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.

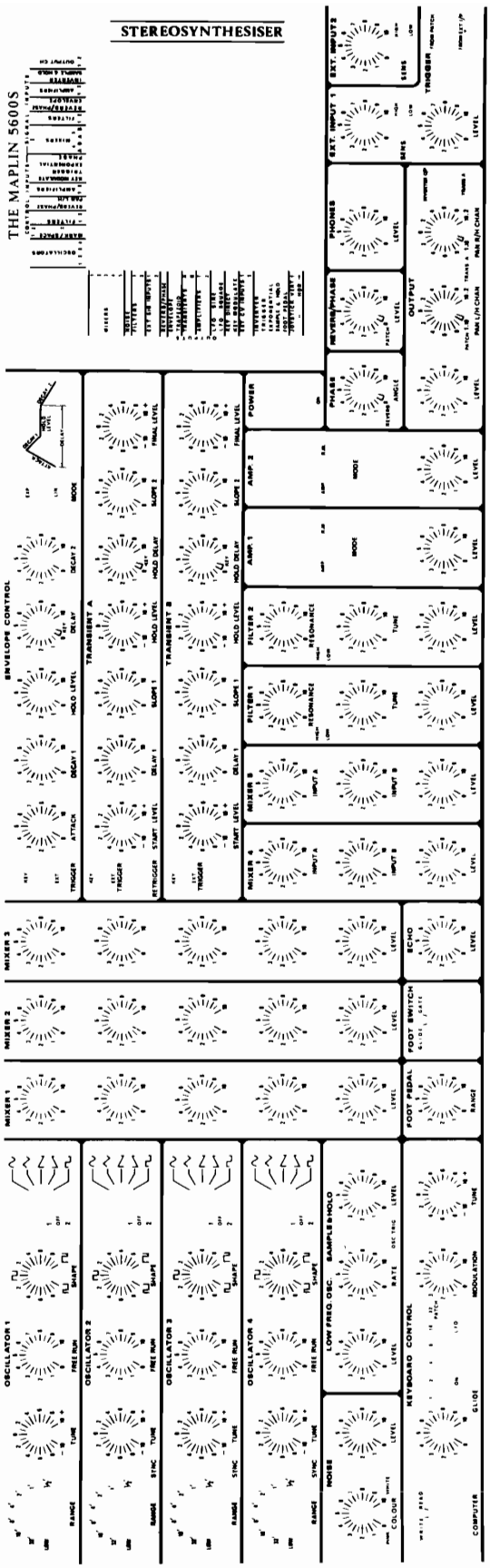
Oscillators

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

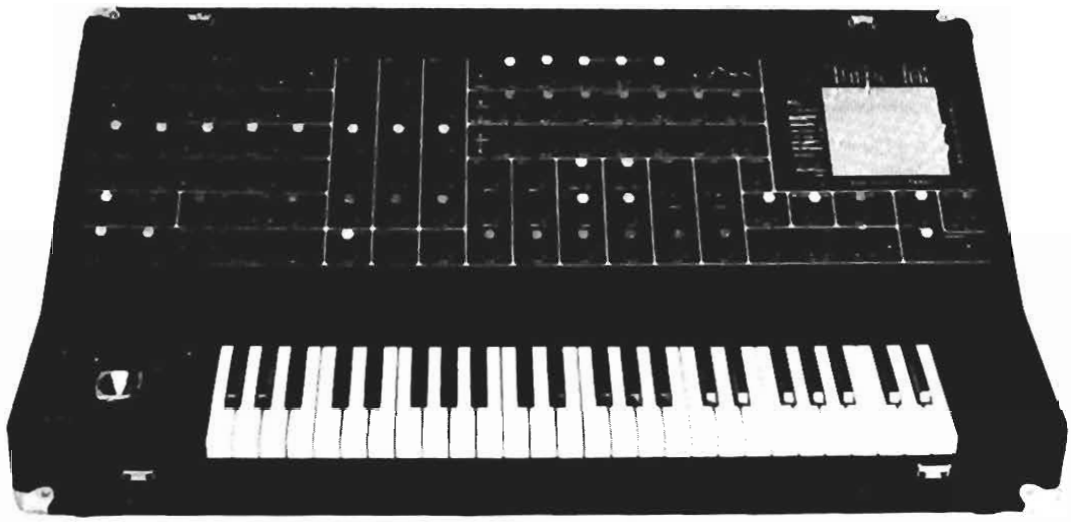
Glide may be switched on and off or a gate trigger pulse may be generated from an external foot switch. Switched on front panel.

