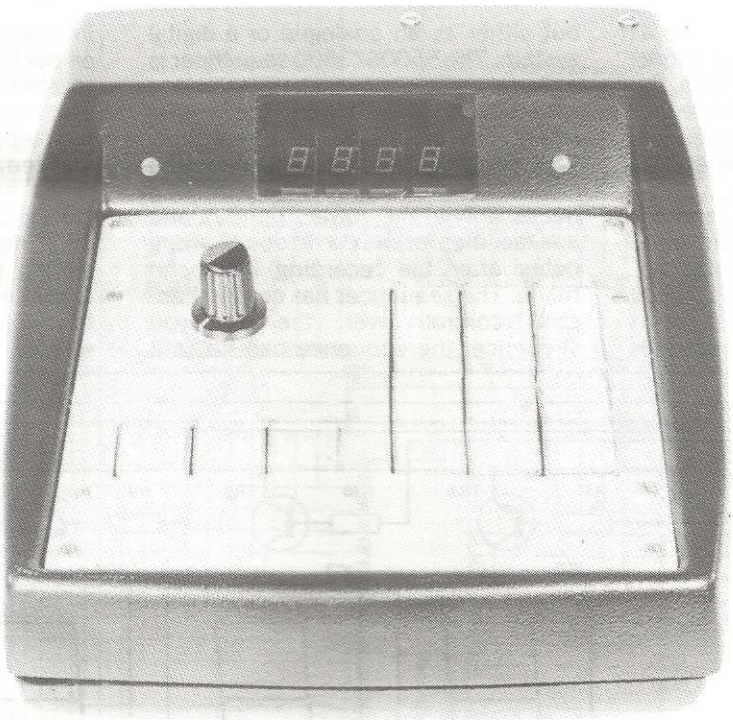
THE MAPLIN 600~NOTE SEQUENCER



Designed by Glenn Rogers

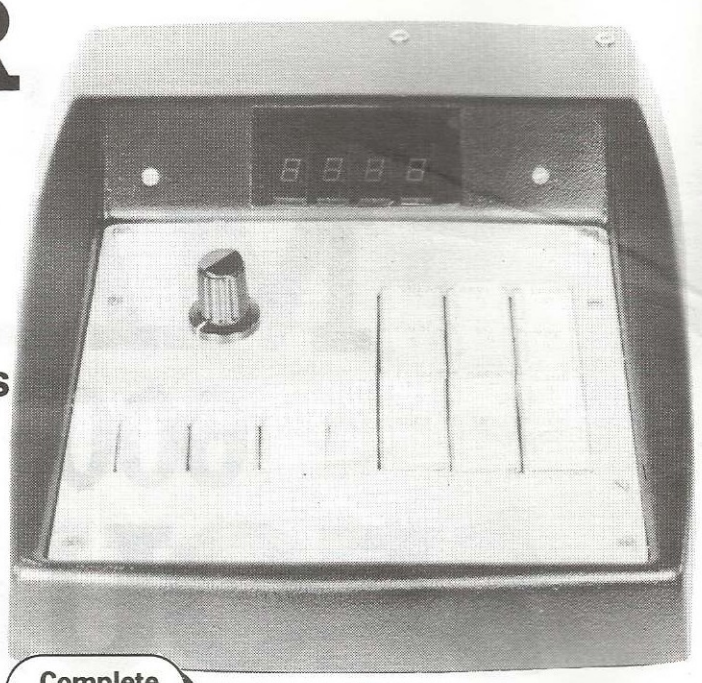
For use with the 3800 & 5600S synthesisers

Maplin Electronic Supplies Ltd., P.O. Box 3, Rayleigh, Essex.

(XH59P)

600-NOTE SEQUENCER

by Glenn Rogers



Complete kit £125.00

- ★ **Designed specifically for the Maplin 5600S and 3800 synthesisers**
- ★ **Works in real time: remembers what you play, up to 600 notes**
- ★ **Recorded sequences may be:**
- ★ **Replayed faster or slower**
- ★ **Linked together**
- ★ **Played forwards or backwards**
- ★ **Edited to correct mistakes**
- ★ **Saved on tape**

The addition of a sequencer to a synthesiser can give a lot more scope. The main advantages attained are that of freedom from the keyboard, to allow the synthesiser controls to be manipulated, the ability to play tunes which repeat frequently exactly the same each time, and to record difficult pieces of music at a slow speed and then replay them at the correct tempo. The sequencer is a unit for memorising and replaying a pattern of notes. This function can be carried out either as an analogue or a digital system. The 5600S/3800 sequencer is a digital sequencer which will interface with the digital keyboard of the synthesisers. The unit works on a 'real time' basis, which means the sequence to be stored has to be played in time (but not necessarily at the correct tempo), and has facilities for the correction of wrong notes after the recording has been made. The sequencer has comprehensive control over the replayed sequence; the sequence can be split into various sections, played forwards or backwards with repeats and linked together in any order. A footswitch can also be used to provide external control for stepping on to another sequence. The tempo can be altered over a wide range, and a socket to enable external clocks to be used is also provided. The other main feature is the provision for storing your recorded sequences on cassette in digital form, so that they can be reloaded and used at a later date without having to be reprogrammed.

