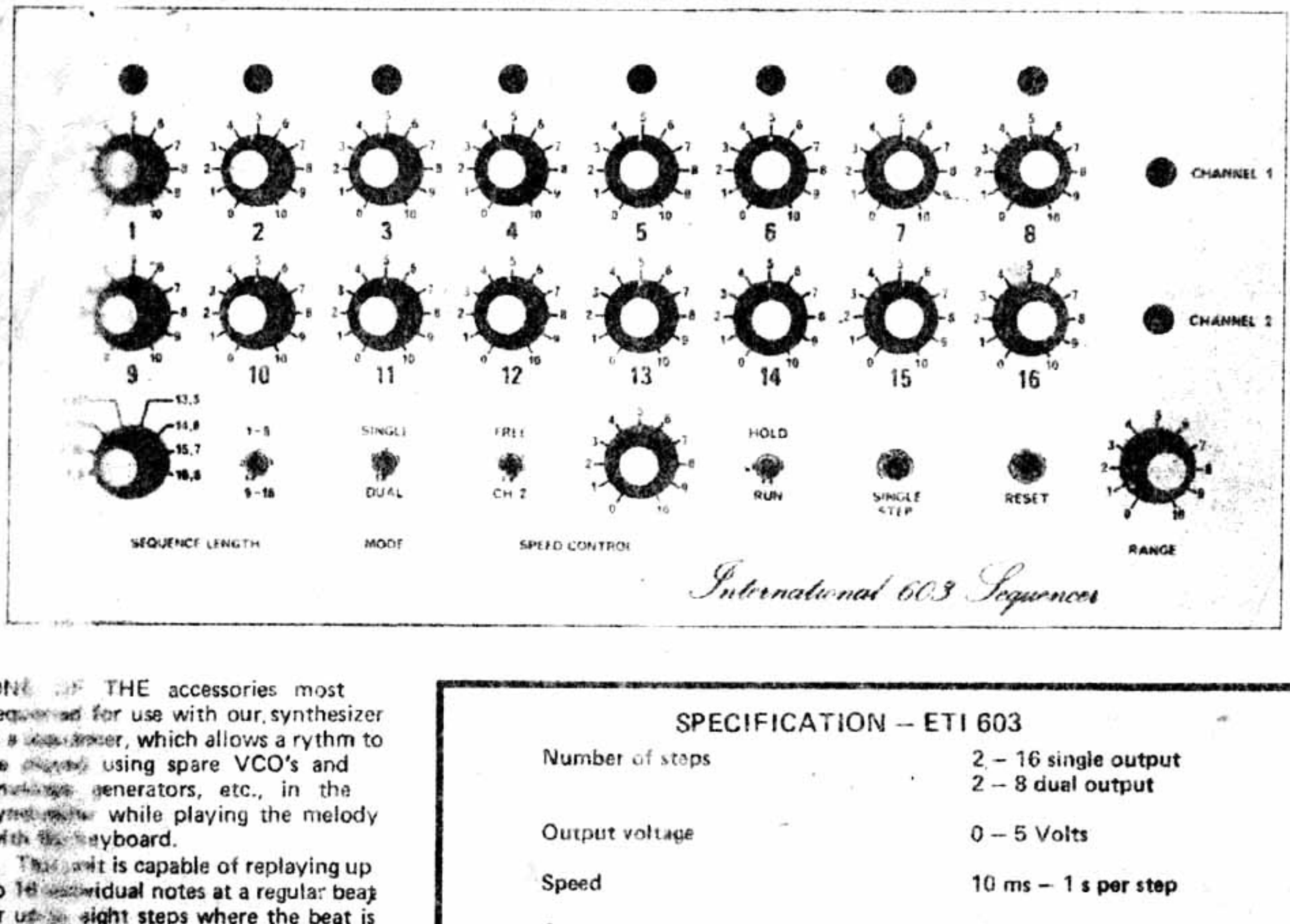
SEQUENCER



ONE OF THE accessories most required for use with our synthesizer is a sequencer, which allows a rythm to be played using spare VCO's and envelope generators, etc., in the synthesizer while playing the melody with the keyboard.

This unit is capable of replaying up to 16 individual notes at a regular beat or up to eight steps where the beat is variable as well as the pitch. If a regular beat is used, two separate channels are available, provided the length is limited to eight notes or less.