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 OV the voltage at the patchboard will remain at OV. 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

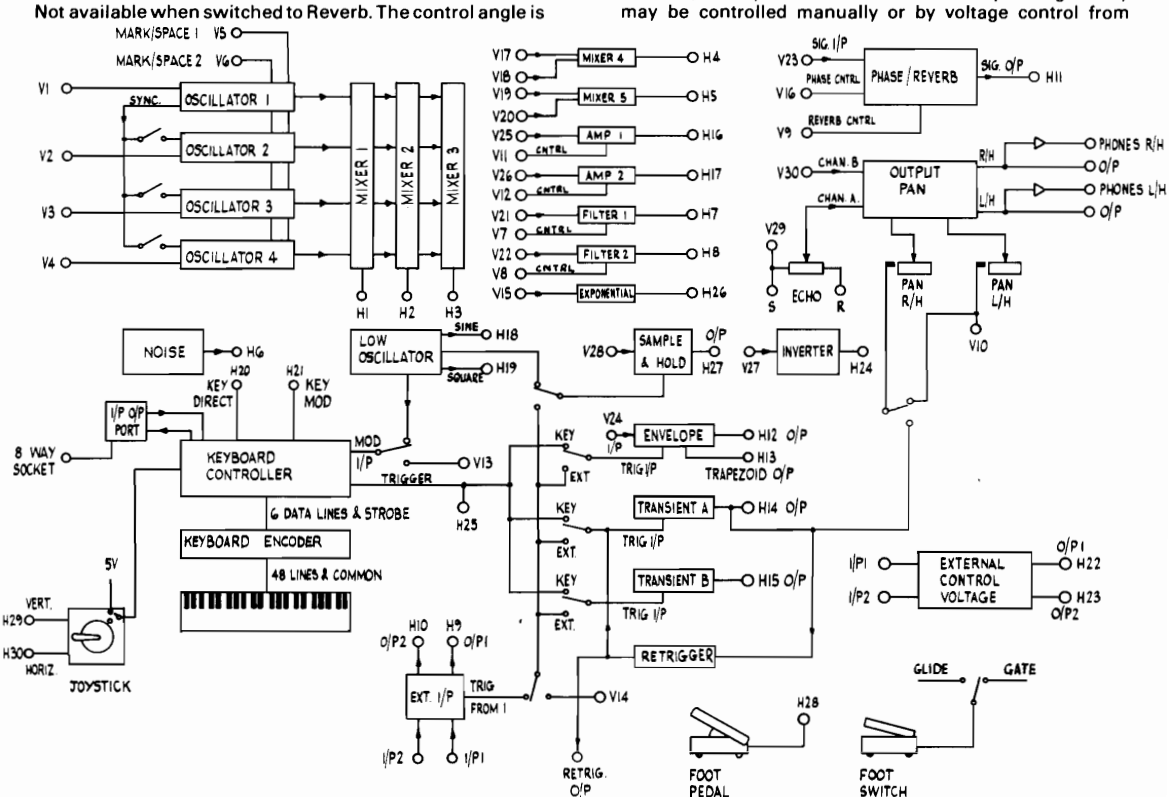


Fig. 1 Block Schematic of 5600S

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: 2kΩ

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: 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.