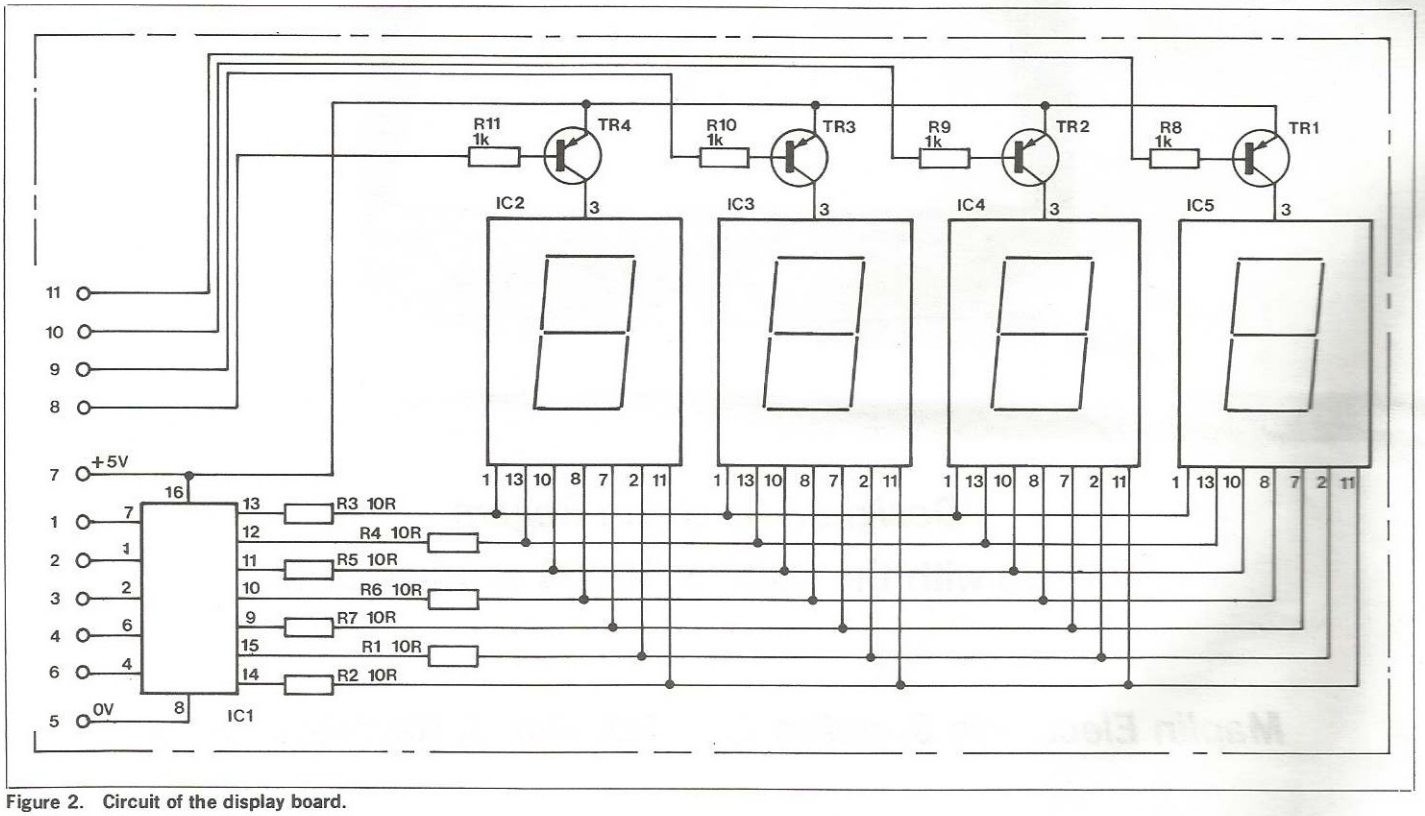


Figure 2. Circuit of the display board.

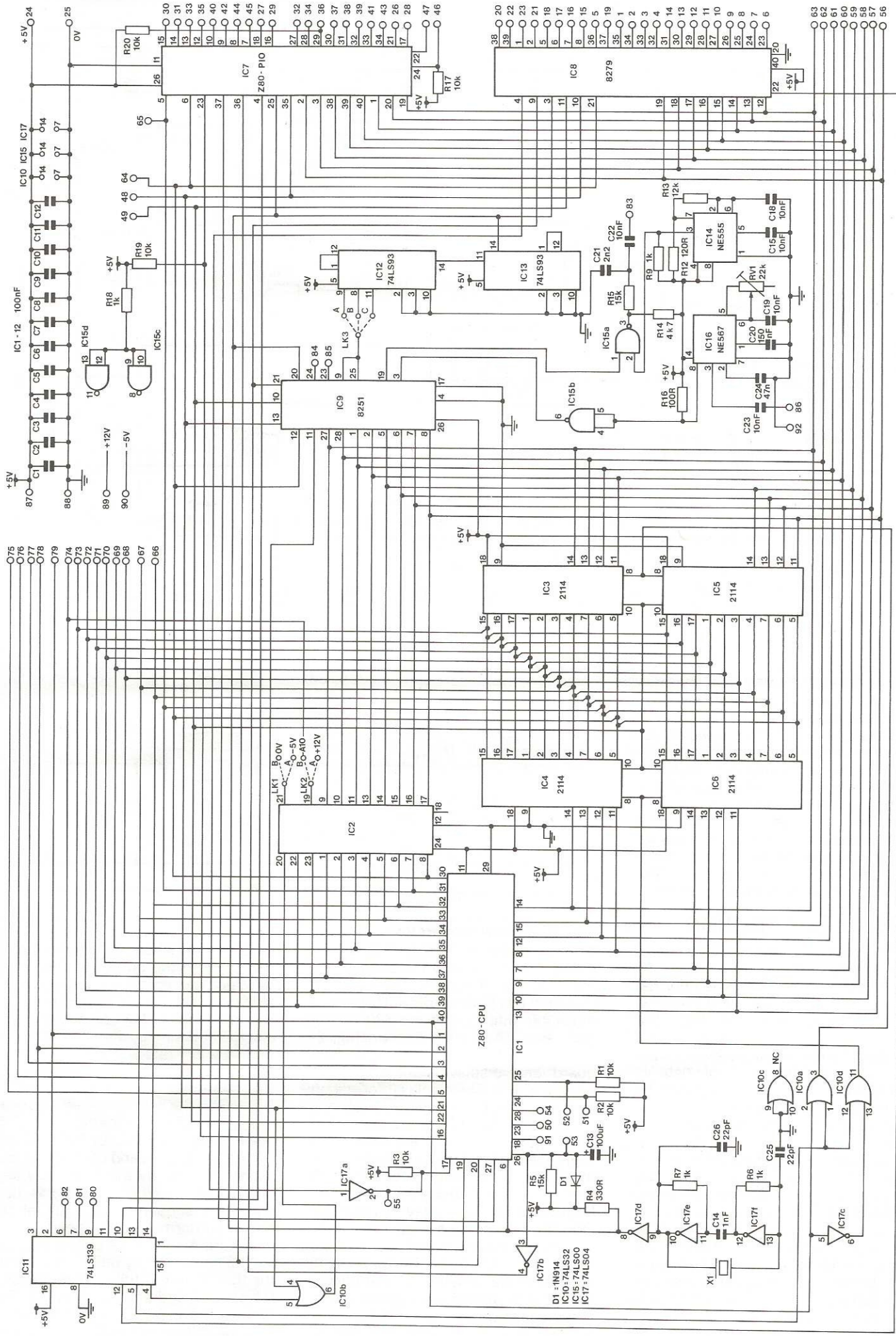


Figure 1. Circuit of the main sequencer board.

