 from the patchboard is fed via IC10 to IC5 and IC13 which are also voltage controlled amplifiers. If a positive controlling voltage is applied from the patchboard to IC1 with VR11 fully anti-clockwise and therefore SW1 open, a negative going voltage appears at the output of IC2 whose level is set by VR1.

This causes IC5 to have more gain and after inversion in IC4 whose level is set by VR2, causes IC6 to have less gain. The signal appearing at the mixer amp IC7 will now come from IC5 instead of IC6 and the signal present at the patchboard channel 2 will be fed to the audio output instead of that at output channel 1. The control circuits for each output channel are identical except that the control input for channel 2 is wired via SW3 to either the output of Trans 'A' or the output of the Inverter. When VR11 is rotated clockwise, SW1 is made and the panning of the left-hand output is under the control of VR11 only.

7 Setting-up Voltage Controlled Panning

Restore all mixer controls to zero, clear patchboard, patch mixer 1 to output channel 1 and patch transient B to output channel 2 (to stop crosstalk). Patch 'key direct' to oscillator 1 and set oscillator 1 to sawtooth wave, free run to zero, tune to zero and range to 4 foot and press middle C. Turn mixer 1/oscillator 1 level and mixer 1 level fully clockwise. Turn echo level control fully anticlockwise.

Turn the pan right-hand control fully anticlockwise and connect a 'scope to pin 16 of the vc pan and anc pcb. Turn VR3 fully clockwise and measure the peak-to-peak voltage. Rotate the pan right-hand control to '0' (centre) and adjust VR3 for half the peak-to-peak voltage previously measured. Now patch mixer 1 to output channel 2 and transient B to output channel 1 and connect the 'scope to pin 7. Turn pan left-hand control fully clockwise. Turn VR1 fully clockwise and measure the peak-to-peak voltage. Rotate the pan left-hand control to '0' (centre) and adjust VR1 for half the peak-to-peak voltage previously measured.

Patch mixer 1 to output channel 1 and transient B to output channel 2. Turn pan left-hand control fully anticlockwise and adjust VR2 fully clockwise and measure the peak-to-peak voltage. Now turn the pan left-hand control to '0' (centre) and adjust VR2 for half the peak-to-peak voltage previously measured. Patch mixer 1 to output channel 2 and transient B to output channel 1 and connect the 'scope to pin 16. Turn pan right-hand control fully clockwise and adjust VR4 fully clockwise and measure the peak-to-peak voltage. Now turn the pan right-hand control to '0' (centre) and adjust VR4 for half the peak-to-peak voltage previously measured.

Remove all patch pins.

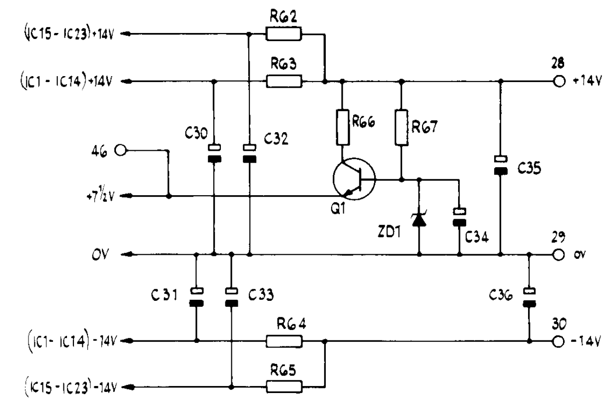


Fig. 39 Circuit Diagram of Supply Decoupling on VC Pan and Anc. Pcb

Foot Pedal — How It Works

When the foot pedal VR10 is fully depressed there is a minimum of negative feedback in IC15 and the trim pot VR5 may be set so that turning the range pot VR9 from 0 to 10 produces a voltage at the output of IC15 which will rise from 0V to +5V. Now with VR9 set fully clockwise, raising the foot pedal and thereby decreasing its resistance, increases the negative feedback in IC15 and the voltage output goes down towards 0V.

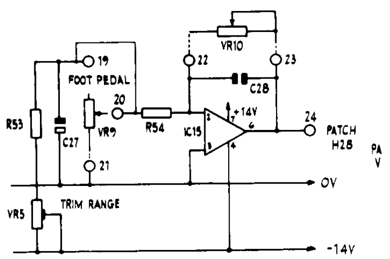


Fig. 40 Circuit Diagram of Foot Pedal Circuitry

14 Setting-up Foot Pedal

Measure with a voltmeter between H28 and 0V. Plug the foot pedal into its jack socket. With the pedal fully up the meter should read 0V. Now fully depress the foot pedal and turn the foot pedal control fully clockwise. Adjust VR5 on the VC Pan and Anc. pcb for +5V.

Inverter — How It Works

IC16 acts as a high input impedance stage driving a zero gain inverter IC17. VR6 may be adjusted so that the output voltage goes from 0V to +5V when the input voltage goes from +5V to 0V.

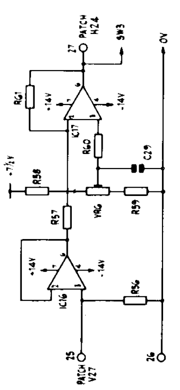


Fig. 41 Circuit Diagram of Inverter

12 Setting-up Inverter

Remove all patch pins. Measure with a voltmeter between H24 and 0V. Adjust VR6 on VC Pan and Anc. pcb for +5V. Apply +5V to V27. Voltmeter should read 0V.

External Control Voltage Input — How It Works

These two circuits are simply voltage followers with inputs clamped by zener diodes so that the output voltage cannot go below -0.5V or above +9V.

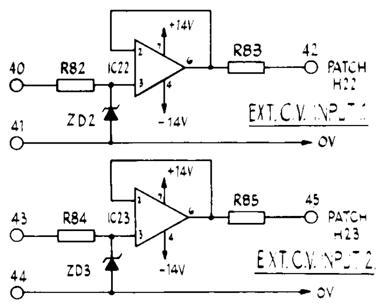


Fig. 42 Circuit Diagram of External Control Voltage Inputs

13 Setting-up External Control Voltage Inputs

Measure with a voltmeter between H22 and 0V. Apply 0V to external control voltage input number 1 socket. Voltmeter should read 0V. Apply +5V to that input and voltmeter should read +5V. Apply +14V to input and voltmeter should read around 8V. Move the voltmeter to H23 and repeat for external control voltage input 2.

Exponential Converter — How It Works

The exponential converter consists of IC20, Q2, Q3 and IC21. The input signal is inverted and attenuated by IC20; VR7 adjusts the gain and VR8 provides the required offset. The exponential relationship between the base-emitter voltage and collector current of a transistor (Q2) is used to provide the required law. Q3 provides temperature compensation as it is glued to Q2 to provide intimate thermal contact. The collector current of Q2 is converted into a proportional voltage providing an exponential relationship between input and output.

11 Setting-up Exponential Converter

Connect a wire to the +5V on the power supply and connect it to tags V1 and V2 on the patchboard. Patch H1/V29 and H1/V30. Turn mixer 1 level to 10 and mixer 1/oscillator 1 and mixer 1/oscillator 2 to 5. Turn the free run controls to '0', the waveform to sine wave and the range to 8 foot on both oscillators. Readjust the free run on oscillator 2 for minimum beats.

Remove the 5V from V2 and reconnect it to V15 (i.e. +5V is now connected to V1 and V15). Patch H26/V2. Turn VR7 on the VC Pan and Anc. pcb to the centre position and adjust VR8 until both oscillators are producing roughly the same frequency, then adjust VR7 for minimum beats. Remove the 5V from V15 only.

Connect a 0V to V15. Switch oscillator 1 to 32 foot and oscillator 2 to 1 foot. Readjust VR8 for minimum beat. Take 0V from V15 and reapply +5V. Set both oscillators to 8 foot and readjust VR7 for minimum beats. Repeat from the beginning of this paragraph until no further adjustment is required.

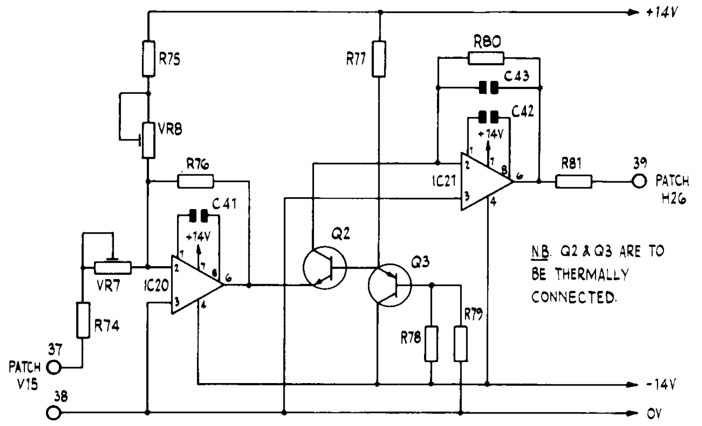


Fig. 43 Circuit Diagram of Exponential Converter

Joy Lever Construction

Assemble the joy lever pcb as shown in Fig. 45 and fix to the base using spacers and self-tapping screws in the position shown in the internal layout photograph.

Joy Lever

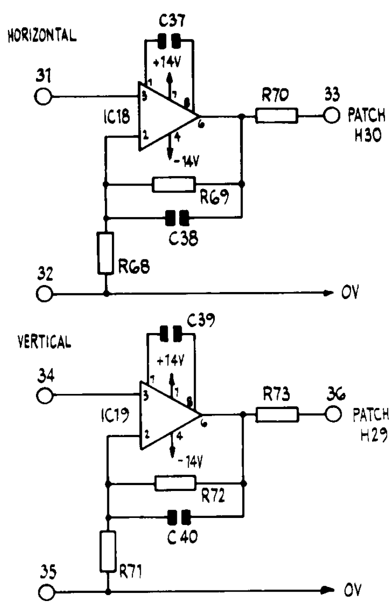


Fig. 44 Circuit Diagram of Joystick Controls

Now make the joystick.

Remove the four self-centring springs. Screw the self-tapping screws into holes 'f', 'c' and 'h' and tighten up on the spindles, then slacken off screws by turning them twice anti-clockwise. From above, centre the four zero adjusters (toothed knobs). Hold the joystick so that it appears as in Fig. 47. Slacken clamp screws 'k', 'j' and 'n'. Twist pot 'B' clockwise two or three times allowing

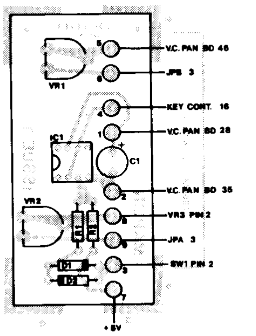


Fig. 45 Component Overlay for Joy Lever

gimbal 'P' to move freely towards pot 'A' ending up with the pot tags as shown in Fig. 47. Tighten screw 'k'. Move the stick to bring gimbal 'P' as close as possible to pot 'C' and hold gimbal in this position. Tighten screw 'f'.