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

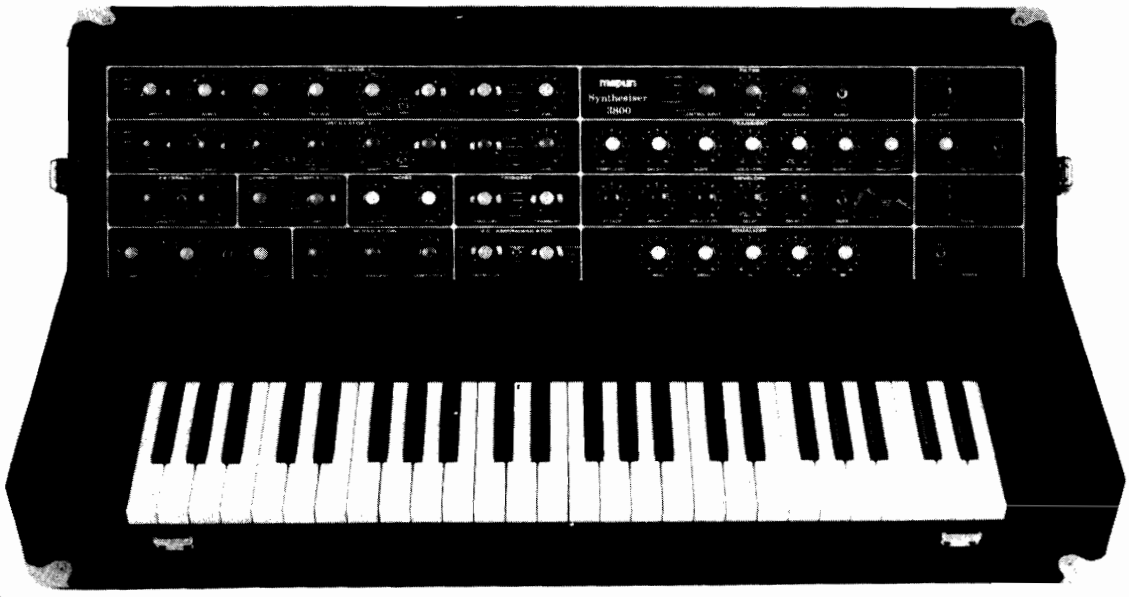
Keyboard
48-note F to E monophonic. (Could use a keyboard of up to 63 notes, but not in our cabinets.) Each note generates its own specific 6-bit digital code which is decoded in the keyboard controller. Thus notes may be generated directly by a microprocessor or other digital input. The code being used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

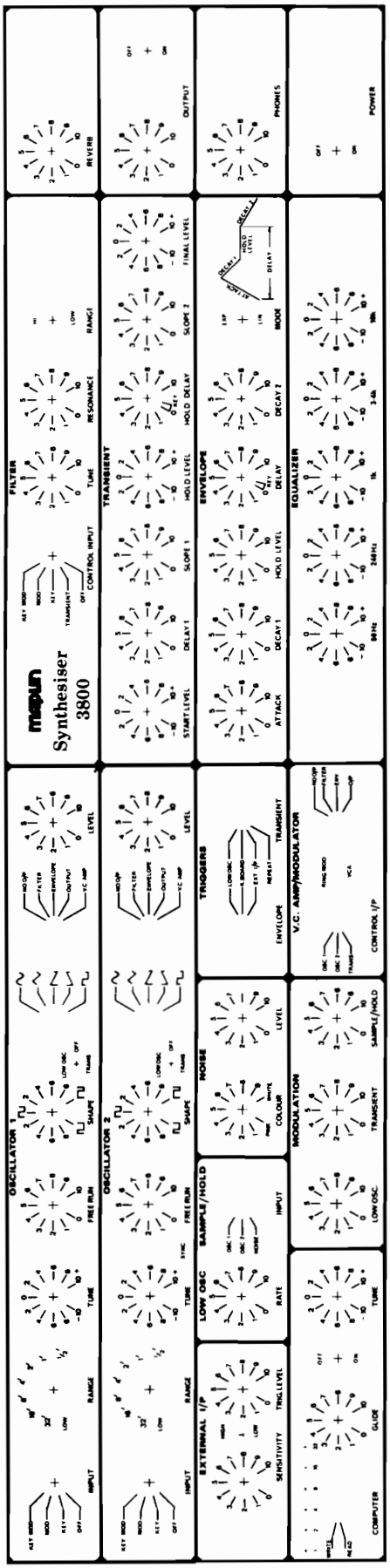
Modulation
Provides a source of modulation for oscillators other than from the keyboard.
Controls:
Low oscillator: Selects low oscillator as source.
Transient: Selects transient as source.
Sample and Hold: Selects held voltage.