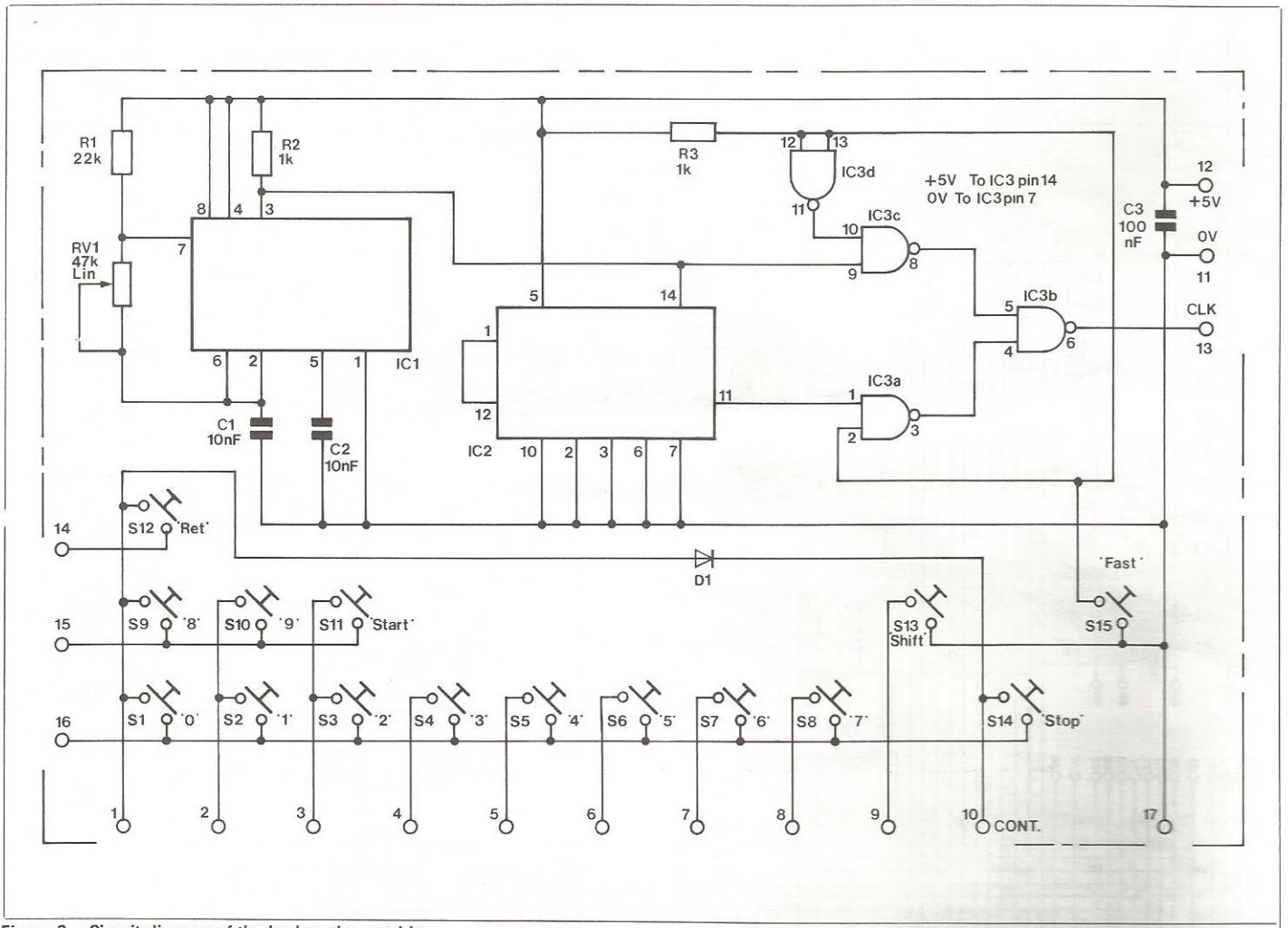


Figure 3. Circuit diagram of the keyboard assembly.

The sequencer is based on the Z80 microprocessor and its associated input/output port. Data transfer between the synthesiser and the sequencer is via the parallel input/output port. The sequence information is stored in 2K bytes of RAM and the program is stored in a 2K byte EPROM. The Intel 8279 is used to control the keyboard matrix and the display. The cassette interface is built around the 8251 USART and a tone decoder chip.

Circuit Description

The main board is basically a microcomputer with the keyboard and display board to monitor it. The information to and from the synthesiser is passed through the Z80 PIO. The lengths of the notes are timed by counting the number of pulses from the tempo clock. The input of data is controlled by interrupts generated by the keyboard gate pulses. The circuit diagram of the main board is shown in Figure 1.

IC17 forms a crystal oscillator with X1 and this is the system clock for the microprocessor. The address decoding is carried out by IC11, one half decodes the memory addresses and the other the input/output addresses. The memory is addressed in 2K byte blocks, IC2 being the program memory (EPROM) and ICs 3, 4, 5 and 6 forming a 2K byte block of RAM.

IC8 takes all the hard work out of interfacing to the user, the keyboard is a simple scanned matrix connected directly to the IC and the display is a scanned 1 of 4 system. The interrupt output of this IC is connected to the non maskable interrupt of the Z80 microprocessor. The switch debouncing, 2-key lockout and scanning of the keyboard and display is all under the control of IC8. The display information is output in BCD form by IC8, and this is decoded by IC1 of the display board (see Figure 2) to drive the four seven segment displays. The supply to each of the displays are switched by TR1, 2, 3 and 4 on the display board. The brightness of the display depends on the current limiting resistors R1 to R7.

The heart of the digital data storage system is the USART. IC14 is used in its astable mode to generate the carrier signal for the digital information, a 'one' is represented by a tone and a 'zero' is represented by a no tone. The square-wave signal, after being gated with the digital information, is filtered before being fed to the output socket. Three different transmission rates are available for the cassette interface, and these are selected by LK3 A, B or C. This clock is obtained by dividing the crystal oscillator down to a suitable frequency with IC13 and IC12.

The tempo clock is formed by IC1, 2 and 3 on the keyboard (see Figure 3). IC1 generates a variable frequency pulse wave controlled by RV1. IC2 and 3 are used to gate and divide the clock as determined by the Fast/Slow keyboard switch. When the key is held down the sequencer will run at ten times the normal (slow) speed.