With reference to Fig. 47, twist pot 'A' clockwise two or three times allowing gimbal 'Q' to move freely towards pot 'D' ending up with the pot tags as shown in Fig. 47. Tighten screw 'j'. Move the stick to bring gimbal 'Q' as close as possible to pot 'B'. Tighten screw 'c'. Holding the stick approximately vertical rotate pot 'D' two or three times clockwise ending up with the tags closest to pot 'C'. Tighten screw 'h'. Turn the pot back until its tags are as shown in Fig. 47 and tighten screw 'n'.

Fix the joystick to its mounting plate and fix the self-centring springs on pots 'B' and 'D' only. Fix SW1 and VR3 to the plate and wire the plate components to the pcb using Fig. 46 and Fig. 47.

Joy Lever — How It Works

The vertical movement of the lever causes the voltage on JPB pin 2 to go from 0V to a positive level adjustable by VR1. This is fed to IC19 on the VC Pan and Anc board which amplifies the range to give 0 to +5V. The horizontal movement is similar

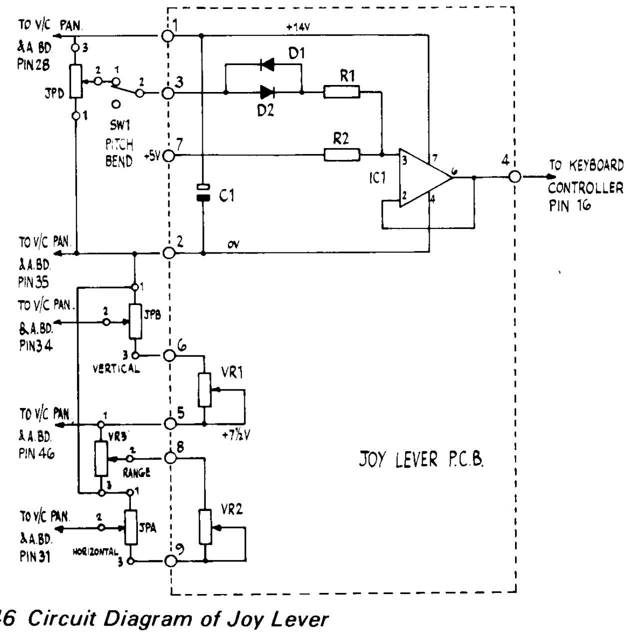


Fig. 46 Circuit Diagram of Joy Lever

except that the range may be manually adjusted by VR3.

When SW1 (pitch bend) is made, the +5V input to IC1 may be pulled higher or lower by a small amount by moving JPD above and below +5V. This causes the output voltage of IC1 to vary and this modifies the +5V on the voltage divider chain in the keyboard controller, resulting in approximately one semitone up or down change in a controlled oscillator. Diodes D1 and D2 provide about ½V of dead area in case the stick does not return exactly to the centre.

Parts List for Joy Lever PCB

(1 required for 5600S only)

R1	Min Res 100k
R2	Min Res 47k
VR1,2	Hor S-Min Preset 100k
VR3	Pot Lin 10k
C1	Tant 2.2 μF 35V
IC1	μA741C 8-pin DIL
D1,2	1N4148
SW1	Sub-Min Toggle A

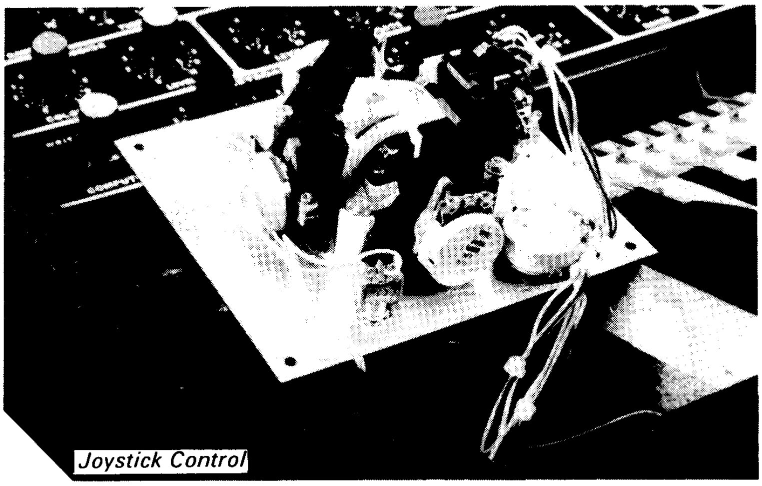
Also required

1 Joy Lever PCB
1 Joystick Pot
1 Joystick Mtg Plate
1 DIL Socket 8-pin
9 Veropin 2141
4 6BA Spacer ⅛in.
4 Self-Tapper No. 4 ½in.
1 15mm Collet Knob Black
1 15mm Collet Nut Cover
1 15mm Collet Cap Red

15 Setting-up Joystick

Measure with a voltmeter between H29 and 0V. Set the black knurled adjusters to their centre positions. Patch H20/V1, H1/V29 and H1/V30. Set mixer 1 level to 10 and mixer 1/oscillator 1 level to 5. Switch to 'bend', set oscillator 1 to 4 foot, tune and free run to zero and sine wave output. Press middle C. Refer to Fig. 47.

Slacken screw 'n' and rotate the body of pot 'D' to and fro without moving the joystick lever. The pitch will vary up and down, but there will be a small band over which the tone will not change. Set the pot



Joystick Control

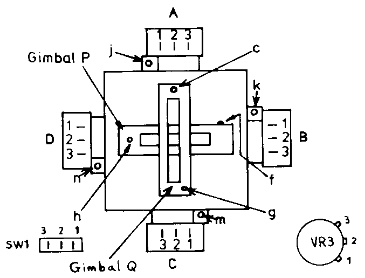


Fig. 47 Joystick Control

to the centre of this band and tighten screw 'n'. With the joy lever held centrally by its own springs, switch 'bend' off and on again. The tone should not change frequency. If it does, readjust pot 'D'.

Pull the joy lever to the front and meter should read approximately 0V. If not slacken screw 'k' and rotate pot 'B' until 0V can be achieved with the joy lever pulled forward. Tighten screw 'k'. Push lever to rear and adjust VR1 until meter reads +5V. Return to centre and adjust knurled knob for pot 'B' until meter reads 2.5V. If this cannot be achieved slacken screw 'k' again and rotate pot 'B'. Repeat above procedure until all three voltages are correct.

Measure with a voltmeter between H30 and 0V. Turn the range control to maximum and move the lever fully to the left. The meter should read about 0V. If not, slacken screw 'j' and rotate pot 'A' until 0V can be achieved with the joy lever pulled fully to the left. Tighten screw 'j'. Push lever fully to the right and adjust VR2 until the meter reads +5V. Return the lever to about the centre and adjust the knurled knob for pot 'A' until meter reads 2.5V. If this cannot be achieved slacken screw 'j' again and rotate pot 'A'. Repeat above procedure until all three voltages are correct.

Check that with the lever fully to the right, rotating the range control anticlockwise reduces the 5V to 0V.

Joystick Control — How It Works

For description see joy lever how it works.

External Inputs Construction

The external inputs are provided so that other electronic instruments may be fed into the synthesiser in order to obtain new and different sounds. One of the two inputs has circuitry which generates trigger pulses from the external instrument's signal, thus allowing the transient generators to be triggered.

Assemble the pcb as shown in Fig. 48. Fix the front panel components to the bracket then the pcb and interwire as shown in Fig. 50. Fix the assembled module to the front panel.

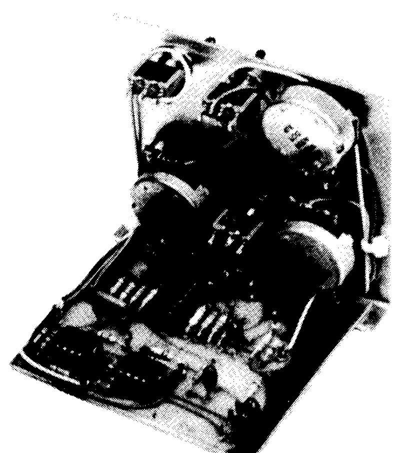
External Input Specification

Input level: 2mV to 5V rms.
Input impedance: 50k.
Frequency response 20Hz to 50kHz: +0 -3dB.
Maximum gain
high sensitivity: 56dB
low sensitivity: 34dB
Trigger level: adjustable from 0 to +5V.
Trigger release time: approx. 20 milliseconds.

External Inputs — How It Works

The two preamplifiers for the external inputs are provided by a low-noise dual integrated circuit type LM381. A 47k potentiometer at the input allows attenuation of the input and sets the input impedance.

The LM381 IC differs from the normal operational amplifier we have been using in that it uses a single power supply of +14 volts and, in that the output has to be biased to mid-voltage (7 to 8V) by an external network — in our case R5 and R7. Gain of the amplifier is set by R7/(R1 +R3) and, since R3 may be switched in or out, two gain ranges are available. These are 56 dB and 32 dB (voltage gains of 630 and 40). These, of course, are fully variable by means of the input potentiometer.