Design Features

When initially looking at this unit we had to decide between two different approaches. The first, which is presented here, is to use a heap of potentiometers on which the individual voltages are manually set up and a large multiplexer to select the potentiometers sequentially.

This system is economical up to about sixteen steps. Beyond this, the cost of the hardware, i.e. potentiometers, knobs, panel space, etc., is far more than the cost of the electronics involved.

In the second system, which we may publish at a later date, the tune is entered 'live' through the keyboard and the individual notes, the key depression times, and the intervals between notes are stored in a memory. Up to 256 notes or more could be stored in this way and then replayed as a rythm (or melody!).

This system is obviously much more flexible but it is more expensive and complex if a short sequence is all that is required. However, cost does not rise much for longer lengths.

SPECIFICATION – ETI 603

Number of steps	2 – 16 single output 2 – 8 dual output
Output voltage	0 – 5 Volts
Speed	10 ms – 1 s per step
Output impedance	<1 Ohm
Load resistance	>500 Ohms
Trigger pulse	2 ms negative pulse
Power supply	8 – 15 V dc

SEQUENCER

TO KEYS SWITCH.

Tracking sequence. (linear only)

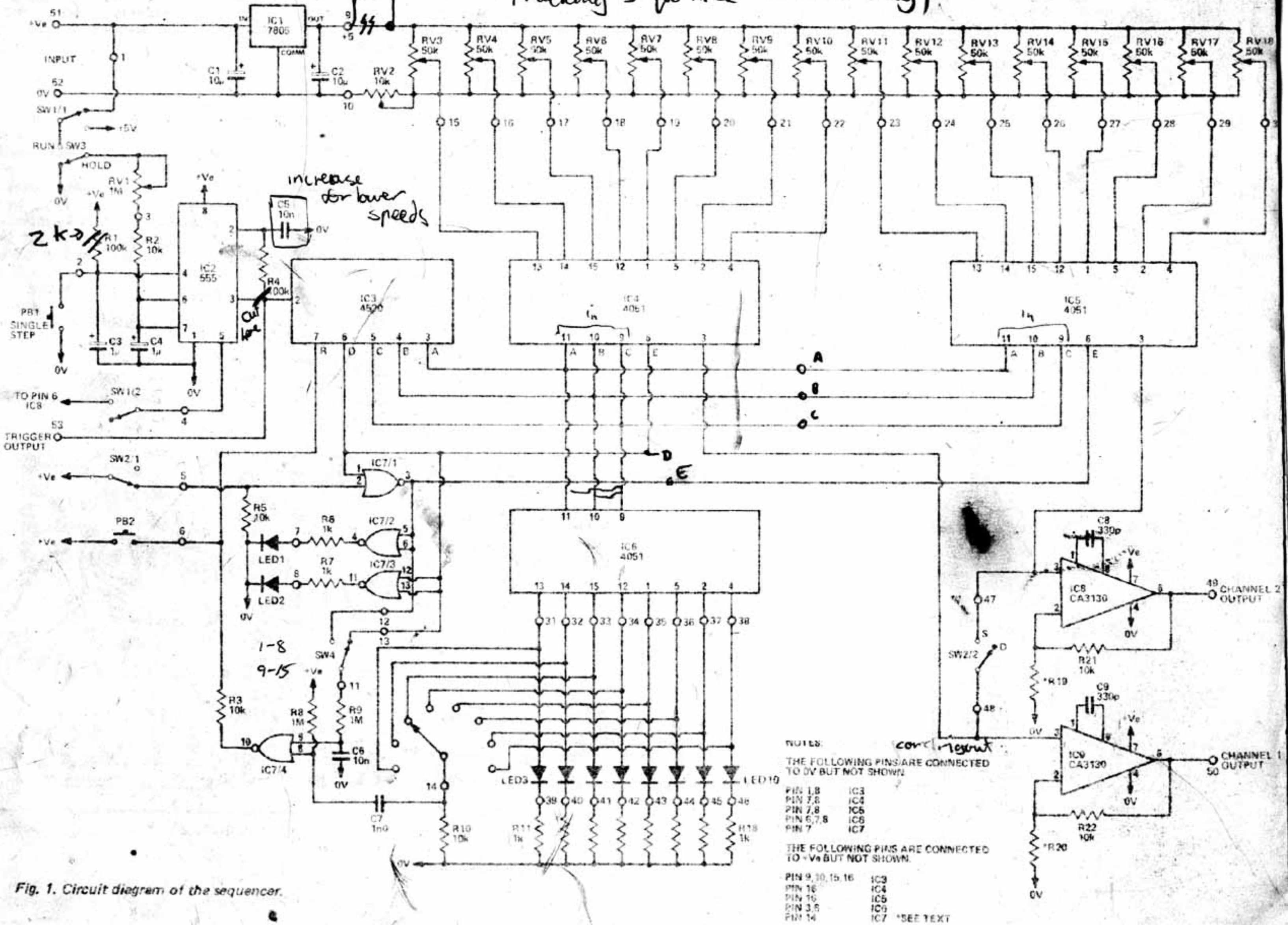


Fig. 1. Circuit diagram of the sequencer.

NOTES:

THE FOLLOWING PINS ARE CONNECTED TO 0V BUT NOT SHOWN

PIN 1,8	IC3
PIN 7,8	IC4
PIN 7,8	IC5
PIN 6,7,8	IC6
PIN 7	IC7

THE FOLLOWING PINS ARE CONNECTED TO +Ve BUT NOT SHOWN.

PIN 9,10,15,16	IC3
PIN 16	IC4
PIN 16	IC5
PIN 3,5	IC9
PIN 14	IC7 *SEE TEXT

HOW IT WORKS – ETI 603

The sweep time of the sequencer is controlled by IC2 which is a 555 timer. It clocks IC3, a four-bit binary counter, which gives the 16 steps required. The output however is in four-bit binary form.