Figure 4 shows the circuit diagram for the power supply unit. The AC from the transformer is full wave rectified by D1 and D2 and smoothed by C2. The regulator is a 3 pin series type which sets the voltage to 5V DC. C1 is fitted to prevent glitches on the mains supply

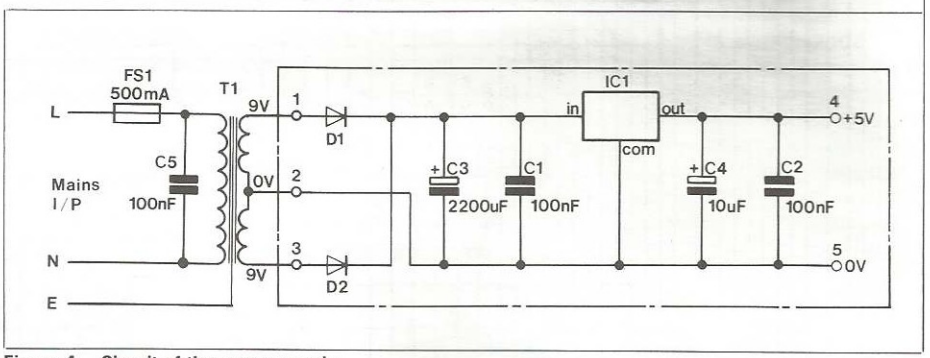


Figure 4. Circuit of the power supply.

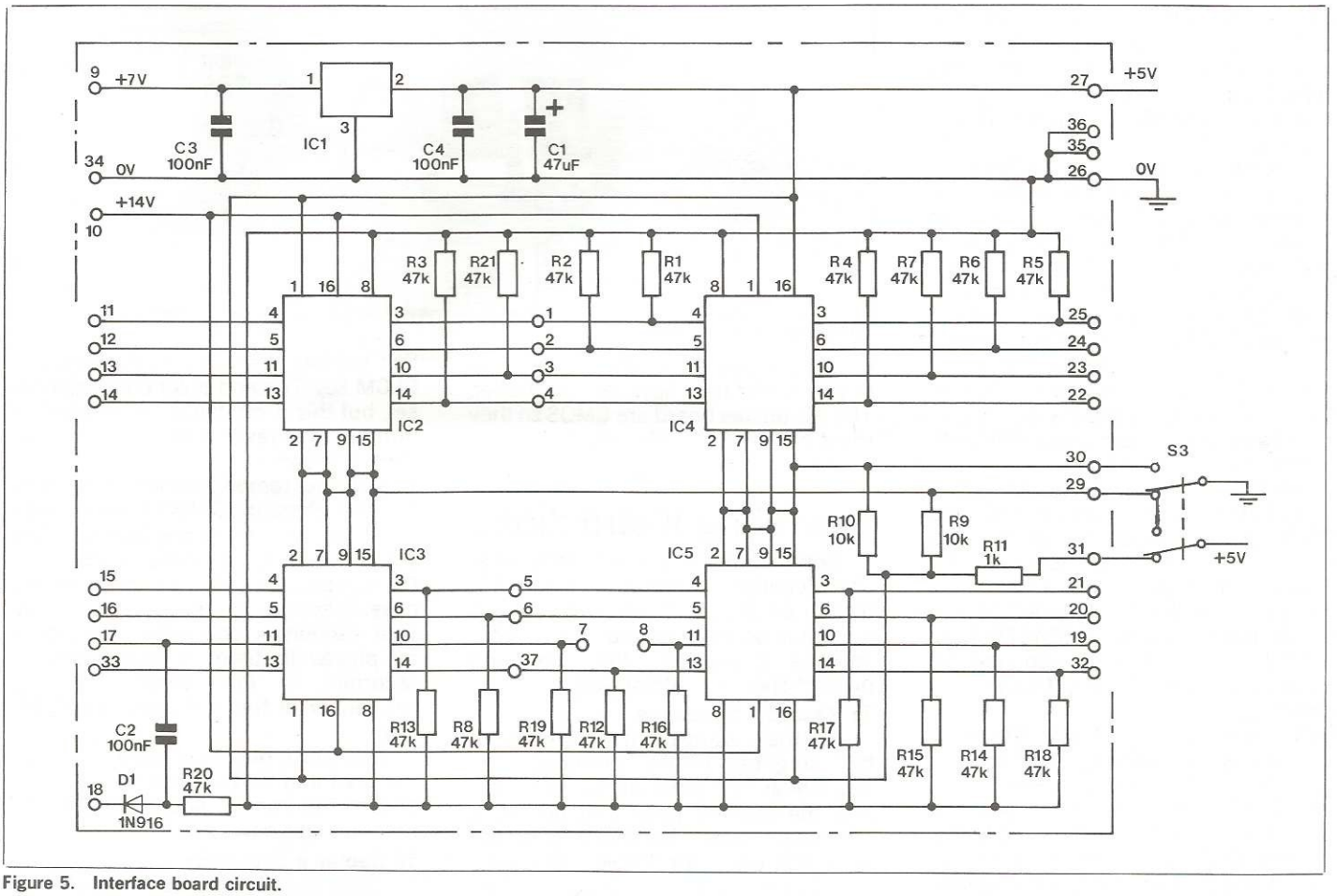
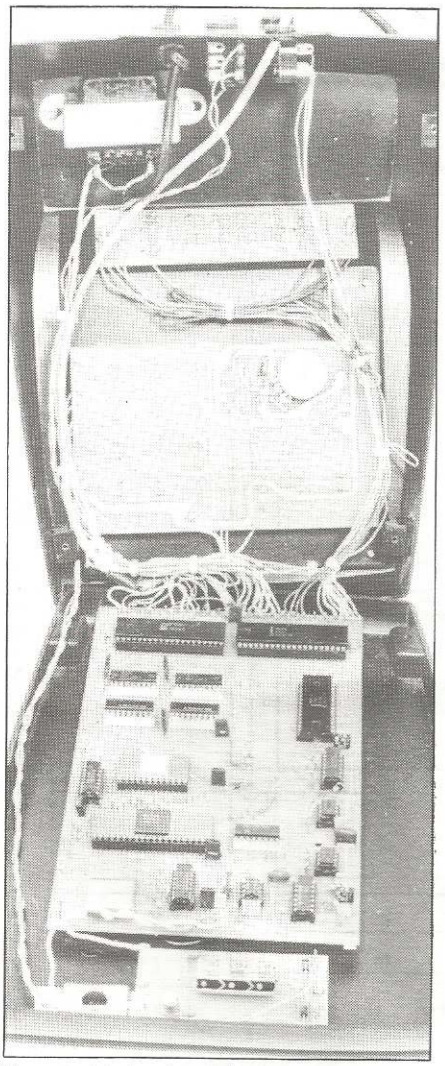


Figure 5. Interface board circuit.



The completed main pcb in situ.

upsetting the computer.

Finally, we have the interface pcb, the circuit of which is shown in Figure 5. This circuit enables the bi-directional bus of the sequencer to feed the synthesiser's input and output connections. The ICs used also provide the necessary level shifting to enable the 5 volt signals from the sequencer to interface with the 15 volt signals of the synthesiser. The routing of the data throughout the interface board is controlled by the Read/Write switch on the synthesiser front panel.