External Inputs

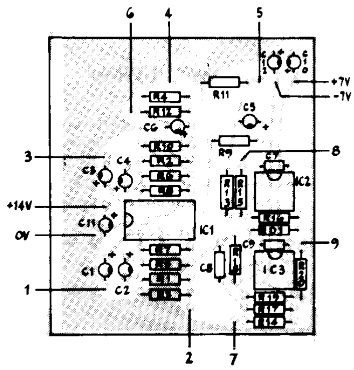
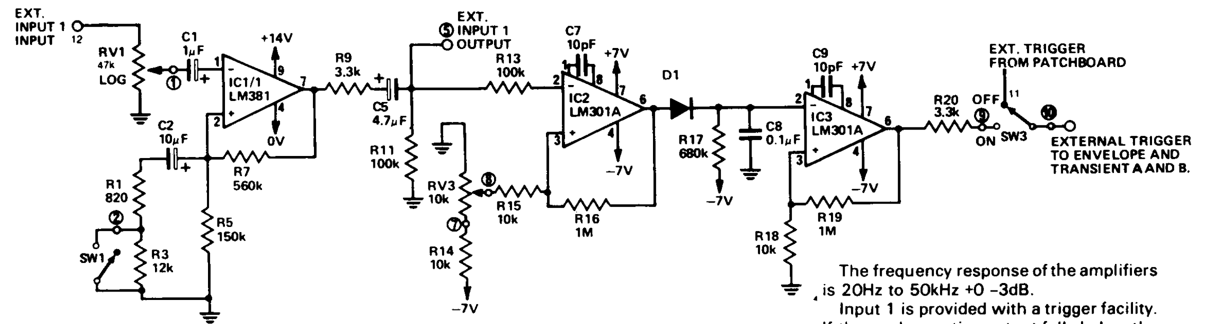


Fig. 48 Component Overlay for External Inputs



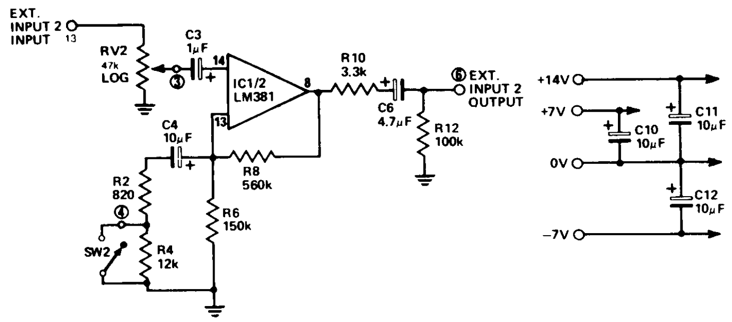


Fig. 49 Circuit Diagram of External Inputs

The frequency response of the amplifiers is 20Hz to 50kHz +0 -3dB.

Input 1 is provided with a trigger facility. If the peak negative output falls below the voltage selected by RV3, the output of IC2 (acting as a comparator) will go to +6 volts and remain there whilst the RV3 voltage is exceeded. At all other times the output of IC2 will be at -6 volts.

During the positive excursion of IC2, C8 charges rapidly to +6 volts and when IC2 goes negative again C8 discharges slowly via R17 to -7 volts. Another comparator, IC3, will have its output at -6 volts if the voltage on C8 is above 0 volts, and at +6 volts if the voltage on C8 is below '0' volts.

The envelope from a conventional instrument will usually have an initial attack period, a sustain period and then a decay. With this type of envelope the trigger will start high, go low whenever the envelope is greater than the preset level and then go high again. It will not respond to individual cycles due to the slow discharge of C8 by R17. The release time is about 20 milliseconds.

Parts List for External Inputs
(1 required for 5600S; 1 required for 3800)

5600S	3800	
R1,2	R1	Min Res 820Ω
R3,4	R3	Min Res 12k
R5,6	R5	Min Res 150k
R7,8	R7	Min Res 560k
R9,10,20	R9,20	Min Res 3k3
R11,12,13	R11,13	Min Res 100k
R14,15,18	R14,15,18	Min Res 10k
R16,19	R16,19	Min Res 1M
R17	R17	Min Res 680k
RV1,2	RV1	Pot Log 47k
RV3	RV3	Pot Lin 10k
C1,3	C1	Tant 1 μF 35V
C2,4,10,11,12	C2,10,11,12	Tant 10 μF 16V
C5,6	C5,6	Tant 4.7 μF 35V
C7,9	C7,9	Ceramic 10pF
C8	C8	Polyester 0.1 μF
IC1	IC1	LM381
IC2,3	IC2,3	LM301A
D1	D1	1N4148
SW1,2,3,	SW1	Sub-Min Toggle A

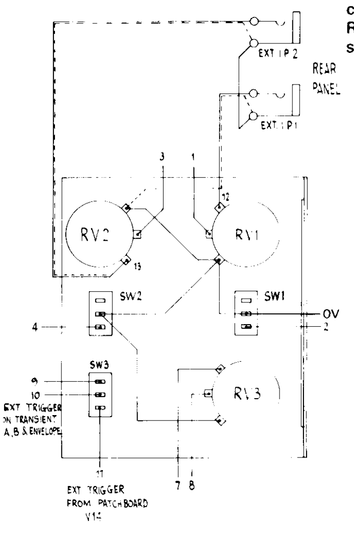


Fig. 50 Front Panel Wiring for External Inputs (5600S only)

Also required
1 Synth Ext I/P PCB
1 DIL Socket 14-pin
2 DIL Socket 8-pin
1 Wafercon Skt 8-way
8 Wafercon Terminals
2 Bolt 6BA ¼in.
2 Nut 6BA
2 Shake 6BA

Also required for 5600S only
1 Ext I/P Mtg Bkt
13 Pin 2141
3 15mm Collet Knob Black
3 15mm Collet Nut Cover
2 15mm Collet Cap Yellow
1 15mm Collet Cap Blue

Also required for 3800 only
1 3800 Ext I/P Mtg Bkt
10 Pin 2141
2 15mm Collet Knob Black
2 15mm Collet Nut Cover
2 15mm Collet Cap Red

Voltage Controlled Filter Construction

Assemble the two pcb's as shown in Fig. 51. They are identical. Fix the front panel components to the bracket then the pcb and interwire as shown in Fig. 53. Fix the assembled modules to the front panel.

Voltage Controlled Filter — How It Works

The voltage controlled filter consists of three main sections:—
1. The buffer amplifier/mixer.
2. A low-pass filter.
3. A voltage controlled oscillator.

The buffer amplifier IC3 is used to give a level shift to the input signal and to provide a constant 100k input impedance. A second input direct to the input of IC3 is used, in the 3800 synthesiser, for additional mixing.

The 4016 analogue switches have all their control inputs connected together and these switches may be regarded as a normal four pole active low-pass filter (two 2-pole in series). The filter has a gain of unity (output of IC3 to output of IC5) below the cut-off frequency and an ultimate slope of 24dB/octave above the cut-off frequency.

As well as an amplitude change with frequency there is also a change in phase relationship. Initially the output of the filter is 180° out of phase with the input (point E), and in phase when 6dB down. It eventually moves 180° out of phase again as the frequency increases. The potentiometer RV3 and resistor R18 take part of the output signal and feed it back into the input of IC3. Below the cut-off frequency this causes the output to be attenuated, at the cut-off frequency the signal is boosted and above the cut-off it again starts to attenuate. This causes the output to peak in the region of the cut-off frequency and then drop suddenly above that frequency. The height of the peak is adjustable. If adjusted too high, the filter will oscillate.

To vary the cut-off frequency we must vary the four capacitors or the four resistors in these areas of the filter.

To obtain the two ranges we switch capacitors in or out and, to give the

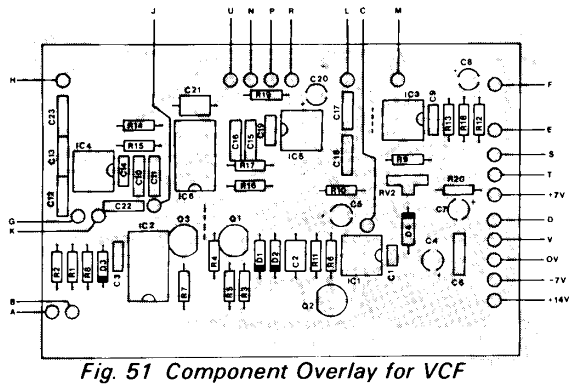
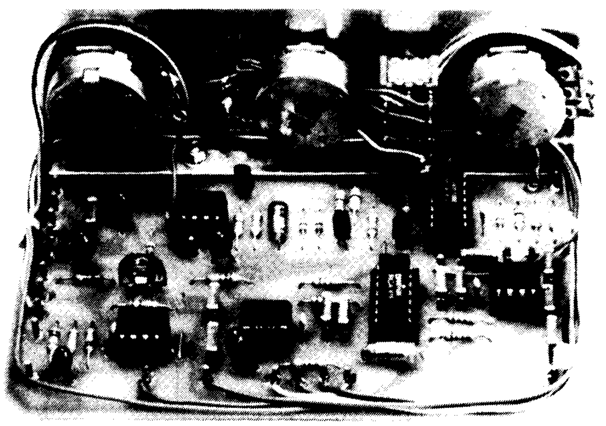


Fig. 51 Component Overlay for VCF



VCF

continuously variable range, we vary the resistors by switching them in and out at a fast rate but with a mark-space ratio which is variable.

By such switching the effective value of a resistor becomes:—

$$\frac{R \times \text{total time}}{\text{time on}}$$

and since on-time is always shorter than total time the resistance can vary from 'R' upwards. We obtain a variable mark-space ratio by using a monostable of about 200n sec triggered by a voltage controlled oscillator which is variable from 5kHz to about 1MHz. We therefore keep the on-time constant and vary the off-time.

The voltage-to-frequency converter used does in fact have a linear relationship from about 10kHz to 1MHz. Frequencies below 20kHz, however, should not be used, as the chopping frequency will become audible.

A variable constant-current source is provided by IC1 and Q2, where the base-emitter voltage of Q2 is compensated by taking feedback from the emitter of Q2 to IC1. A further constant current source is provided by Q1. The current from Q1 can flow either via Q3 to ground (output of IC2/2), or through Q2 as well as into C2. The current provided by Q1 is higher than the maximum available through Q2 and thus C2 will be charged by a constant current (when IC2/2 is high) the value of which is determined by the input voltage.

The voltage on C2 is passed to the input of IC2/1 such that if this voltage is above approximately 7 volts the output of IC2/1 will be low (0V) whereas if the input voltage is less than 7 volts the output will be high (+14V).

In addition RV2 is provided to prevent the oscillator stopping on overvoltage and R11 is provided to prevent the oscillator stopping when there is a negative input voltage.

[20] Setting-up Filters for 5600S

Connect +14V in turn to V7 and then to V8, and patch H7/V29 (then H8/V29) and connect a 'scope to this point. Turn RV2 fully towards R9, set range control to low, resonance to maximum and tune control fully anticlockwise. The filter should act as a very low frequency (inaudible) oscillator. Rotate the tune control clockwise and the frequency will increase and then it may drop slightly. Continue until the control is fully clockwise. Adjust RV2 until oscillation just starts to decrease again. (If it did drop slightly when it was being increased, it may jump up in frequency on adjusting RV2 before starting to decrease.)