The individual levels in the sequence are set on the potentiometers RV3 to RV18 which have a fixed supply voltage across them. One side is at +5 V as set by IC1 and the other side is variable from 0V to about 3.8 V by the range control RV2. This reduces the range over which the synthesizer VCO can be varied, making set-up easier.

These 16 output voltages are connected to the inputs of IC4 and IC5 which are eight-input analogue multiplexers, the selected input depending on the binary code presented to the control inputs. The enable line is used as a control line to allow full 16 input operation. The outputs from IC4 and IC5 both are buffered by IC8 and IC9 to prevent loading the potentiometers.

In the single mode the multiplexers are selected alternately and their outputs are connected so that both buffers have identical outputs. In the dual mode both multiplexers are active, the connection between the outputs is open and the buffer IC9 corresponds to the output of IC4 (RV3 to RV10) and IC8 to that of IC5 (RV11 to RV18). In this mode the sequence is only eight steps long.

Control of sequence length and the position indicator LED's is done by IC6 and IC7. IC6 decodes the lower three bits of the binary code and drives the eight LED's indicating which column is active. The upper bit is inverted by IC7/1 and this output plus the normal output are buffered by IC7/2 and IC7/3 which drive LED's 1 and 2 which are the row indicators.

The output of IC6 is also connected to SW5 which is the sequence length selector. When the sequencer is on the length selected, the voltage on R9 is near the supply rail. When the next step occurs, this voltage falls to zero and C7 connects this pulse onto one input of IC7/4, which resets IC3 back to the start of the sequence, (provided the other input is on zero).

The second input to IC7/4 determines the row and is selected by SW4. The resistor R8 and capacitor C6 provide a slight delay to give correct operation when lengths of 8 or 16 notes are selected.