Construction

Construction of the sequencer is started by fitting all the track pins in the main pcb to join both sides of track. The pins for external connections can then be fitted. Next all the IC sockets can be soldered into position. With the hardware assembled a start can be made on the components, all the resistors, capacitors and the preset can be fitted. The crystal should then be soldered into position and secured with a wire strap soldered through the board.

The basic construction of this board will be finished with the fitting of the following links: LK1B, LK2B, and LK3A.

The display pcb can be assembled next. Again the Vero pins should be inserted first, followed by the IC sockets (the displays are also mounted in IC sockets). Fit the resistors, capacitors and then the transistors next. To complete construction insert the four seven segment displays and IC1.

The keyboard requires care during assembly to ensure a square keypad. The wire links should be made first and then the Vero pins fitted. The IC sockets, resistors and capacitors can be soldered into position next. The keyboard switches can now be carefully soldered in place, ensure that the switches sit squarely on the pcb and to each other. The potentiometer, RV1, can then be mounted on the pcb and connected with flying leads and the diode soldered in place.

The interface pcb can be assembled next. Again, fit the wire links followed by the Veropins and IC sockets. Next the resistors, capacitors, diode and the voltage regulator can be soldered in position.

The construction of the power supply unit pcb should present no problems. Capacitor C5 is mounted across the pins on the mains transformer.

Testing

A certain amount of testing should be carried out at this stage. Useful test gear would include a voltmeter, frequency counter and a logic probe. The power supply is the first unit to test. Connect a mains lead and the pcb to the transformer. Switch on and measure the output with a voltmeter; it should read +5V ±0.25V. Now connect a 6.8ohm 5 watt resistor across the PSU output and check the output is still the same.

Next the keyboard pcb should be checked. Firstly, check that there are no short circuits then plug in the two ICs and connect to the power supply. The frequency counter should be used to

monitor the clock output. The frequency should be variable between approximately 20 and 60Hz using the Tempo control and between approximately 200 and 600Hz with the fast key depressed.

The display pcb can be tested next. A certain amount of care is needed here to avoid blowing the displays. This is because the display is multiplexed so, while testing the board, only momentary contact should be made to pins 8, 9, 10, 11. Now for the test: temporarily link pins 1, 2, 6, 7 to pin 5, then connect to the power supply. When any one of the pins 8, 9, 10, 11 are grounded one of the displays should show a 0.

Now on to the main sequencer pcb. Firstly, check the soldering for possible shorts and dry joints. The power supply should now be connected (no ICs are fitted at this point). Switch on and ensure the power supply is giving +5V. Plug in IC17 and connect a frequency counter to pin 8 of IC17, switch on and check the frequency is 2.4576 MHz ±100Hz. IC 12 and 13 can now be inserted and the following frequencies checked:

LK3: Pin A - 19200 Hz ± 100Hz
Pin B - 38400 Hz ± 100Hz
Pin C - 9600 Hz ± 100Hz

Insert IC14 and 15 and check the frequency at pin 83 is 6.2kHz ± 500Hz.

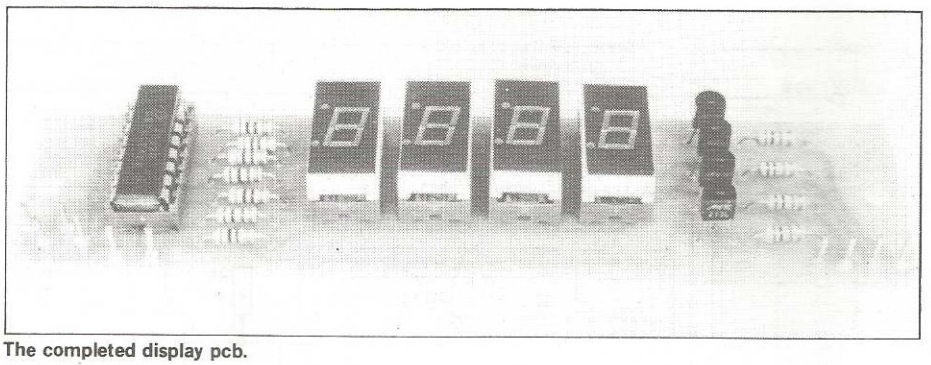
Next fit IC16 and connect pin 86 to pin 83 and monitor pin 6 of IC15 with a logic probe. Adjust RV1 until the logic probe indicates a high, '1', and set RV1 midway between the two transition points between '0' and '1'.

On the interface board the 'on board' voltage regulator can be tested with a 10V power supply. The output from the regulator should be +5V.

If all is well at this stage the final construction can be carried out. The cutouts and drilling details are shown in Figure 6. The sequencer fits neatly into the Vero case chosen for the prototype but the unit can obviously be housed in any suitable case of your choice. The layout of the various pcbs is shown in Figure 7 and the wiring diagram in Figure 8. The use of ribbon cable gives a smart finish and allows easy identification of connections. Ensure enough cable is used to allow for easy disassembly of the case. Once the wiring has been completed the rest of the ICs can be inserted. IC2 should be a preprogrammed EPROM.

Now for the final testing; plug the unit into the mains and switch on. The sequencer should respond by displaying the command prompt (see Figure 12) in the leftmost digit of the display. By pressing any of the numbered keys an error message should be displayed, this can be cleared by the CLEAR key. If either of the FROM, TO or REPT keys are pressed a data prompt should be displayed. Clear the display again and press the START key; the check prompt should then be displayed. The sequencer is now ready to use.

To enable you to connect to the 5600S or 3800 synthesisers you need to fit the Interface pcb. This pcb goes



The completed display pcb.

inside the synthesiser and connects up to the synthesiser keyboard controller. The ICs on this board are CMOS so they must be handled with care. The wiring details are given in Figure 8.

Operating Instructions

Connect the sequencer and synthesiser together as shown in Figure 11. Switch on the synthesiser and set up the initial sound required. Next switch on the sequencer; the command prompt should be displayed.

To Record a Sequence

Set the starting point in the memory by using the FROM command. The sequencer can store up to 600 notes and the starting point can be set to anything between 0 and 599. To set the start first press the FROM key, a data prompt should then be displayed, then enter the number and complete the operation by pressing the RET key. If a mistake is made while entering the number, and realised before the return key is pressed, then press the CLR key and re-enter the command. If the mistake is not realised until after the RET key has been pressed then use the CLCM key. The end point could also be set, but this is often not possible as the number of notes in a sequence are not always known.