(12) Setting-up Filter for 3800

Disconnect the wire from point 'A' on the filter pcb and apply +14V to this point. Turn

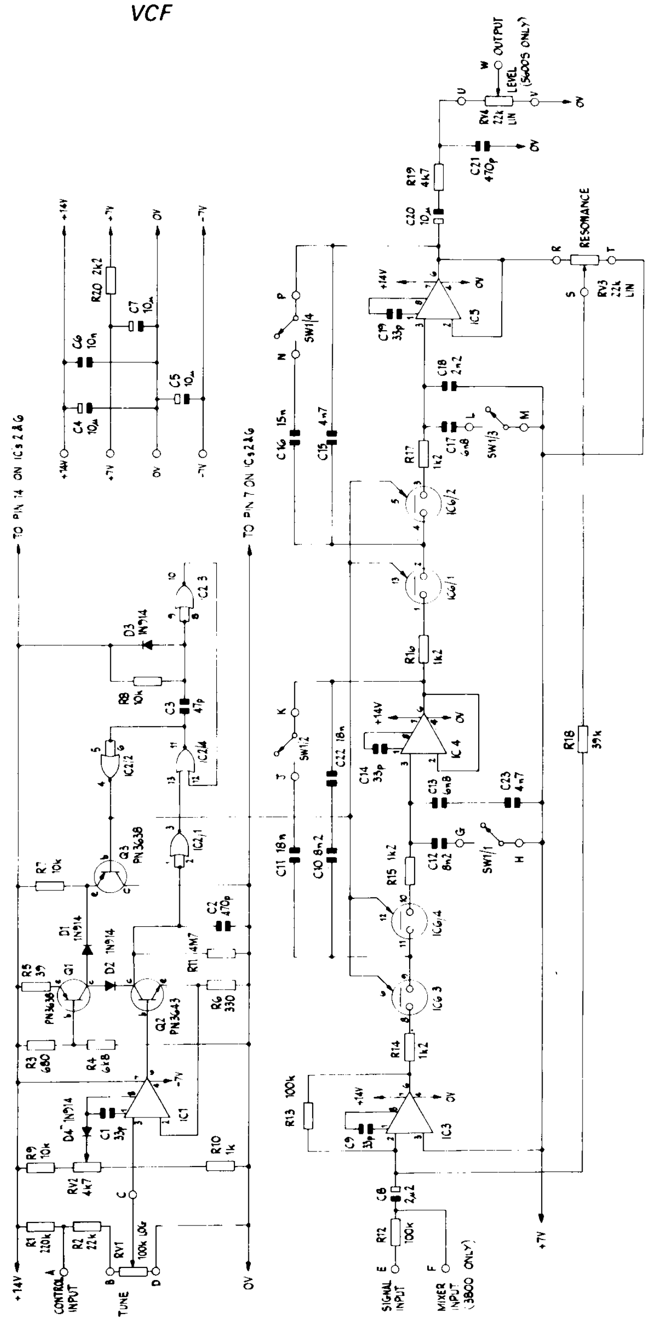


Fig. 52 Circuit Diagram of VCF

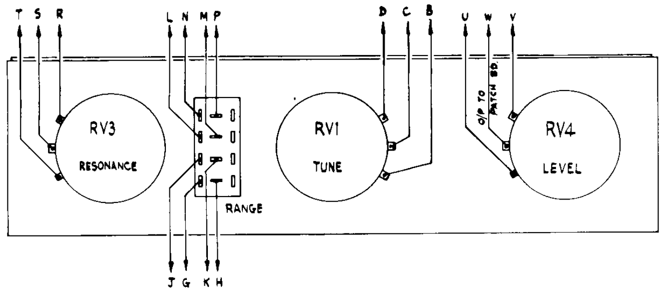


Fig. 53 Front Panel Wiring for VCF (5600S only)

RV2 fully towards R9, set range control to low, resonance to maximum and tune control fully anticlockwise. The filter should act as a very low frequency (inaudible) oscillator. Rotate the tune control clockwise and the frequency will increase and then it may drop slightly. Continue until the control is fully clockwise. Adjust RV2 until oscillation just starts to decrease again. (If it did drop slightly when it was being increased, it may jump up in frequency on adjusting RV2 before starting to decrease.) Disconnect +14V and reconnect the wire from point A on FPC12 to point 'A' on pcb.

Parts List for VCF

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

R1	Min Res 220k
R2	Min Res 22k
R3	Min Res 680Ω
R4	Min Res 6k8
R5	Min Res 39Ω
R6	Min Res 330Ω
R7,8,9	Min Res 10k
R10	Min Res 1k
R11	Min Res 4M7
R12,13	Min Res 100k
R14,15,16,17	Min Res 1k2
R18	Min Res 39k
R19	Min Res 4k7
R20	Min Res 2k2
C1,9,14,19	Ceramic 33pF
C2,21	Polystyrene 470pF
C3	Ceramic 47pF
C4,5,7,20	Tant 10μF 16V
C6	Carbonate 0.01 μF
C8	Tant 2.2 μF 35V
C10,12	Carbonate 0.0082 μF
C11,22	Carbonate 0.018 μF
C13,17	Carbonate 0.0068 μF
C15,23	Carbonate 0.0047 μF
C16	Carbonate 0.015 μF
C18	Carbonate 0.0022 μF
RV1	Pot Log 100k
RV2	Vert S-Min Preset 4k7
RV3	Pot Lin 22k
RV4 (for 5600S only)	Pot Lin 22k
Q1,3	MPS3638
Q2	PN3643
IC1,3,4,5	LM301A
IC2	4001BE
IC6	4016BE
D1,2,3,4	1N4148
SW1	4p S-M Toggle

Also required

1 3600 VCF PCB
2 DIL Socket 14-pin
4 DIL Socket 8-pin
1 Wafercon Socket 8-way
8 Wafercon Terminals
23 Veropin 2141
2 Bolt 6BA ¼in.
2 Nut 6BA
2 Shake 6BA

Also required for 5600S only

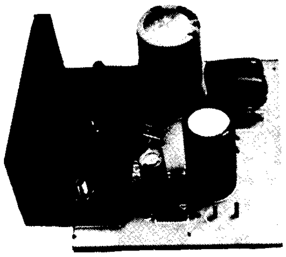
1 Synth VCF Mtg Bkt
3 15mm Collet Knob Black
3 15mm Collet Nut Cover
2 15mm Collet Cap Grey (for VCF 1 only)
1 15mm Collet Cap Blue (for VCF 1 only)
2 15mm Collet Cap Yellow (for VCF 2 only)
1 15mm Collet Cap Blue (for VCF 2 only)

Also required for 3800 only

2 15mm Collet Knob Black
2 15mm Collet Nut Cover
2 15mm Collet Cap Red
1 3600 VCF Mtg Bkt

Headphone Amplifiers Construction

Construct two 8W Amp Kits. Fit and solder the pins to the pcb, then the other components, taking care to ensure that the PC Electrolytics are inserted the right way round. Solder the IC to the pcb then smear the metal tab with Thermpath. Bolt the heatsink to the pcb, then bend the IC over and bolt it to the heatsink. Fix the two amps to the base of the cabinet using two No. 6 self-tapping screws in the positions shown in the internal layout photograph.



Headphone Amp

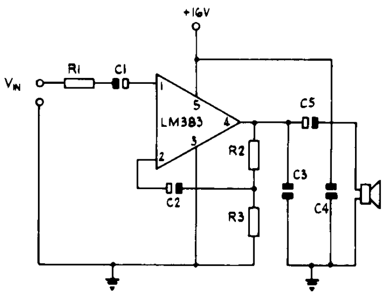
Parts List for 8W Amp Kit

The 8W Amp Kit should contain the following parts.

R1	Min Res 18k
R2	Min Res 220Ω
R3	Min Res 5.6Ω
C1	PC Elect 10μF 40V
C2	PC Elect 470μF 16V
C3,4	Polyester 0.22μF
C5	PC Elect 1000μF 16V
IC1	LM383

Also included

1 8W Hi-Fi Heatsink

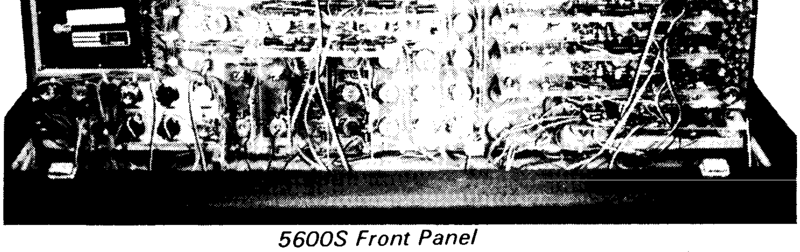


Circuit Diagram of Headphone Amp

1 8W Amp PCB
6 Pins 2145
3 Bolt 4BA ½in.
3 Nut 4BA

Completing the Front and Rear Panels

Fix the foot pedal, foot switch and echo controls to the mixer bracket and front panel. Fix the three 'output' controls and switch, and the three controls and socket immediately above these to the front panel directly. Fix the patchboard using four 6BA ½in. bolts, three fitted with tags to anchor an earth bar made of 20swg strapping wire as shown in the photograph. Cut down all the spindles and fit the knobs as shown in the colour photograph. Fit the components to the rear panel as shown in Fig. 54 and fix the panel to the cabinet. Note that a boot should be fitted to the fuseholder and mains plug.



5600S Front Panel

Interwiring

Carefully follow through the wiring schedule set out in Table 2 picking out first all the wires that interconnect on the front panel. Now put the front panel on the pins of the hinges and screw the hinges to the cabinet so that the pin locates in the blind hole in the cabinet. Complete the wiring shown in Table 2, then connect up all the wiring shown in Fig. 54.

Connect up the keyboard controller to the front panel as shown in Fig. 8. Wire the reverb and phase pcb to the front panel as shown in Fig. 55. Then connect up the other wires shown in Fig. 55. Connect up the wires to the foot pedal, foot switch and echo controls as shown in Fig. 56. Finally wire up the headphone amplifiers as shown in Fig. 57.