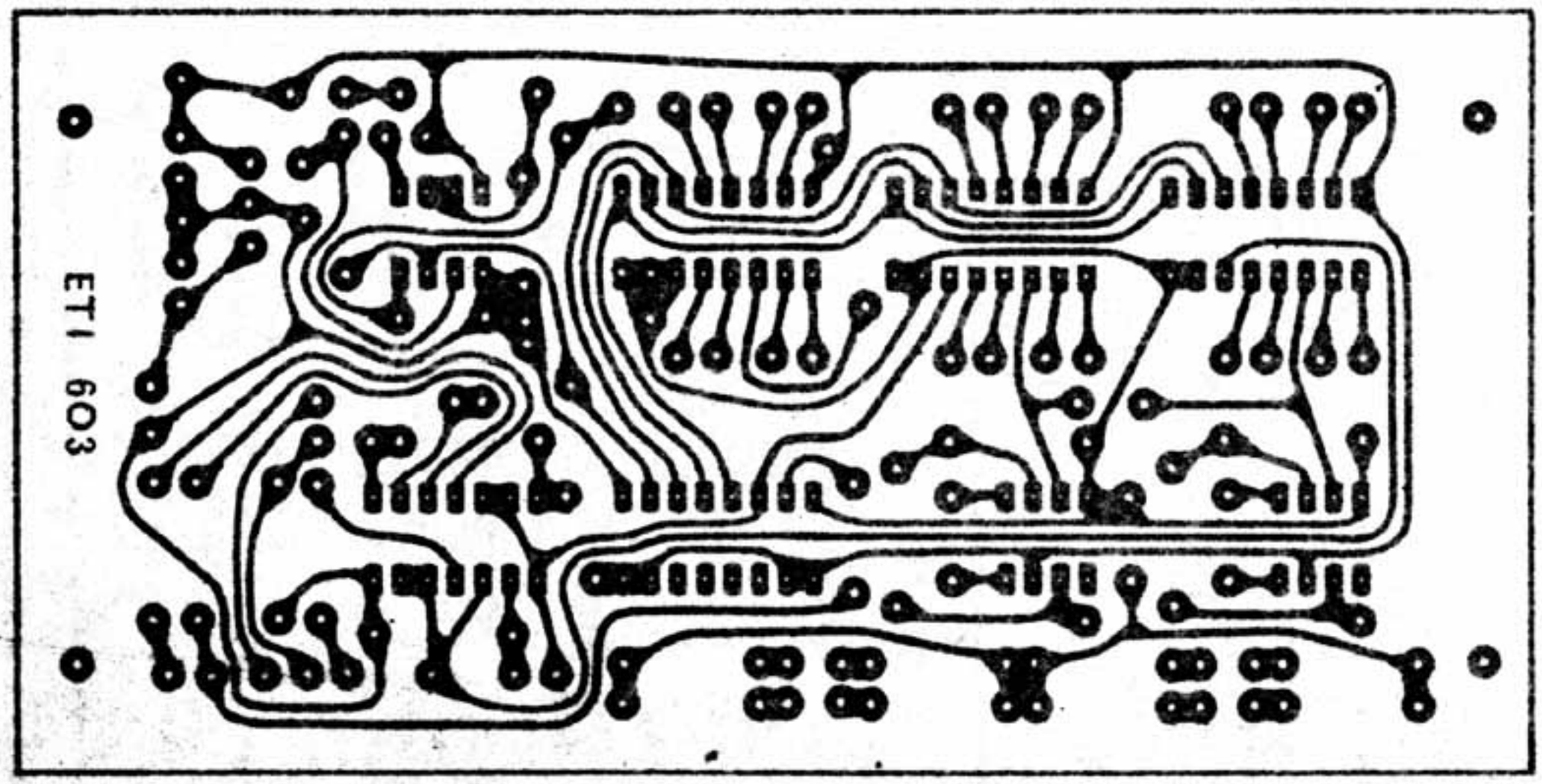


Fig. 2. Printed circuit layout. Full size 140 x 70 mm.

