INTERNATIONAL 3600 SYNTHESIZER

Building the voltage controlled filter

THE VOLTAGE CONTROLLED FILTER used in the model 3600 synthesizer has been designed in the light of experience gained in using the larger 4600 unit.

It was found that the bandpass and high-pass filters were seldom used and that extra presence was required in the lowpass filter. To this end it was decided to redesign the filter to provide a 'resonance' control which allowed the filter to be peaked, as required, just before the cut-off point.

The filter now has a more 'commercial' sound (and may readily be fitted to the larger unit if desired). If the filter is peaked too much it will oscillate. This is an advantage as it effectively provides a useful sinewave oscillator if required.

CONSTRUCTION

The method of assembly is similar to that used for most of the other modules. A small aluminium bracket is used to hold the printed circuit board and associated switches and potentiometers.

When assembling the components to the printed circuit board the usual care must be taken with the orientation of polarized components. Assemble the components to the board in accordance with the overlay Fig. 2 using sockets for the CMOS ICs at least. Note that IC2 MUST be a

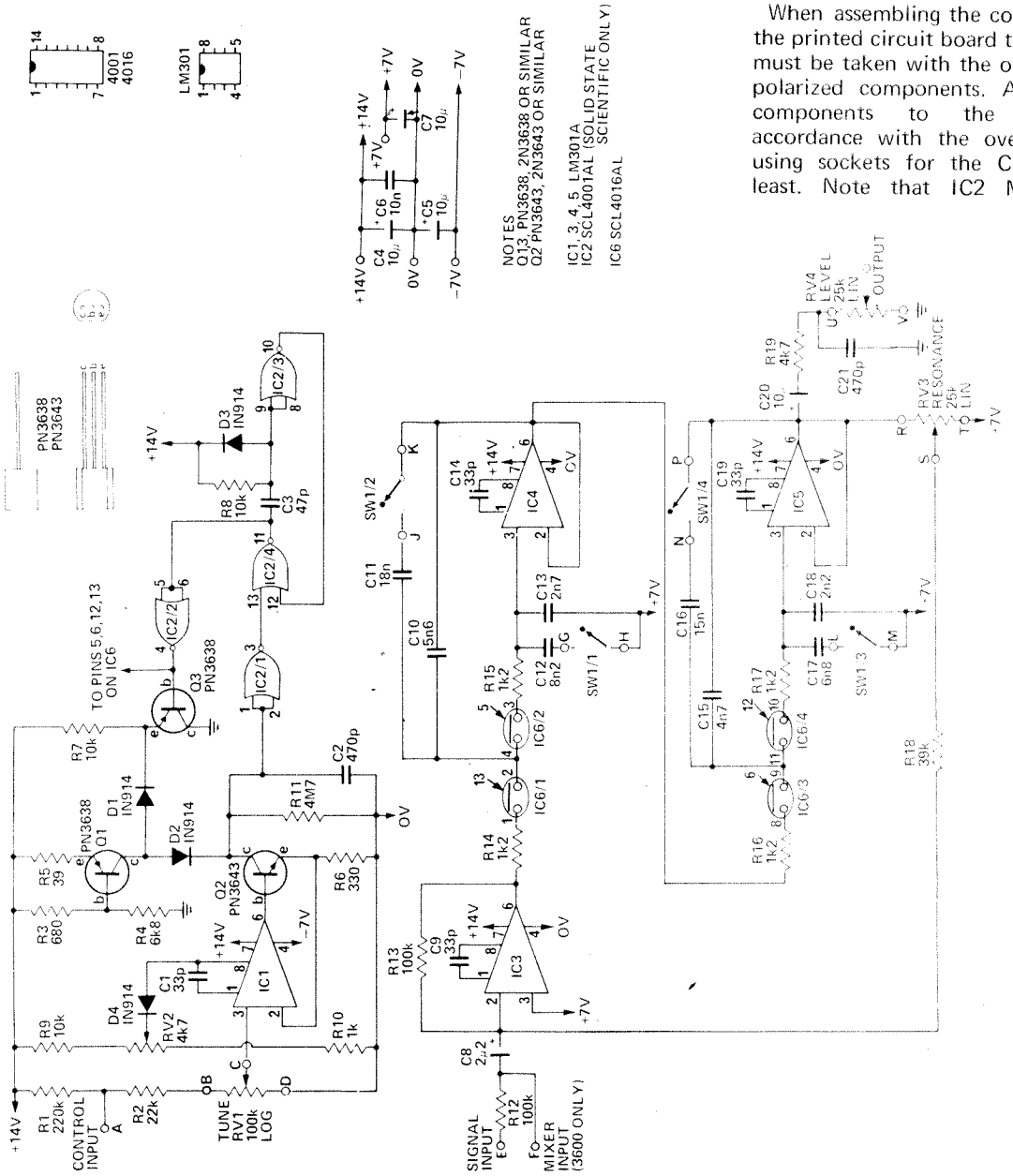

Fig. 1. Circuit diagram of filter module.

SCL4001AL as made by Solid State Scientific. Although this component is made under the same number by other companies, the Solid State Scientific version is much faster and has a much narrower linear region. If another brand is substituted the oscillator may work over a restricted range, or worse still may not work at all.

Two ways of wiring external components are shown, in Figs. 3 and 4. The second drawing (Fig. 3) applies to the larger 4600 synthesizer only.

SETTING UP

The only adjustment necessary is to set the trim potentiometer RV2. This is done as follows. Connect the control input to +14V, turn the resonance control to maximum, such that the filter acts as an oscillator, and set the range control to low. It will be found that as the tune control is advanced the frequency will increase, drop slightly and then cease. When in this state (ceased) adjust RV2 until the oscillation starts again and is at maximum frequency.

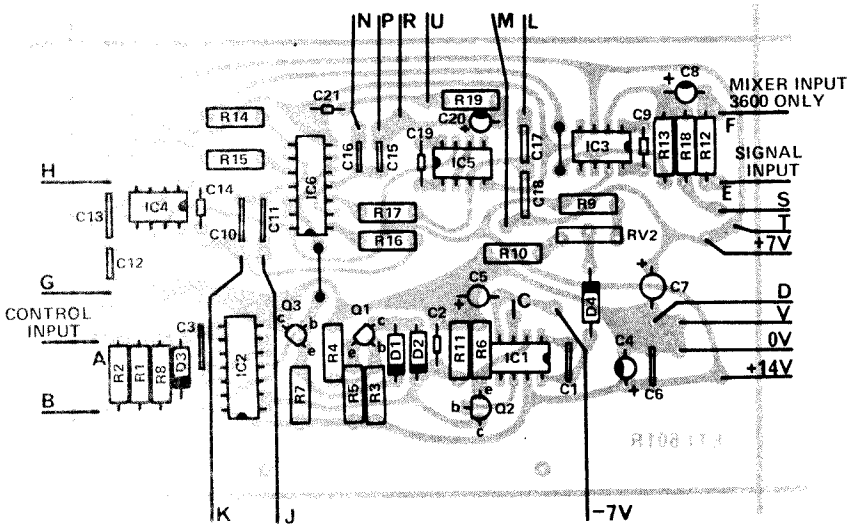

Fig. 2. Component overlay

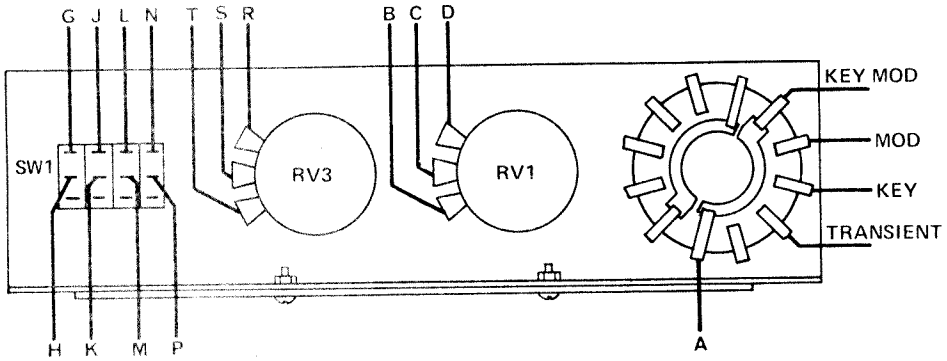

Fig. 3. Potentiometer and switch wiring for 3600 unit.