Oscillators
Two voltage controlled oscillators plus one low oscillator (described separately). Overall range: 0.1Hz to >20kHz 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 (0.1Hz) 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 10kΩ. 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.

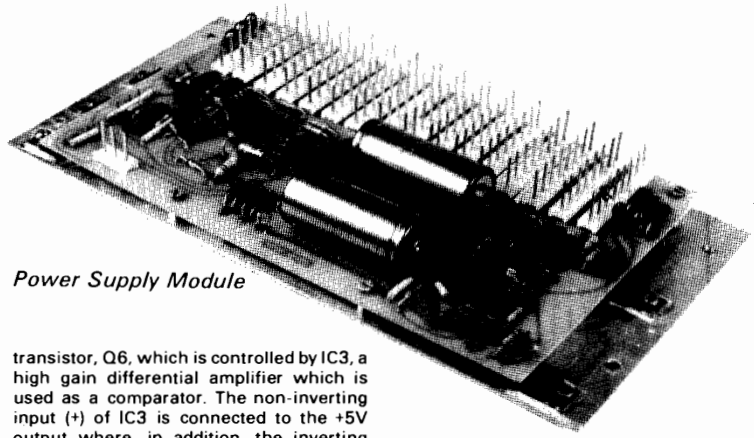
The heatsink should be used as a guide to determine the bending points. Since the transistors are on the underside of the pcb there must be no strain on the joints otherwise the pcb track may be broken. Mount the transistors, using mica insulators, in position on the heatsink. The transistors can then 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 — 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.



Power Supply Module

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.

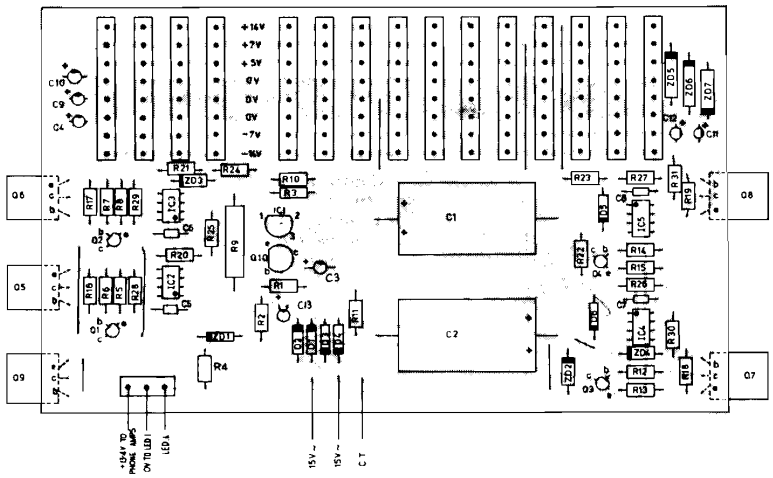


Fig. 2 Component Overlay for Power Supply

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 2200μF 25V
C3,4,9,10,11,12	Tant 10μF 25V
C5,6,7,8	Ceramic 33pF
C13	Tant 33μF 10V
Q1,2	MPS3638
Q3,4	PN3643
Q5,6,9	TIP31A
Q7,8	TIP32A
Q10	2N3704
IC1	μA78L05AWC
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