Set the tempo control to its mid position. Press the START key and when the check prompt is displayed set the computer switch on the synthesiser to the required position, i.e. write in this case. Press the start key again and play your sequence. The sequence should be played in time as the system is recording in 'Real Time'. Stop the sequencer at the end using the STOP key.

It is worth playing a dummy note at the start and finish of the sequence to ensure the correct note timing of the first and last notes.

To Replay a Sequence

Clear the display with the CLR key. Press the START key, then set the synthesiser computer switch to 'read' and press the START key again. The sequencer will now replay the sequence as you recorded it. To stop the sequence use the STOP key, and if you wish the sequencer to continue playing again

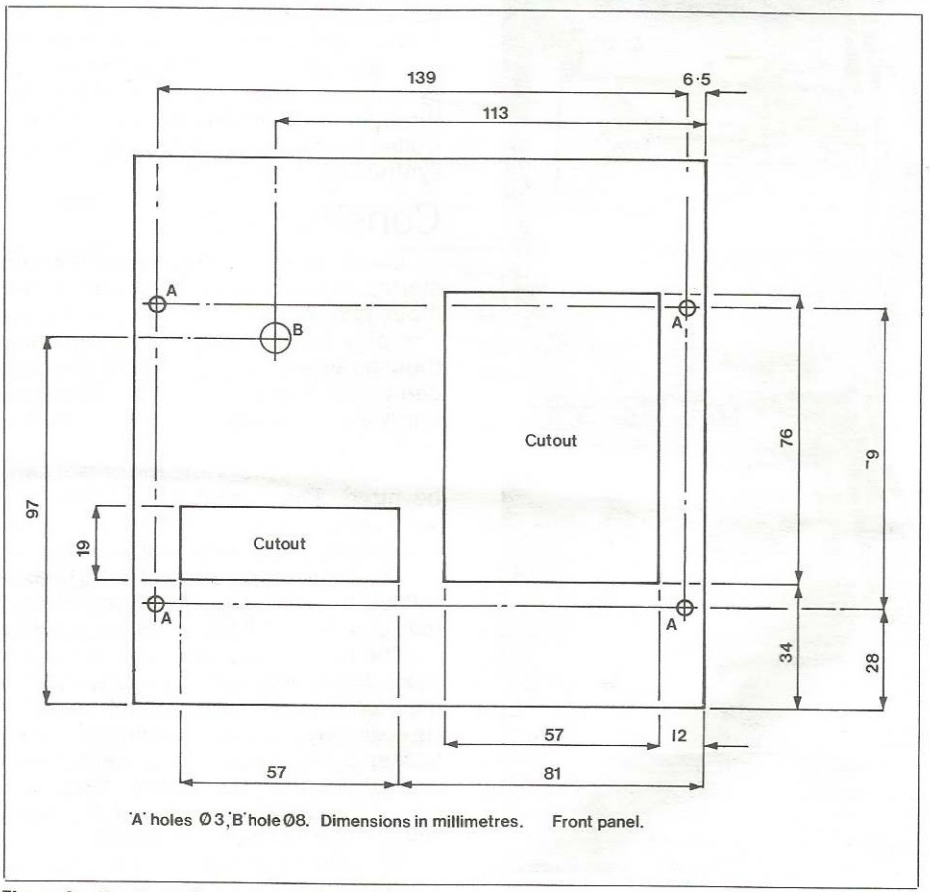


Figure 6. Front panel cutout and drilling details.

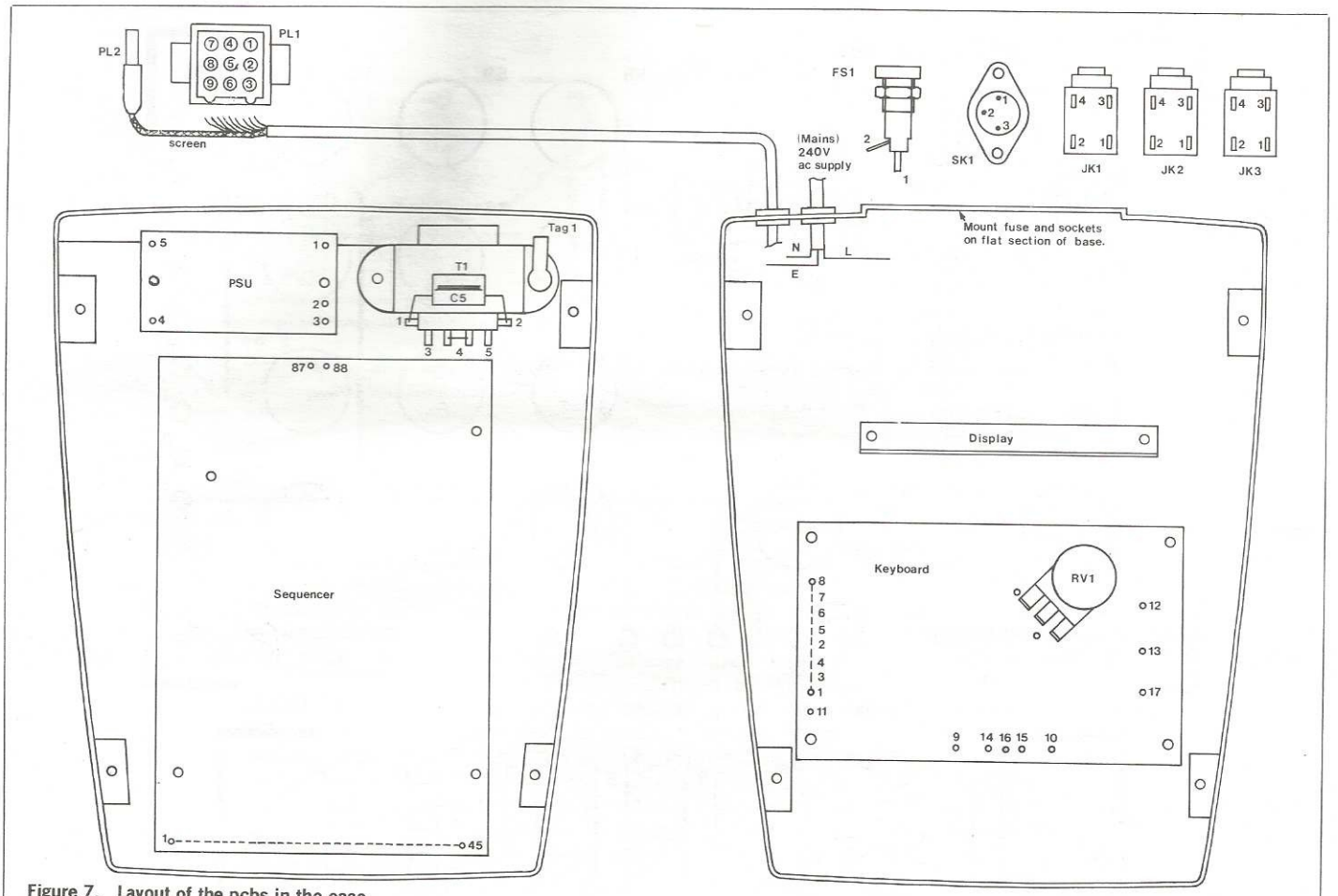


Figure 7. Layout of the pcbs in the case.