HOW IT WORKS

The voltage controlled filter consist of three main sections:–

1. The buffer amplifier – mixer.
2. A low-pass filter.
3. A voltage controlled filter.

The buffer amplifier IC3 is used to give a level shift to the input signal and to provide a constant 100 k input impedance. A second input direct to the input of IC3 is used, in the 3600 synthesizer, for additional mixing.

The 4016 CMOS IC is a four section analogue switch which when 'on' has a resistance of about 200 ohms and when 'off' a resistance of about 10^{12} ohms. Each section has its own control input but in our case all the control inputs are connected together. We may consider the switches on the filter 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 out-off frequency and a ultimate slope of 24 dB 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 6 dB down. It eventually moves 180° out of phase again as the frequency increases. The potentiometer RV3 and resistor R18 takes part of the output signal and feeds 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 the areas of the filter.

To obtain the two ranges we switch capacitors in or out and, to give the 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 200 n sec triggered by a voltage controlled oscillator which is variable from 5 kHz to about 3 MHz. We therefore keep the on-time constant and vary the off-time.

The VCO is virtually identical to that shown in the March 1975 issue and reference should be made to this for how it works. The only changes made is an addition to prevent the oscillator stopping either on overvoltage (RV2) or negative input voltage (R11).

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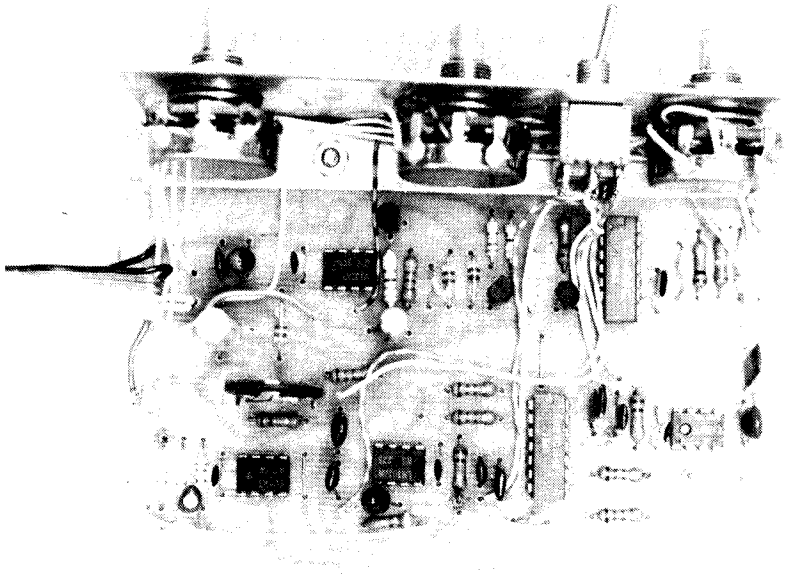
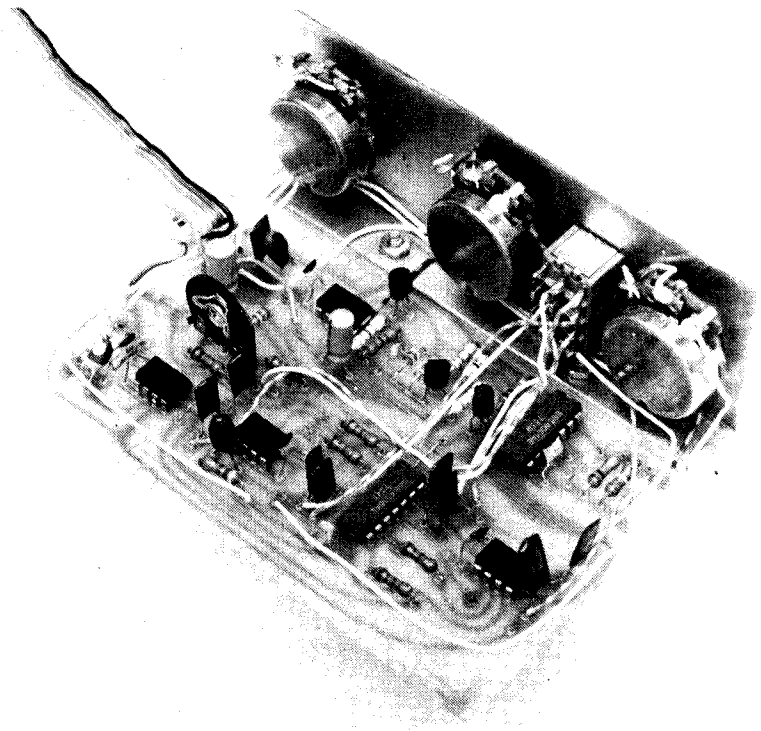
Internal views of filter module.