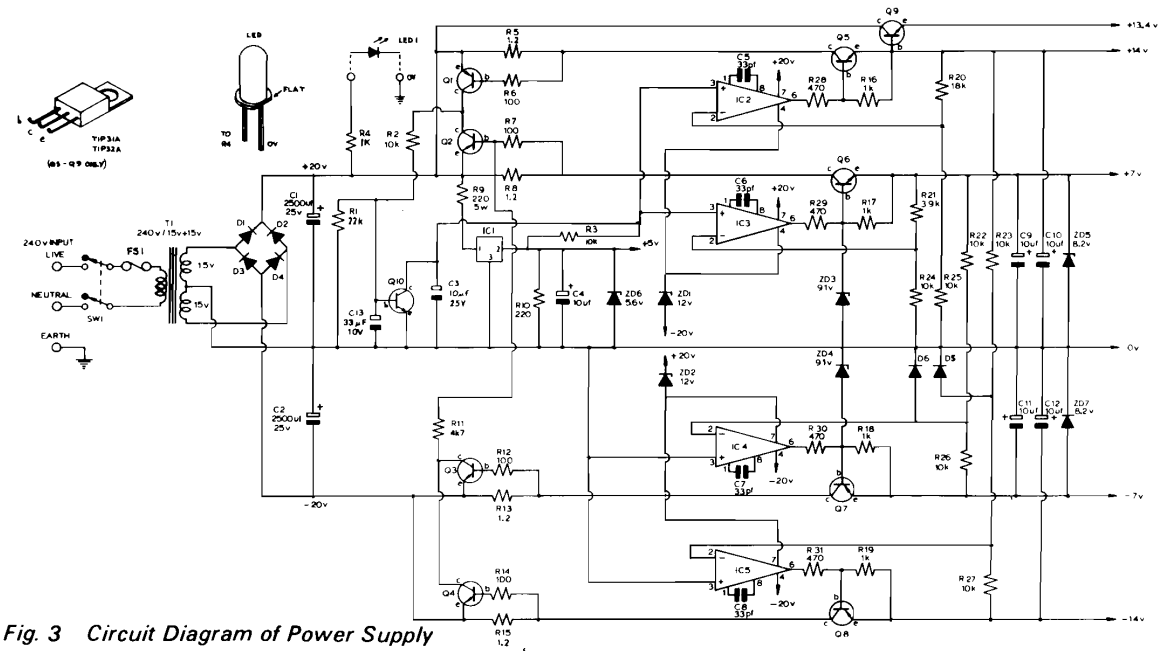


Fig. 3 Circuit Diagram of Power Supply

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-

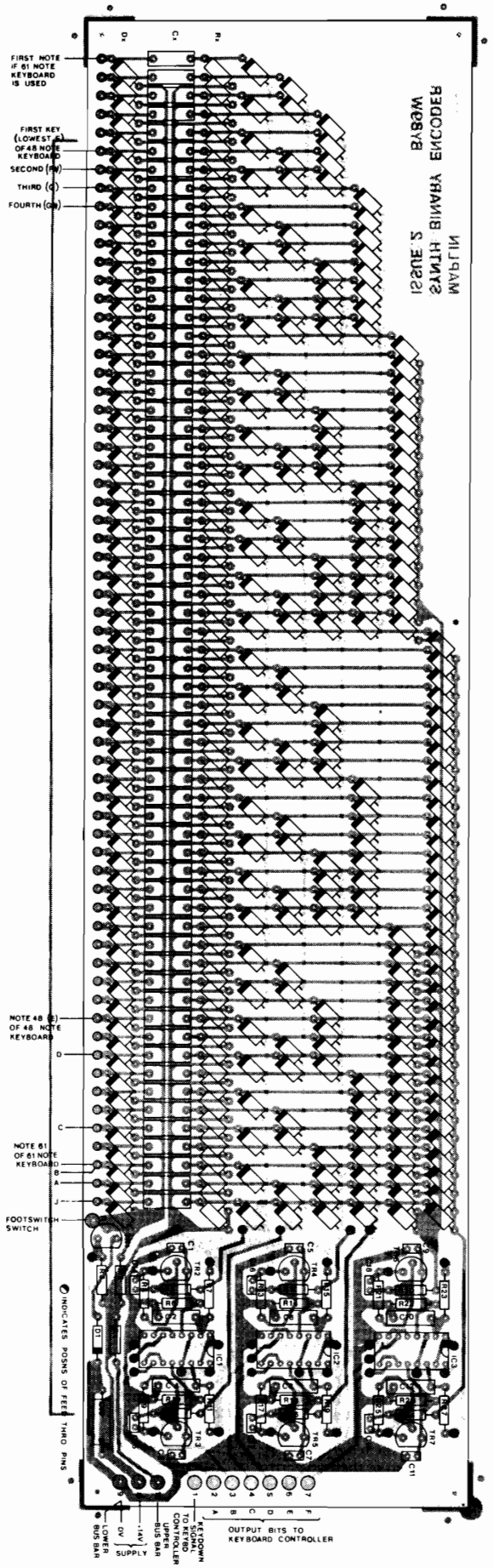
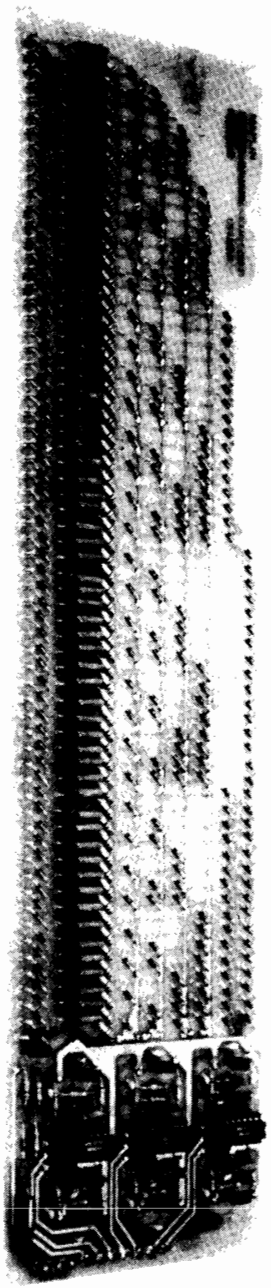