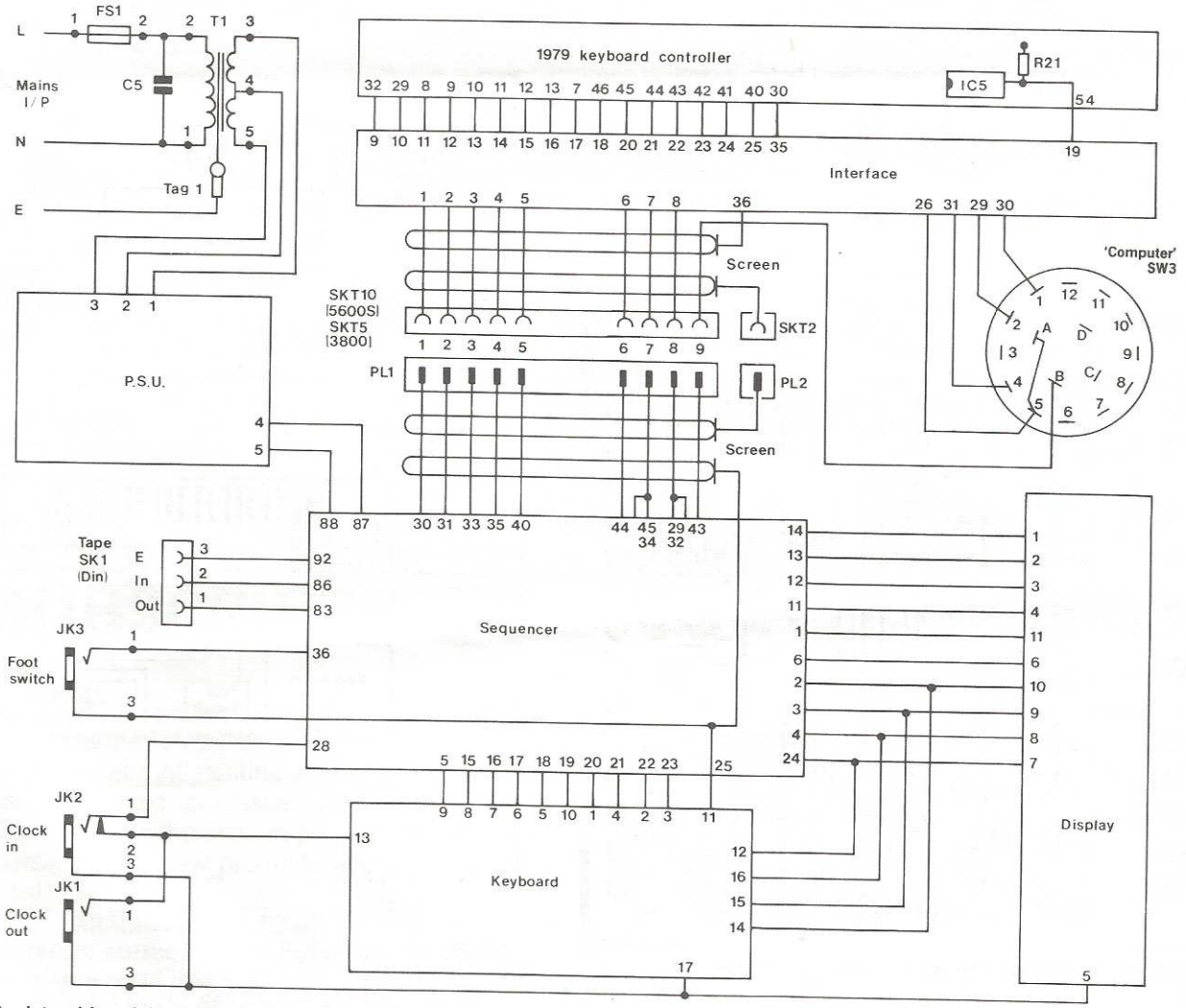


Figure 8. Interwiring of the pcbs.

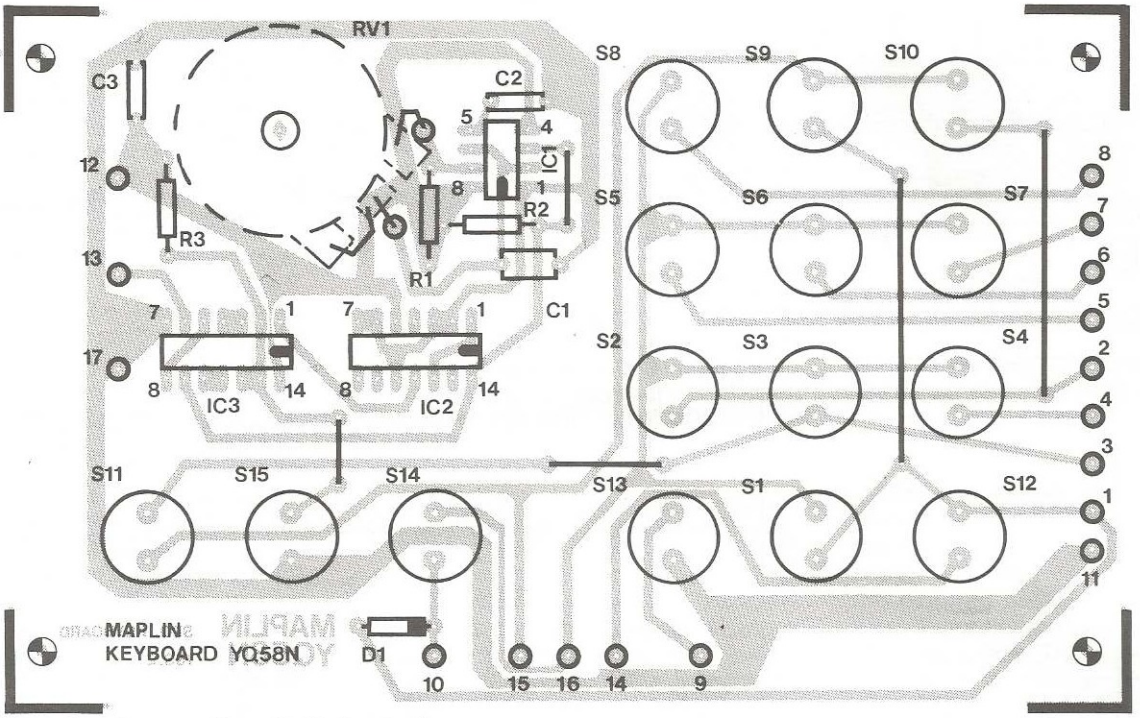


Figure 9a. Component layout for Keyboard pcb.