Other Parts Required For 5600S Only

1 5600S Cabinet
1 5600S Front Panel
2 C/S Panel Screw 4BA 1in } (for front panel)
2 4BA Cup Washer }
2 4600 Hinge
4 Self-Tapper No. 4 ⅜in. (for hinge)
1 Large Patchboard
Large Patch Plugs (as required)
300mm Strapping Wire 18swg }
4 Bolt 6BA ½in. } (for patchboard)
7 Nut 6BA }
3 Tag 6BA }

1 48-note Keyboard
48 Contact Block 1WG
8 Earth Bar
4 KB Mounting Strip
10 Self-Tapper No. 6 ½in. (for keyboard)
2 8W Amp Kit
4 Self-Tapper No. 6 ½in. (for 8W Amp kit)

1 5600S Rear Panel
10 Jack Skt Brk (SK1 to 6,8,9,11,12)
2 Jack Skt Sto (SK7 and Headphone socket)
1 Multisocket 8-way (SK10)
1 Springlatch 8-way
4 Bolt 6BA ½in. } (for Multisocket)
4 Nut 6BA }
8 Self-Tapper No. 4 ⅜in. } (for rear panel)
1 Tag 4BA }
1 roll Strapping Wire 22swg
1 Systoflex 1mm White
1 Systoflex 2mm Yellow
2pk Double Bubble Sachet
4pk Solder D622
1 Small Thermpath
1pk Wire 11C
30m Cable Twin
5m Ribbon Cable 20-Way

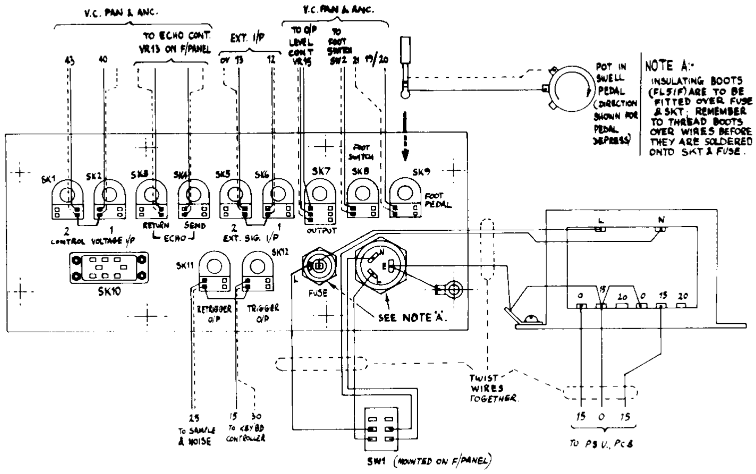


Fig. 54 Rear Panel Wiring (5600S only)

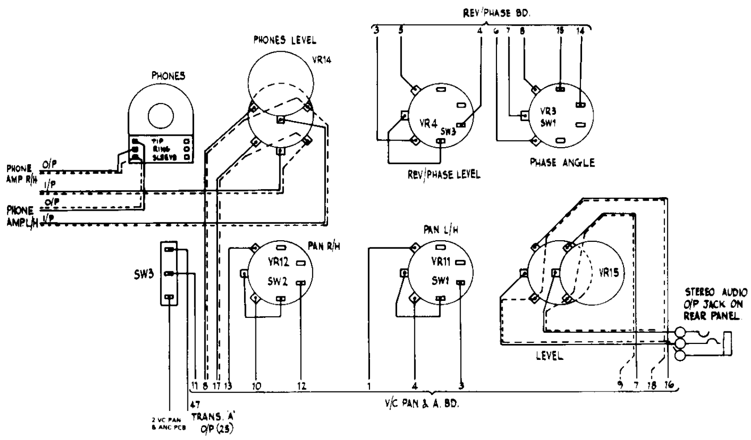
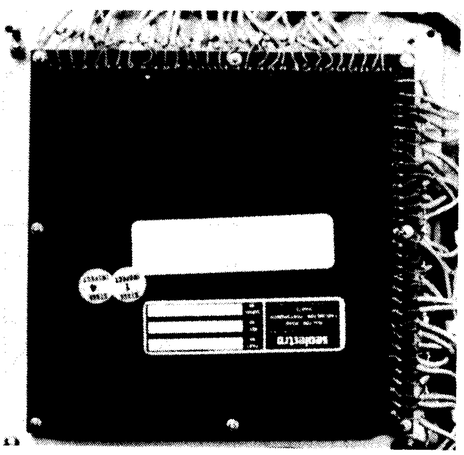


Fig. 55 Reverb, Phase and Output Controls Wiring



Patchboard showing connection of screens to wire straps fixed to tags on fixing screws.

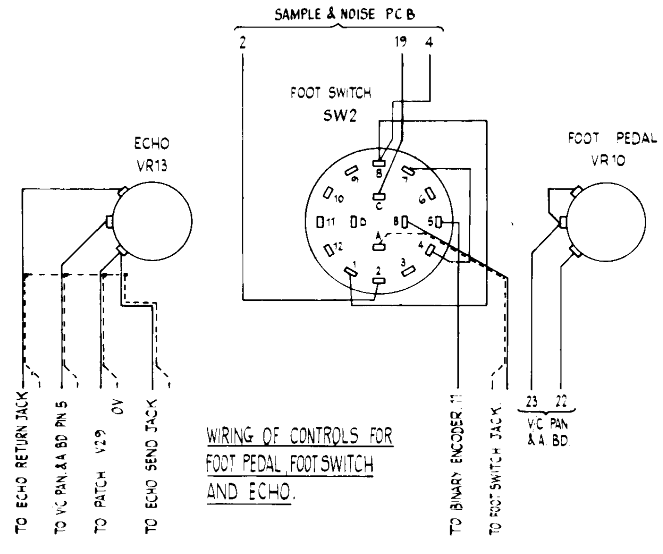


Fig. 56 Wiring of Controls for Foot Pedal, Foot Switch and Echo

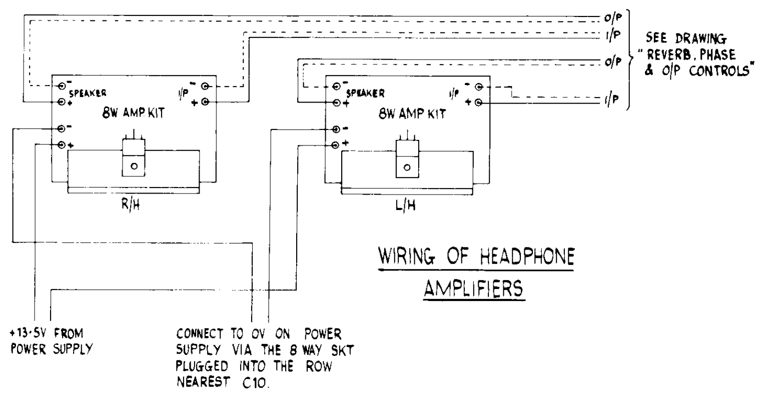
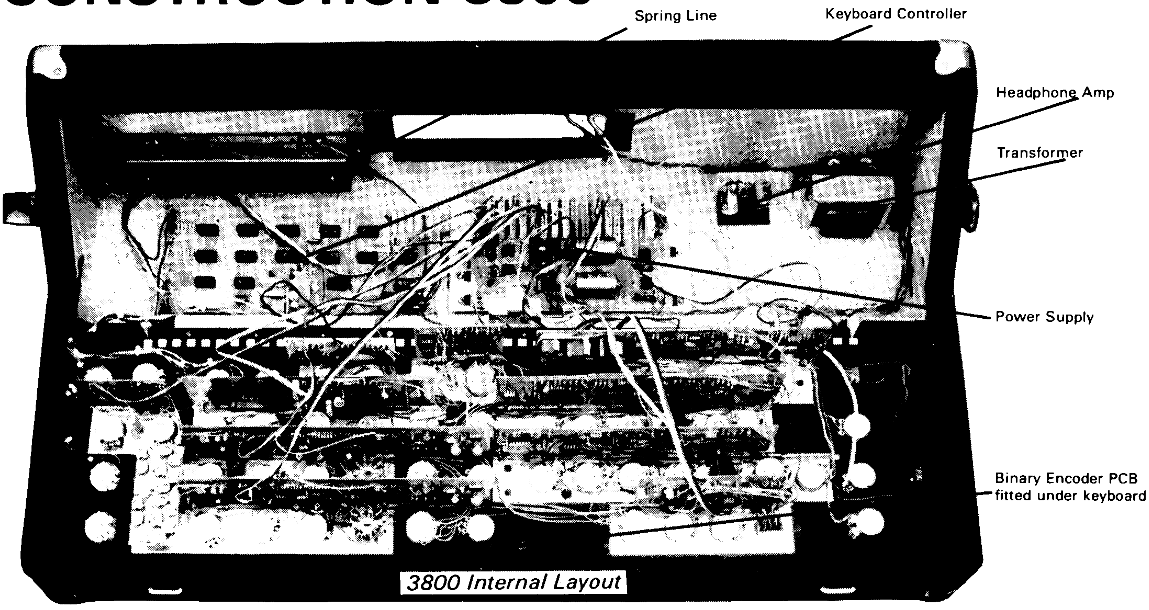


Fig. 57 Wiring of Headphone Amplifiers (5600S only)

CONSTRUCTION 3800



3800 Internal Layout

Power Supply

This board is the same as that in the 5600S synthesiser. Follow the construction details for the 5600S. There are sufficient plugs in the 3800 for every board individually except the binary encoder which is powered from the keyboard controller.

Keyboard and Binary Encoder

This board is the same as that in the 5600S synthesiser. Follow the construction details for the 5600S.

Keyboard Controller

This board is the same as that in the 5600S synthesiser. Follow the construction details for the 5600S.

Oscillator

The oscillators in the 3800 are identical to those in the 5600S except that there are only two in the 3800. As in the 5600S, oscillator 2 is wired differently from oscillator 1. When wiring the bracket mounted components as per Figs. 12 and 13 omit the wires between SW4 and pins 20 and 21 on both oscillators. Fix the oscillators to the front panel.