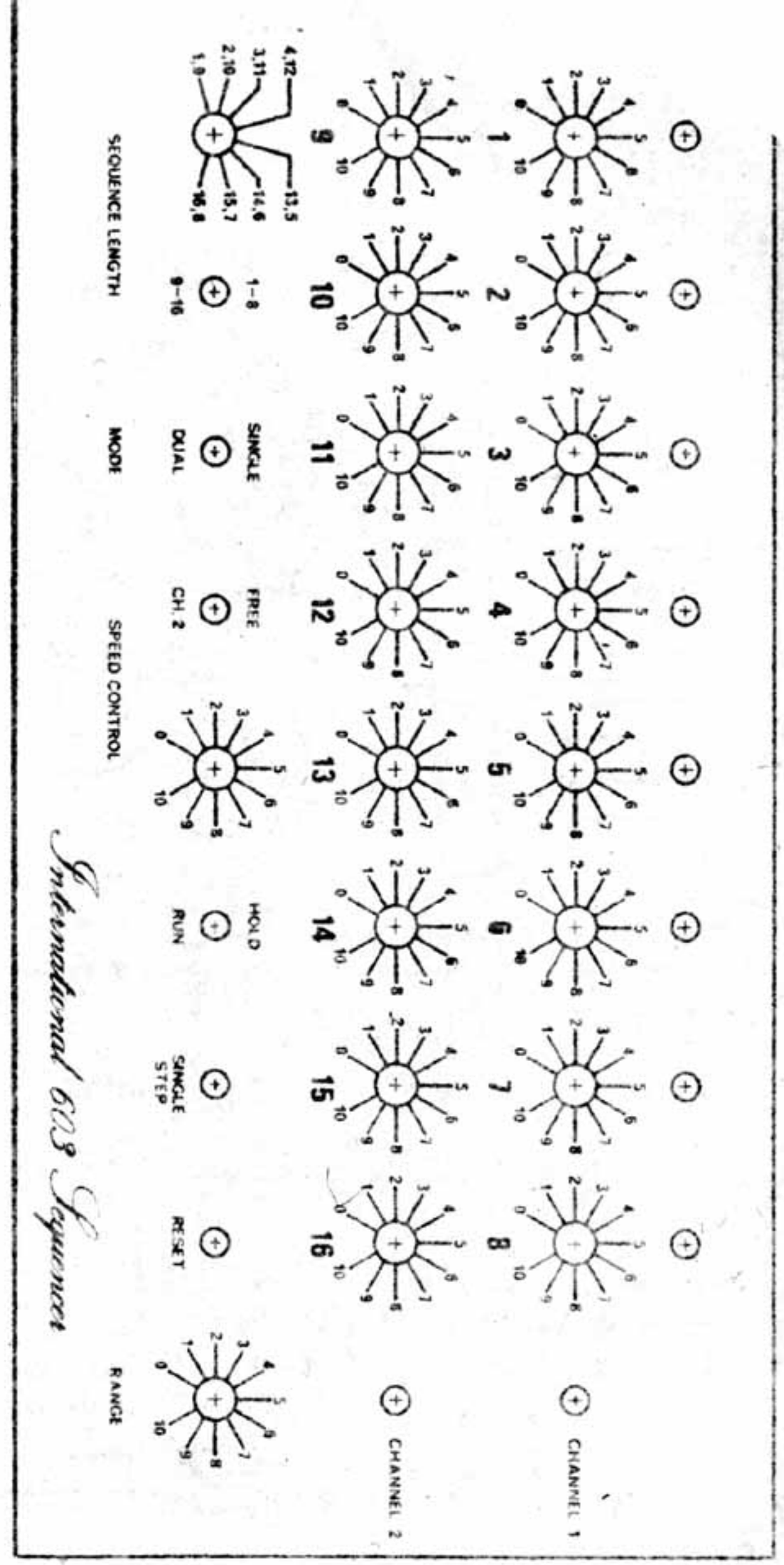


Fig. 3. Front panel artwork. See Fig. 8 for dimensions.