PARTS LIST

R5	Resistor	39ohm	5%	¼W
R6	"	330ohm	"	"
R3	"	680 "	"	"
R10	"	1k	"	"
R14,15,16,17		1.2k	"	"
R19	"	4.7k	"	"
R4	"	6.8k	"	"
R7,8,9	"	10k	"	"
R2	"	22k	"	"
R18	"	39k	"	"
R12,13	"	100k	"	"
R1	"	220k	"	"
R11	"	4.7M	"	"
RV1	Potentiometer	100k	Log rotary	
RV3,4	"	25k	LIN "	
RV2	"	4.7k	Trim type	
C1,9, 14,19	Capacitor	33pF	ceramic	
C3	"	47pF	"	
C2,21	"	470pF	"	
C18	"	0.0022μF	polyester	
C13	"	0.0027μF	"	
C15	"	0.0047μF	"	
C10	"	0.0056μF	"	
C17	"	0.0068μF	"	
C12	"	0.0082μF	"	
C6	"	0.01μF	"	
C16	"	0.015μF	"	
C11	"	0.018μF	"	
C8		2.2μF 16V	electrolytic	
C4,5,7,20	"	10μF 16V	"	
Q1,3	Transistor	PN3638,2N3638 or similar		
Q2	"	PN3643, 2N3643 or similar		
IC1,3,4,5	Integrated Circuit	LM301A		
IC2	"	"	SCL4001*	
IC6	"	"	SCL4016	

* MUST be solid state scientific

D1-D4 Diode IN914

SW1 Switch 4 pole 2 position toggle

PC board ETI 601R

3600 Synthesizer

1 pole 5 position rotary switch metal bracket to fig.

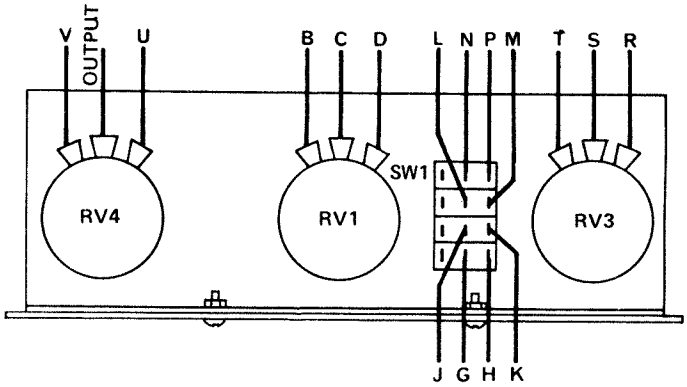
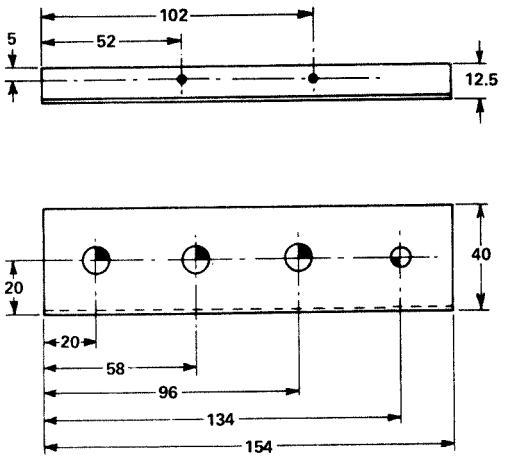


Fig. 4. If desired this filter module can advantageously replace that originally designed for the 4600 synthesizer Here's how to wire it in to the 4600 unit.



MATERIAL 1.2mm ALUM
OR STEEL

- 2 HOLES 3.2mm DIA
- 1 HOLE 6.4mm DIA
- 3 HOLES 9.6mm DIA

Fig. 5. This bracket is used when the filter is used with the 3600 unit. (not needed for the 4600 unit).