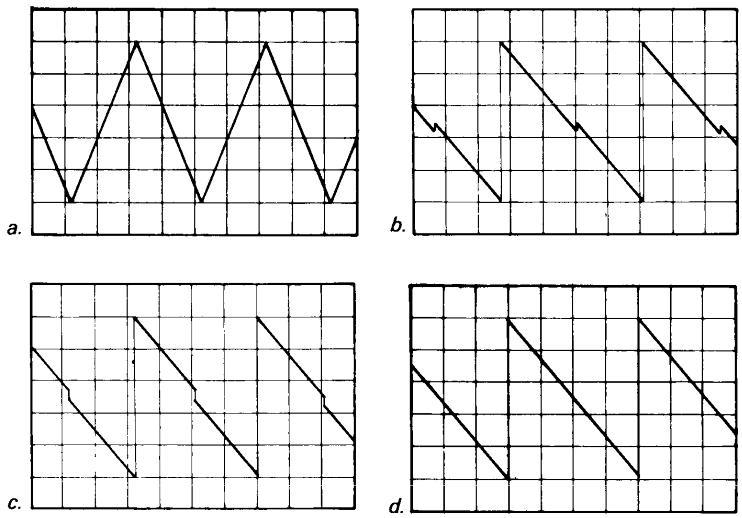


Fig. 58 Setting-up Oscillators

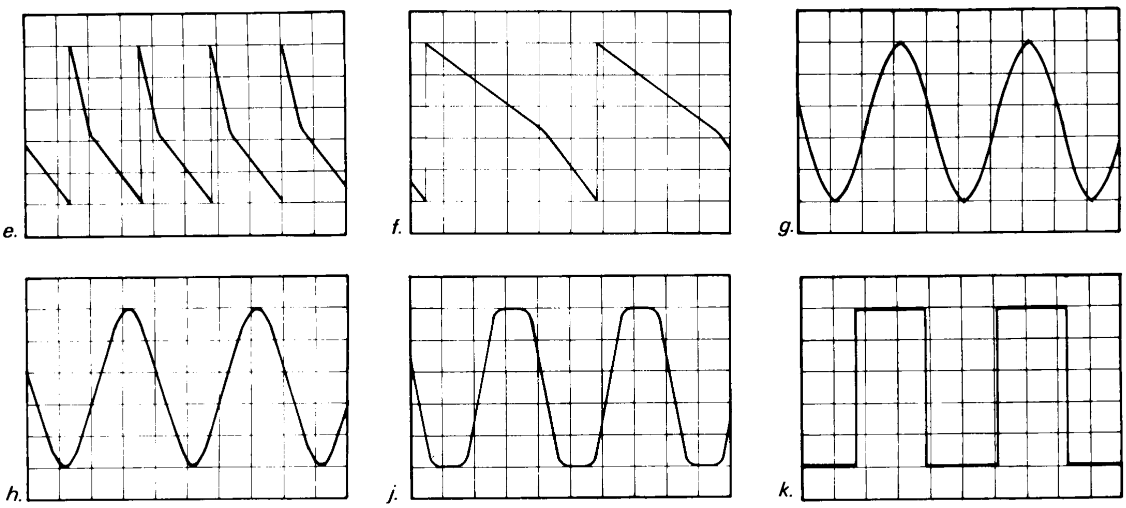


Fig. 58 Setting-up Oscillators

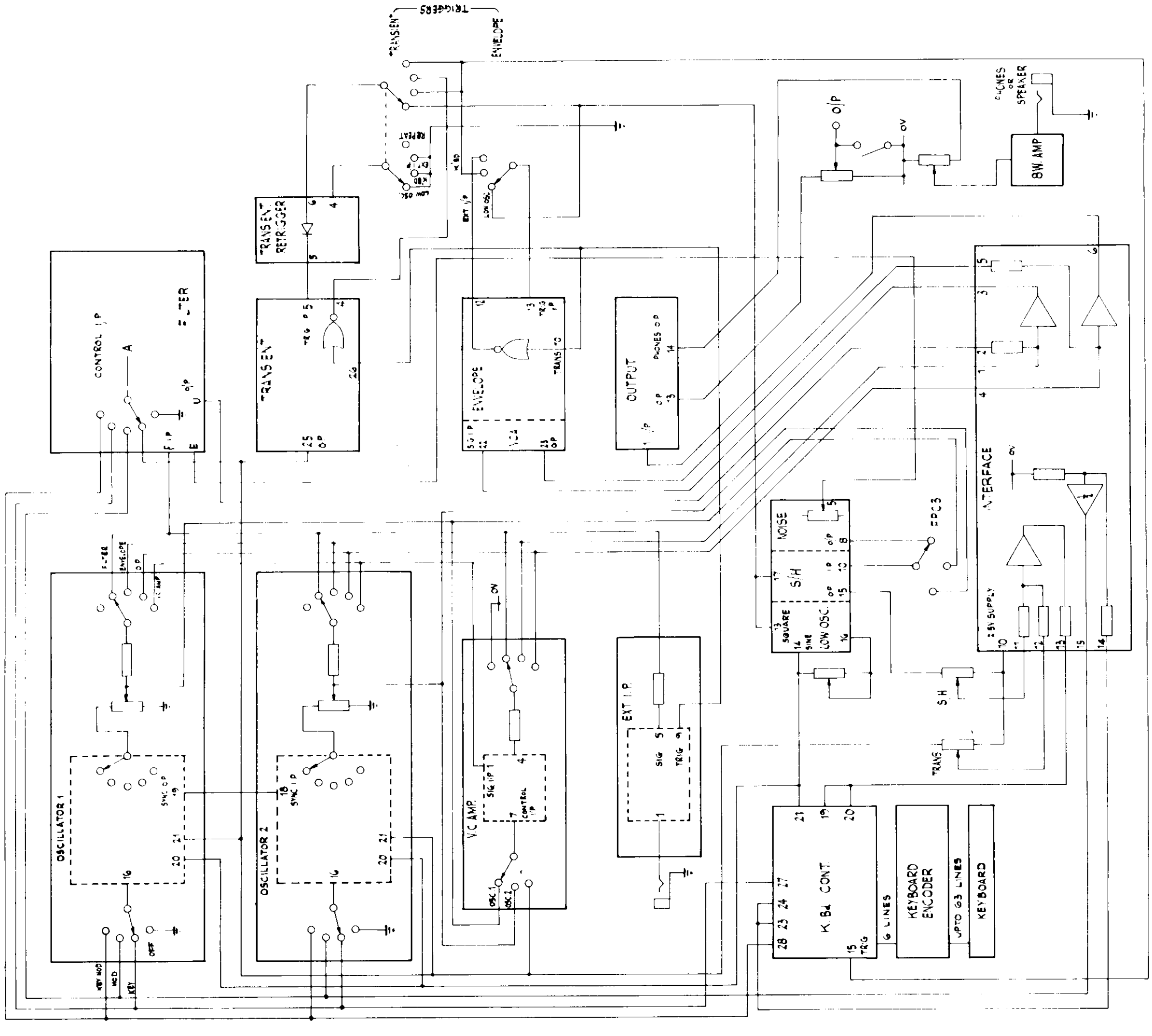


Fig. 59 Block Schematic of 3800

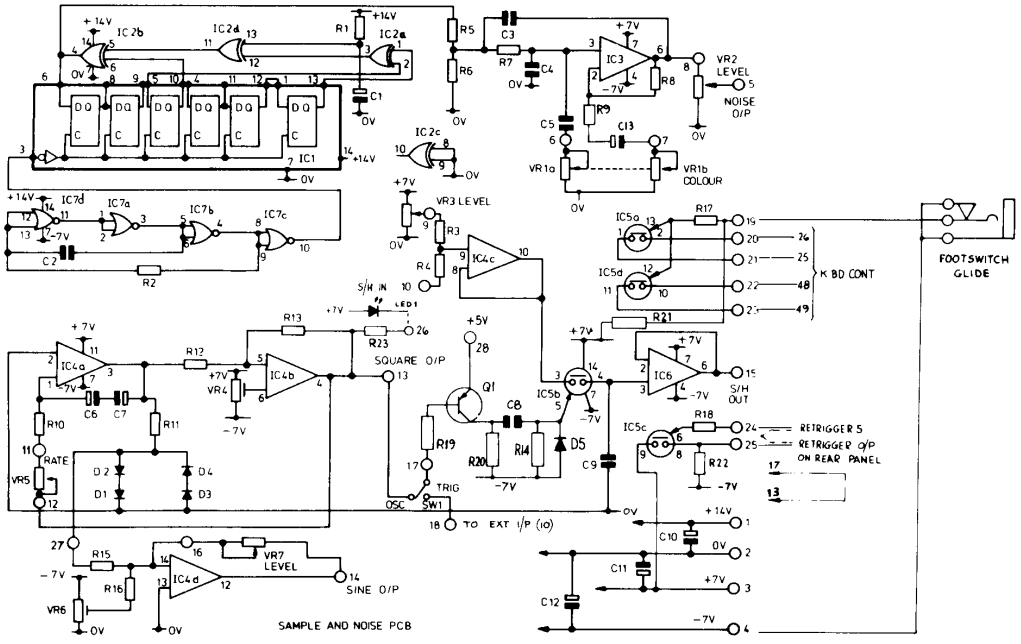


Fig. 60 Circuit Diagram of Sample and Noise (3800 only)

Sample and Noise

This board is the same as that in the 5600S synthesiser. Follow the construction details for the 5600S until the pcb is finished. Then fix the pcb and the front panel controls to the bracket, but do not proceed with any interwiring yet. The circuit in the 3800 is different from the 5600S and is shown in Fig. 60. Fix the bracket to the front panel.

External Input

The external input is provided so that other electronic instruments may be fed into the synthesiser in order to obtain new and different sounds. A trigger pulse is generated from the external instrument's signal, thus allowing the transient generators to be triggered.

Assemble the pcb as shown in Fig. 48, but omit: R2, R4, R6, R8, R10, R12, C3, C4 and C6. Pins 3, 4 and 6 are not required. Fix the front panel controls and the pcb to the bracket and interwire as shown in Fig. 61. Fit the assembly to the front panel.

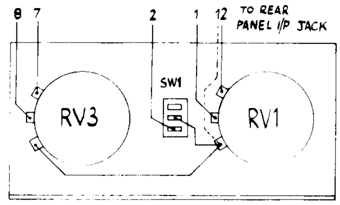


Fig. 61 Front Panel Wiring for External Inputs (3800 only)

Interface Construction

Assemble the pcb with the aid of the component overlay Fig. 62. Fix the front panel controls and the pcb to the bracket. Fix the assembly to the front panel.

Parts List for Interface

(1 required for 3800 only)

R1,2,3,4	Min Res 100k
R5	Min Res 82k
R6	Min Res 18k
R7,8,9,12,13	Min Res 22k
R10,11	Std Res 22k
C1,2	Tant 10 μF 25V
VR1,2	Pot Lin 22k
IC1	4136
IC2	μ A741C 8-pin DIL

Also required

1 3800 Interface PCB
1 Interface Mtg Bkt
1 DIL Socket 14-pin
1 DIL Socket 8-pin
1 Wafercon Socket 8-way
8 Wafercon Terminals
17 Veropin 2141
2 15mm Collet Knob Black
2 15mm Collet Nut Cover
2 15mm Collet Cap Grey
2 Bolt 6BA ¼in.
2 Nut 6BA
2 Shake 6BA

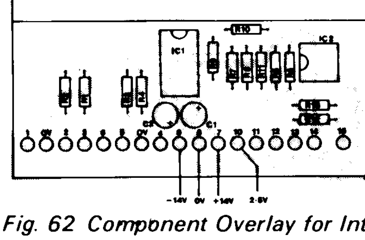


Fig. 62 Component Overlay for Interface

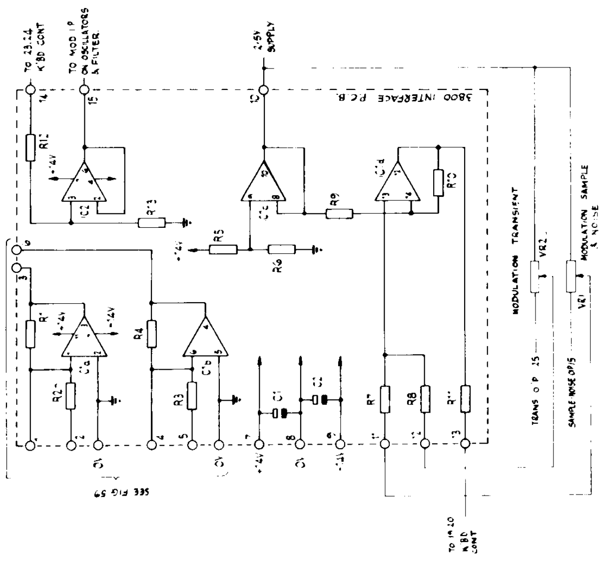


Fig. 63 Circuit Diagram of Interface

VCA

Assemble the VCA pcb using the component overlay Fig. 25 taking care with the orientation of the polarised components. Mount the front panel components and the pcb to the bracket and fix to the front panel with FPC10 and FPC11 (see Fig. 69).