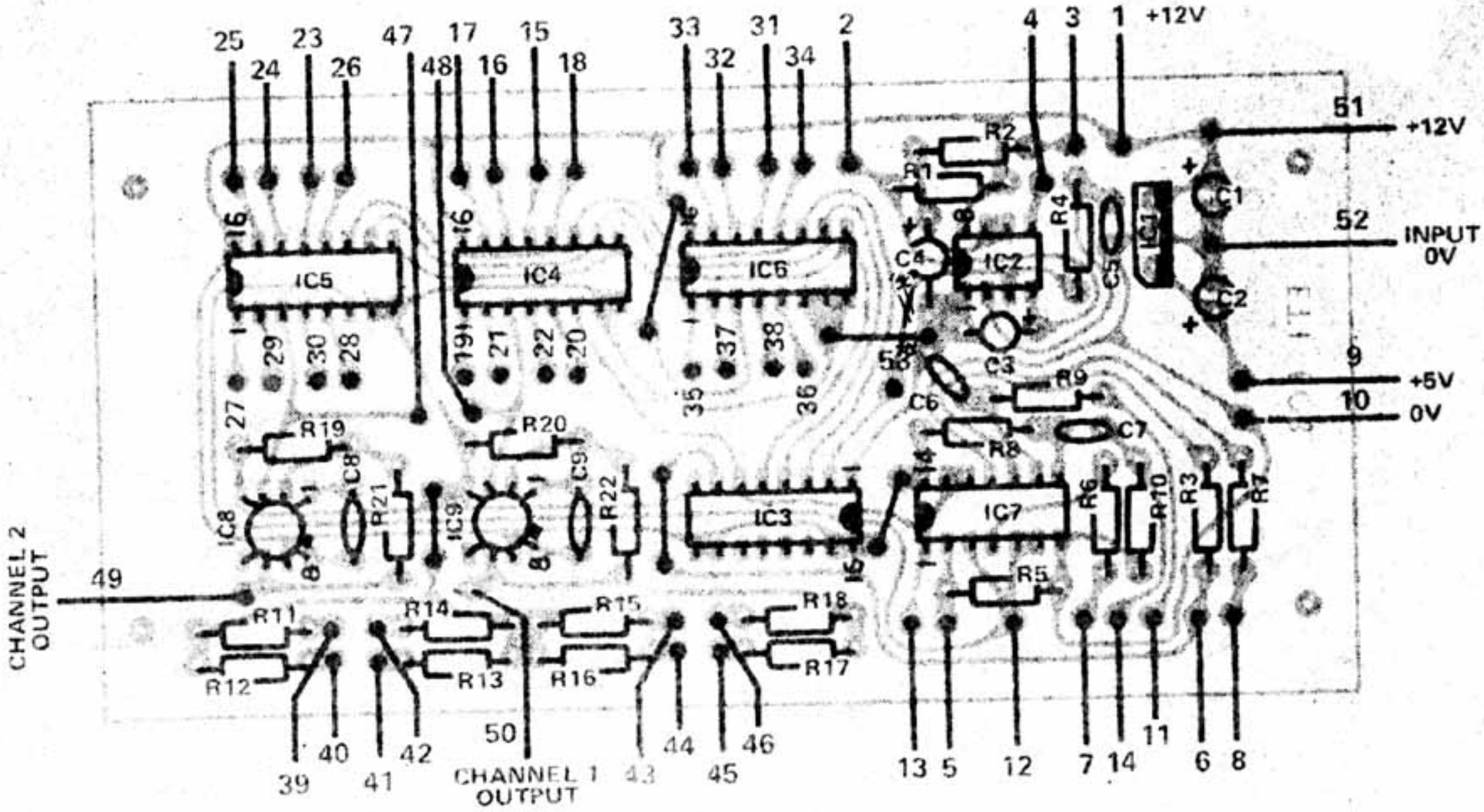


Fig. 4. Component overlay of the sequencer.

Construction

The PC board should be assembled as shown on the overlay diagram (Fig. 4). The CMOS IC's should be installed last and the power supply pins (7 and 14 or 8 and 16) should be soldered first to allow the internal protection diodes to work.

The front panel can be assembled as shown in Fig.5 and interwired to the PC board using the numbers on the wires for reference. Due to the large number of wires it is recommended that 'rainbow' cable be used for neatness. When connecting the LED's note that the shorter lead or the lead nearest the notch or flat on the body is the negative side (cathode).

The mechanical construction we have used need not be followed if the unit has to fit into an existing space and none of the wiring is critical as regards length or layout. We didn't use a power switch as the module was used on the synthesizer power supply.

The output of the unit is in the range of 0V to +5V if R19 and R20 are not used. If a higher voltage is required the value of R19 and R20 can be calculated as follows,

$$R19,20 = \left(\frac{V\ max.}{5} - 1\right) \times 10000 \text{ ohms}$$

Connection

The synthesizer has to be modified slightly to allow the sequence to be used. This involves fitting a 5 pin plug to the rear (0V, +14 V, 2 outputs and trigger) and also three single pole toggle switches (or a 3 pole toggle) to disconnect the external input module from the patch board. The diagram for this is shown below.

These modifications are for the 4600 units; for while the sequencer can be used with the 3600 the number of spare modules limits its usefulness. One of the outputs could, however, be connected to the "off" position of the oscillators but the trigger pulse is not the correct level to operate the envelope. This module would however be tied up with the keyboard.