Fig. 4 Component Overlay for Binary Encoder

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

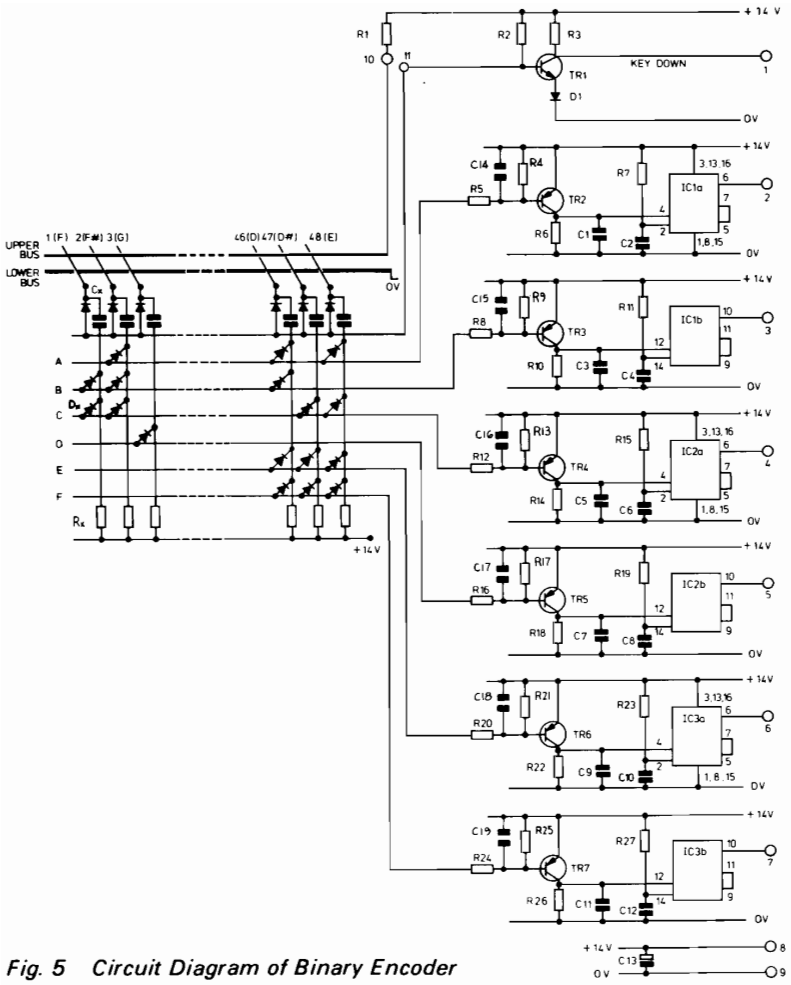


Fig. 5 Circuit Diagram of Binary Encoder

Parts List for Binary Encoder

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

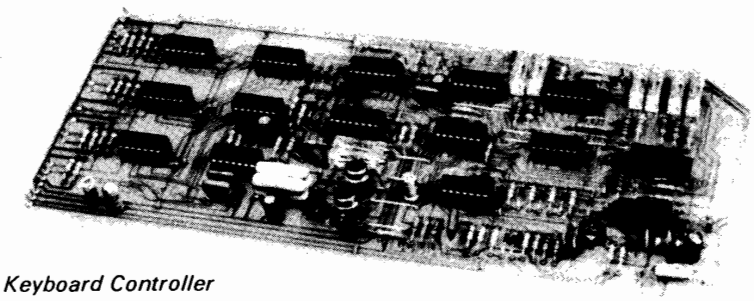
R1,5,8,12,16, 20,24	Min Res 2k2
R2	Min Res 47k
R3	Min Res 10k
R4,9,13,17,21, 25	Min Res 1k
R6,10,14,18, 22,26	Min Res 27k
R7,11,15,19, 23,27	Min Res 68k
Rx (63 required)	Min Res 100k
C1,3,5,7,9,11, 14,15,16,17, 18,19	Ceramic 470pF
C2,4,6,8,10,12	Polyester 0.01 μF
C13	Axial 10 μF 25V