Voltage Controlled Filter

Assemble the pcb as shown in Fig. 51. Fix the front panel components and the pcb to the bracket and interwire as shown in Fig. 64. Fix the assembly to the front panel.

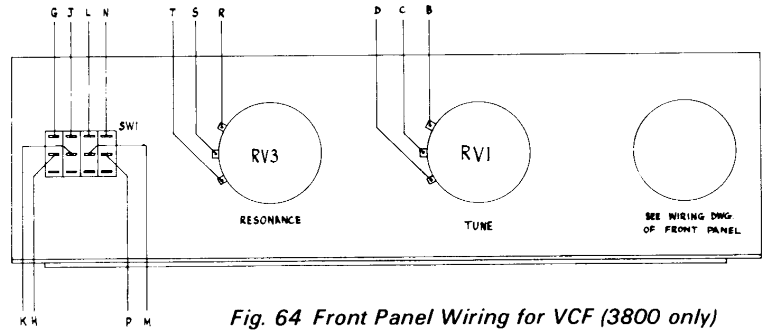


Fig. 64 Front Panel Wiring for VCF (3800 only)

Transient A

Assemble the transient 2 pcb as shown in Fig. 29 and the transient retrigger pcb as shown in Fig. 33. Fix the two pcb's and the front panel controls to the bracket and interwire as shown in Fig. 31 omitting the wiring to SW1 and SW3. Fix the assembly to the front panel.

Envelope

Assemble the 'transient' pcb as shown in Fig. 20 and the VCA pcb as shown in Fig. 22. Fix the pcb's and the front panel controls to the bracket and interwire as shown in Fig. 24 omitting the wiring to SW2. Fix the assembly to the front panel.

Output Module Construction

Assemble the pcb as shown in Fig. 65. Fix the pcb and the front panel components to the bracket and fix the bracket to the front panel. Fix the spring line to the cabinet as shown in the internal layout photograph. The spring line should be mounted on two rubber grommets. Wire the spring line to the output module as shown in Fig. 67.

Output Module — How It Works

This pcb can be broken down into four sections as follows:—

- Input Buffer
- Equaliser
- Reverberation
- Output Amplifier

The input buffer (IC1) has a 200k Ω input impedance and gives an attenuation of 6dB (½). The attenuation is required to prevent clipping in the equaliser output stage.

The output from the buffer is directly coupled to the input of the equaliser stage. This stage is a little unusual, since the equalising networks are arranged to vary the negative feedback. If we consider one section with the others disconnected, at the resonant frequency of the series LCR combination the impedance of the entire network will be equal to 680ohms. Either

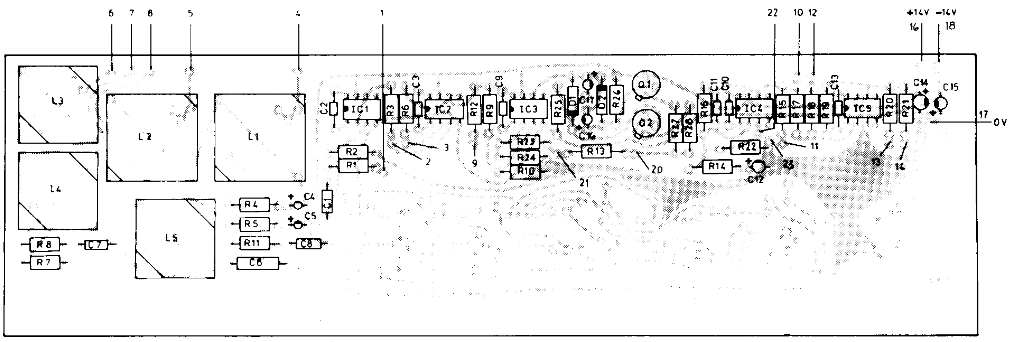


Fig. 65 Component Overlay for Output Module

side of resonance the impedance of the network will increase (with a slope dependent on the Q of the network), due to uncancelled inductive reactance above resonance and uncancelled capacitive reactance below resonance. We can

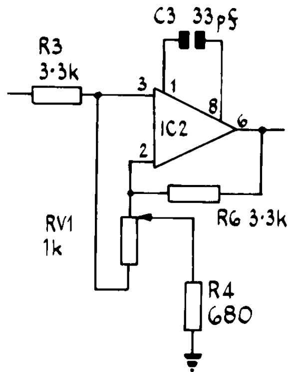


Fig. A Equivalent circuit of the equaliser with the potentiometer set for maximum boost at the resonant frequency of the network.

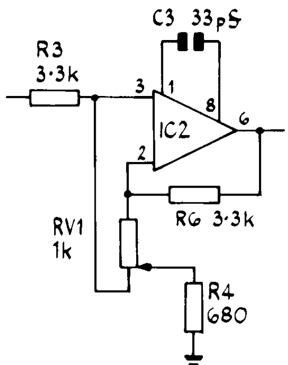


Fig. B Equivalent circuit of the equaliser with the potentiometer set for maximum cut at the resonant frequency of the network.

therefore represent the equaliser stage with equivalent circuits as reproduced here. These circuits consider only one network is in circuit, the input signal frequency is the resonant frequency of the network, and the resistance of the inductor is negligible.

With the slider of the potentiometer at the top end (Fig. A) we have 680ohms to the zero volt line from pin 2 of IC2, and a 1kohm between pin 3 and pin 2. The IC will

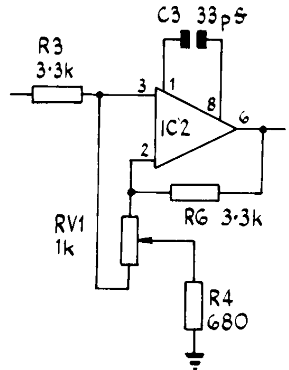


Fig. C Equivalent circuit of the equaliser with the potentiometer set for unity gain regardless of frequency.

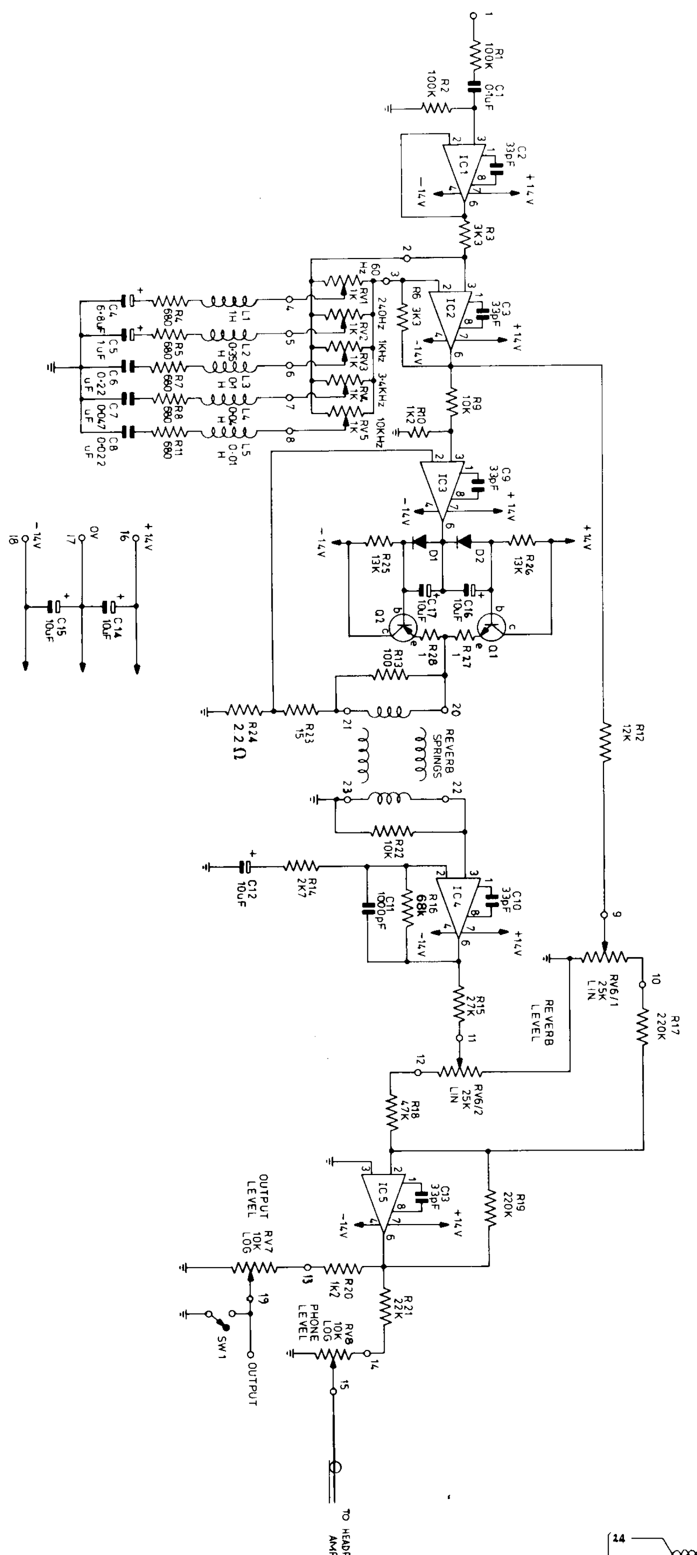


Fig. 66 Circuit Diagram of Output Module

act due to the feedback to keep the potential between pins 2 and 3 virtually zero, thus there is zero current through RV1. The voltage on pin 3 (IC2) is therefore equal to the output of the mixer since there is virtually no current through and no voltage drop across R3.

The output of IC2 in this case is approximately the input signal times (R6 + 680)/680ohms, indicating a gain of about 15dB. If the slider is at the other end of the potentiometer (Fig. B) the signal appearing at pin 3 and thus also at pin 2 is about 0.2 of the output of the previous stage due to the voltage division of R3 and the 680Ω. There is still zero current through RV1 and also zero current through R6 since there is no path. The output voltage is therefore the same as that at pin 2, which happens to be about 0.2 times the output of the previous stage. The gain is therefore 0.2 or −13dB.