An alternative solution would be to build an extra oscillator and perhaps an envelope generator into the sequencer case. This would then form the free-standing unit which could be used with any synthesizer or even electronic organs.

PARTS LIST — ETI 603

Resistors all ½ W 5%

R1	100k
R2,3	10k
R4	100k
R5	10k
R6,7	1k
R8,9	1M
R10	10k
R11–R18	1k
R19,20	see text
R21,22	10k

Potentiometers

RV1	1M lin rotary
RV2	10k lin rotary
RV3 – RV18	50k lin rotary

Capacitors

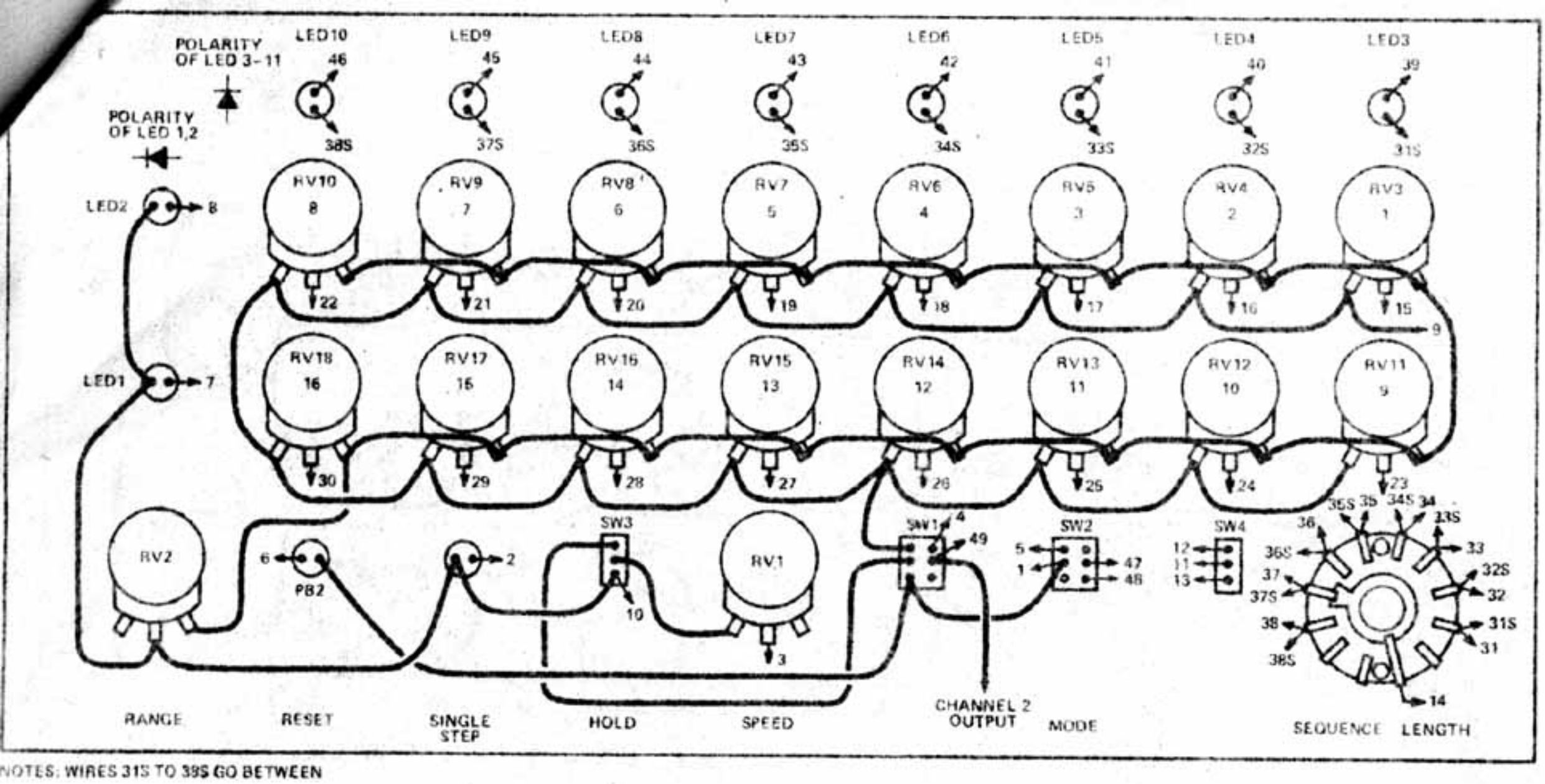
C1, 2	10µ 16V electro
C3, 4	1µ0 16V electro
C5,6	10n polyester
C7	1n0 polyester
C8, 9	330p ceramic