Cx (63 required)	Polyester 0.01 μF
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 μs 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.

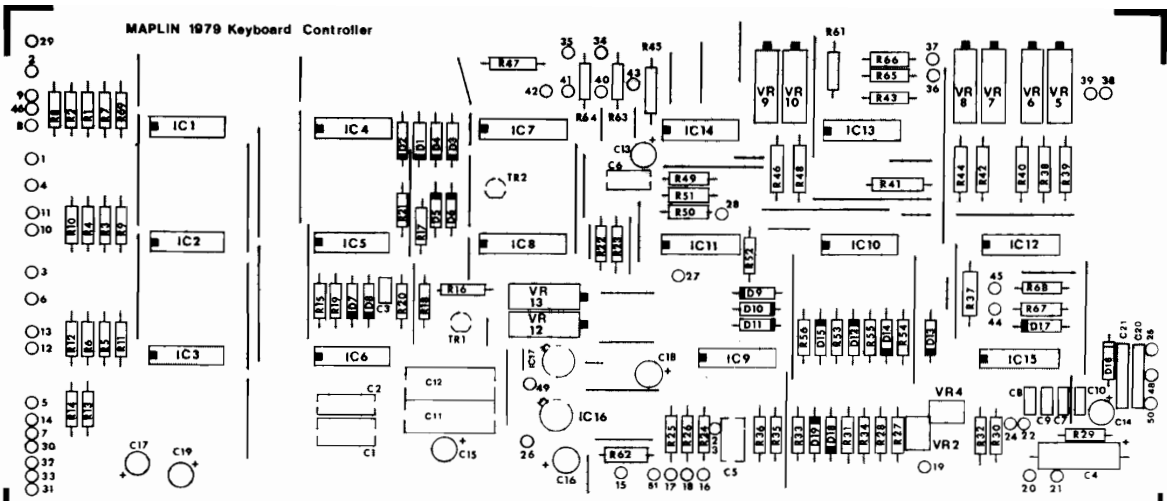


Fig. 6 Component Overlay for Keyboard Controller

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 0.1 μF
C2	Polyester 0.068 μF
C3	Ceramic 2200pF
C4	Axial 1 μF 63V
C5,6	Polyester 0.01 μF
C7,8	Ceramic 100pF
C9,10	Ceramic 470pF
C11,12	Polyester 0.47 μF
C13,14,15,16, 17,18	PC Elect 10 μF 35V
C19	PC Elect 4.7 μF 63V
C20,21	Disc 0.1 μF
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.*