With all networks in circuit, the maximum boost and cut will be reduced, but a range of ±10dB is still available. With the wiper of the potentiometers set midway (Fig. C), the gain will be unity regardless of frequency, due to the symmetry of the entire network.

The equaliser output is fed into the reverb drive circuit (IC3, Q3, Q4). The reverb is connected in the feedback of the IC in such a way that the drive is mostly constant current and not constant voltage. This drive method provides a more uniform frequency response. The output of the reverb is a very low amplitude signal which is amplified by IC4. The output of IC4 and the output of the equaliser (IC2) both go to RV6 which selects the percentage of each required.

The final amplifier, IC5, amplifies the output of RV6 and applies it to RV8 which adjusts the output level to the main amplifier. The output of IC5 also goes to the headphone amplifier.

④ Setting-up Output Module

Switch oscillator 1 to output and listen either on main output or on phones. Check that the output module facilities all work correctly (i.e. reverberation and equaliser).

Parts List for Output Module

(1 required for 3800 only)

R1,2	Min Res 100k
R3,6	Min Res 3k3
R4,5,7,8,11	Min Res 680Ω
R9,22	Min Res 10k
R10,20	Min Res 1k2
R12	Min Res 12k
R13	Min Res 100Ω
R14	Min Res 2k7
R15	Min Res 27k
R16	Min Res 68k
R17,19	Min Res 220k
R18	Min Res 47k
R21	Min Res 22k
R23	Min Res 15Ω
R24	Min Res 2.2 Ω
R25,26	Std Res 13k
R27,28	Std Res 1Ω
C1	Polyester 0.1 μF
C2,3,9,10,13	Ceramic 33pF
C4	Tant 6.8 μF 35V

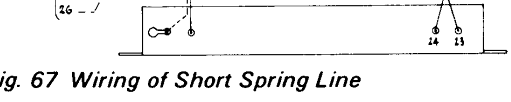


Fig. 67 Wiring of Short Spring Line

C5	Tant 1μF 35V
C6	Polyester 0.22μF
C7	Polyester 0.047μF
C8	Polyester 0.022μF
C11	Polystyrene 1000pF
C12,14,15,16, 17	Tant 10μF 25V
RV1,2,3,4,5	Pot Lin 1k
RV6	Dual Pot Lin 25k
RV7,8	Pot Log 10k
Q1	2N2219
Q2	2N2905
IC1,2,3,4,5	LM301A
D1,2	1N4148
SW1	Sub-Min Toggle A
L1	GE Coil L11
L2	GE Coil L12
L3	GE Coil L6
L4	GE Coil L14
L5	GE Coil L15

Also required

1 Output Stage PCB
1 Trans 1/Env Mtg Bkt
1 Short Spring Line
2 Self-Tapper No. 6 ½in.
2 Grommet Small
5 DIL Socket 8-pin
1 Wafercon Socket 8-way
8 Wafercon Terminals
21 Veropin 2141
2 Bolt 6BA ¼in.
2 Nut 6BA
2 Shake 6BA
8 15mm Collet Knob Black
8 15mm Collet Nut Cover
5 15mm Collet Cap Grey
1 15mm Collet Cap Black
1 15mm Collet Cap Blue
1 15mm Collet Cap Red

Headphone Amplifier Construction

This board is the same as that in the 5600S synthesiser (except that there is only one). Follow the construction details for the 5600S and then fix the complete assembly to the cabinet in the position shown in the internal layout photograph. Wire up the amplifier as shown in Fig. 68.

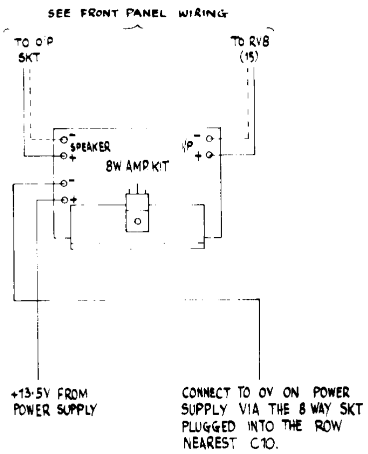


Fig. 68 Wiring of Headphone Amplifier (3800 only)

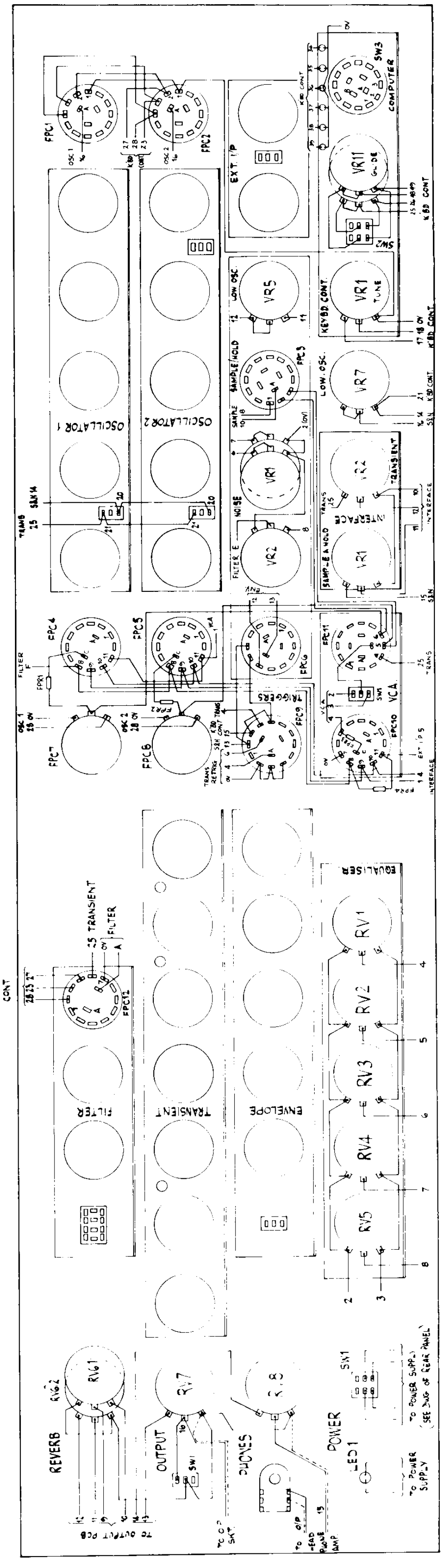


Fig. 69 Wiring of Front Panel

Completing the Front and Rear Panels

Fix the rest of the components to the front and rear panels. Carefully wire the front panel as shown in Fig. 69 and the rear panel as shown in Fig. 70. Cut down all the spindles and fit the knobs as shown in the colour photographs. Fix the rear and front panels to the cabinet. Note that a boot should be fitted to the fuseholder and mains plug.

Other Parts Required For 3800 Only

1 3800 Cabinet
1 3800 Front Panel
6 Rd Woodscrew No. 4 Black ½in. (for front panel)
4 Rotary Sw 4 (FPC 1,2,6,9)
2 Rotary Sw 3 (FFC 3,11)
4 Rotary Sw 6 (FPC 4,5,10,12)
2 Pot Lin 22k (FPC 7,8)
4 Min Res 100k (FPR 1,2,3,4)
12 15mm Collet Knob Black
5 15mm Collet Indicator
7 15mm Collet Nut Cover
2 15mm Collet Cap Black
3 15mm Collet Cap Blue
4 15mm Collet Cap Green
2 15mm Collet Cap Red
1 15mm Collet Cap Yellow

1 48-note Keyboard
48 Contact Block 1WG
8 Earth Bar
4 KB Mounting Strip
10 Self-Tapper No. 6 ½in. (for keyboard)
1 8W Amp Kit
2 Self-Tapper No. 6 ½in. (for 8W Amp kit)
1 3800 Rear Panel
6 Jack Skt Brk (SK1,2,3,4,6,7)
1 Multisocket 8-way (SK5)
1 Springlatch 8-way
4 Bolt 6BA ½in. } (for Multisocket)
4 Nut 6BA }
8 Self-Tapper No. 6 ⅜in. } (for rear panel)
1 Tag 4BA }

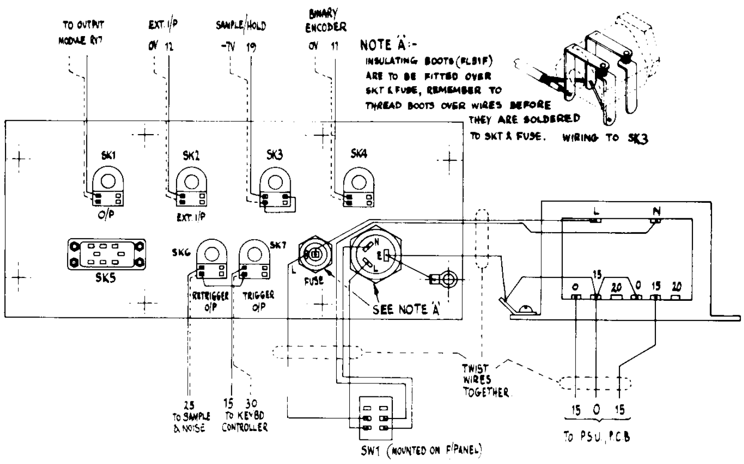
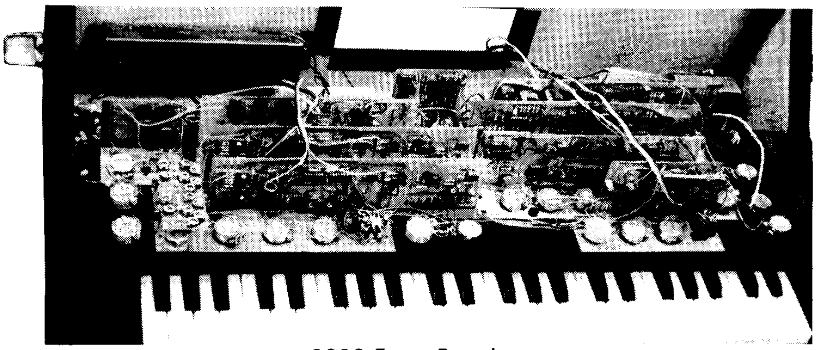


Fig. 70 Wiring of Rear Panel (3800 only)



3800 Front Panel

1 Jack Skt Sto (for headphones)
1 roll Strapping Wire 22swg
1 Systoflex 1mm White
1 Systoflex 2mm Yellow
2pk Double Bubble Sachet
3pk Solder D622
1 Small Thermpath
1 Foot Sw
1 Adaptor A (for Foot Sw)
1pk Wire 11C
15m Cable Twin
4m Ribbon Cable 20-Way

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