Semiconductors

IC1	78L05 or 7805 regulator
IC2	555 timer
IC3	4520 dual binary counter
IC4 – IC6	4051 8-bit data selector
IC7	4001 quad 2-input NOR
IC8, 9	CA3130 op-amp
LED1 – LED10	Red LED with mounting clip

Miscellaneous

PC board	ETI 603
SW1, 2	DPDT toggle
SW3, 4	SPDT toggle
SW5	single pole, 8 or 11 position
PB1, 2	single make pushbuttons
Front panel to Fig. 8	
Bracket to Fig. 7	
19 Knobs	



NOTES: WIRES 31S TO 39S GO BETWEEN

Fig. 5. Wiring of the front panel.

. 6. Interconnections needed to operate sequencer with the 4600 synthesizer.

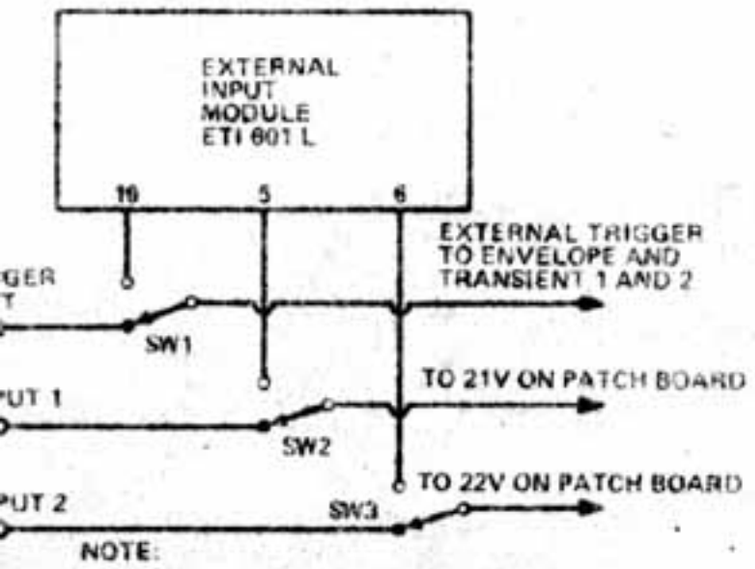


Fig. 7. Details of the small bracket which supports the PC board.

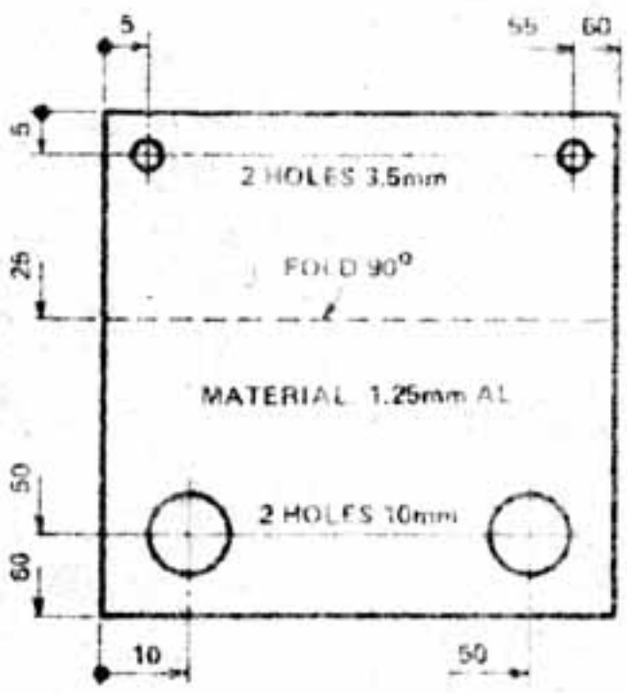


Fig. 8. Details of the front panel metalwork.