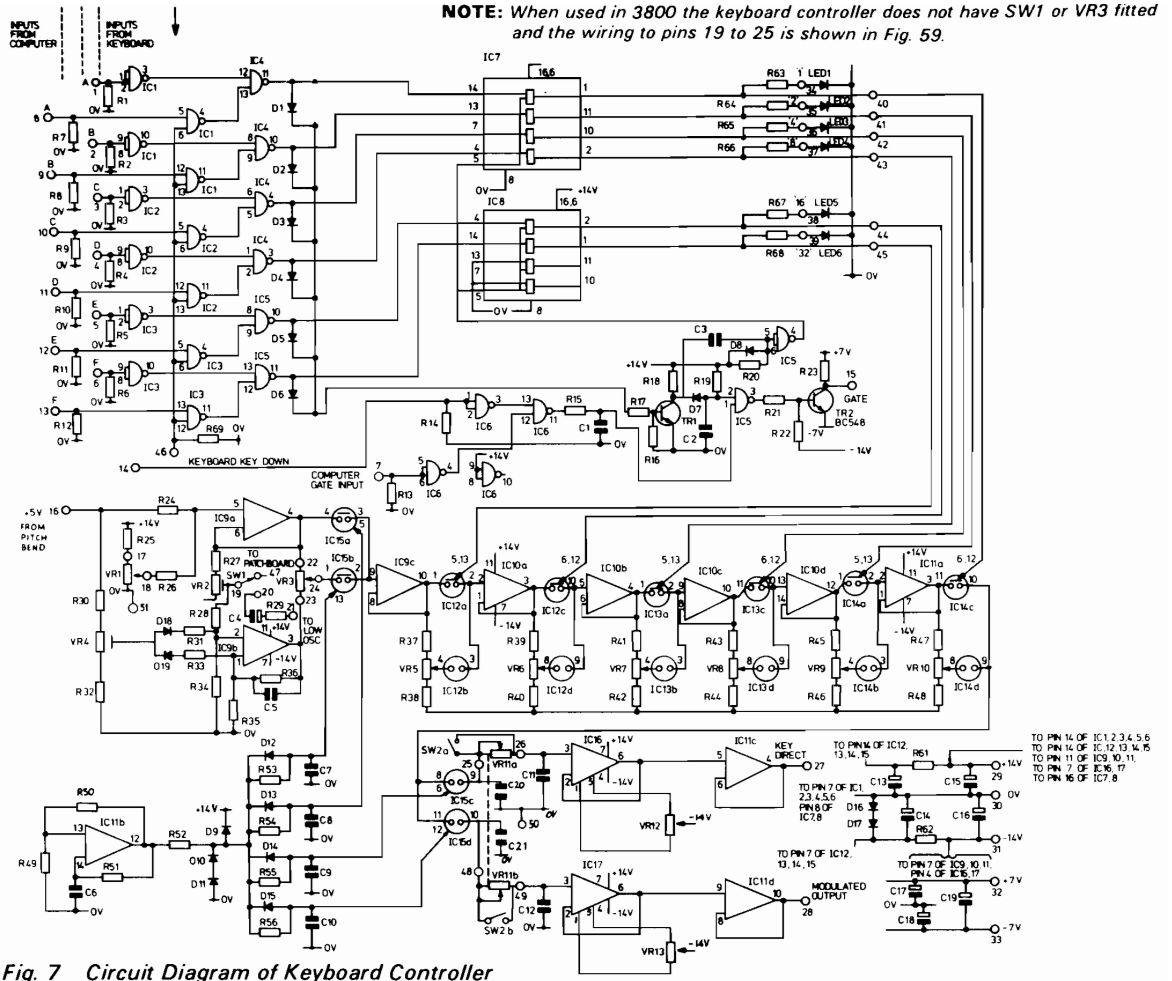


Fig. 7 Circuit Diagram of Keyboard Controller

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.

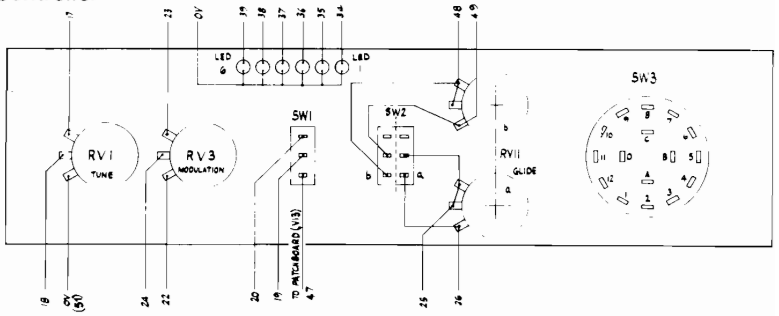


Fig. 8 Front Panel Wiring for Keyboard Controller

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 (0V 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.