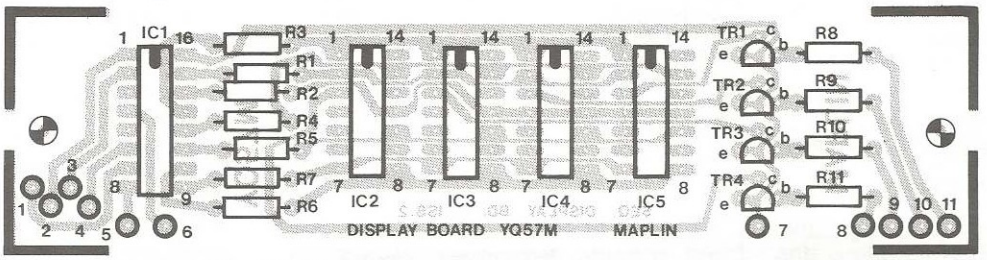


Figure 9b. Component layout for Display pcb.

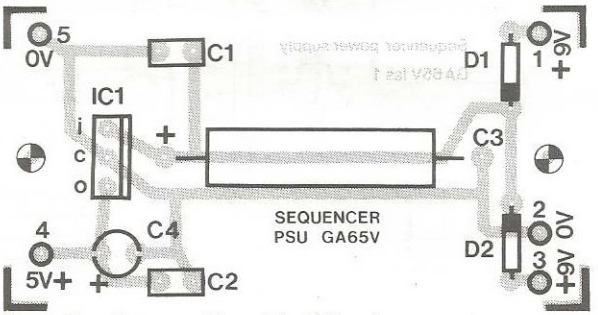


Figure 9c. Component layout for PSU pcb.

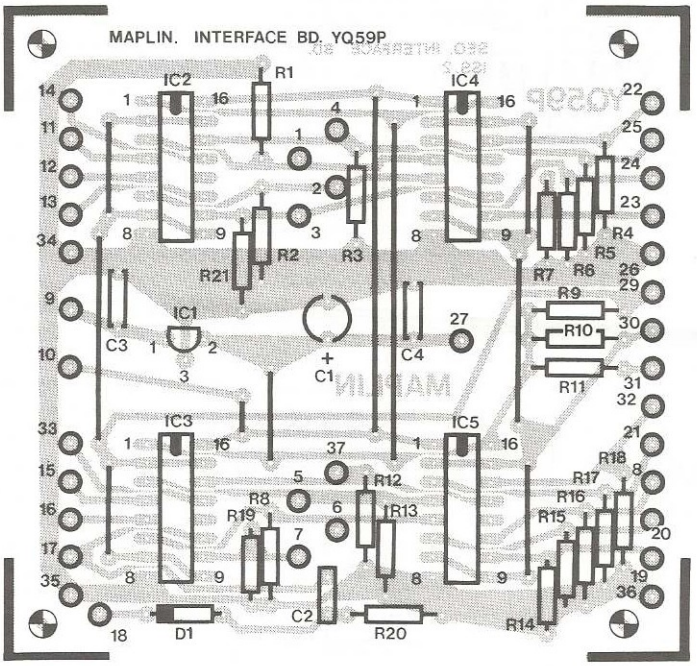


Figure 10. Component layout for interface pcb.

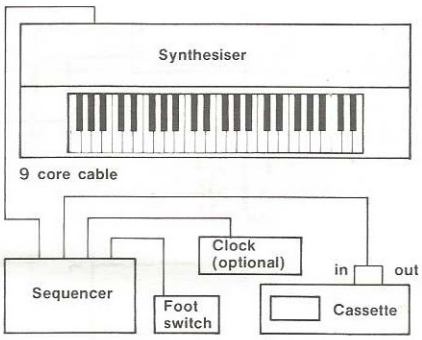


Figure 11. Connections to the sequencer.

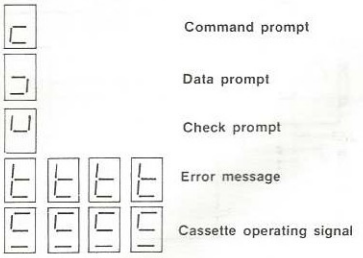
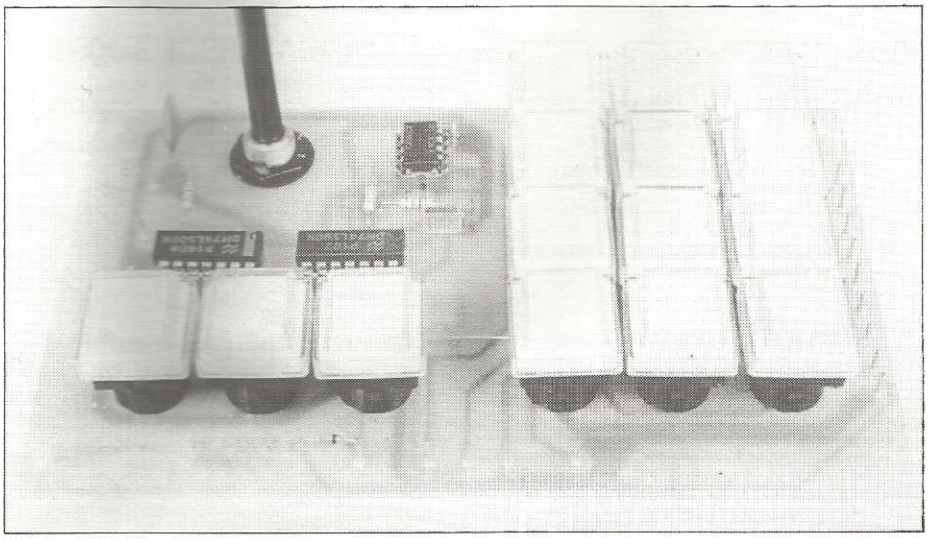


Figure 12. Display symbols.



The completed keyboard pcb.

from the point at which you stopped, press the CONT key. The additional commands on the sequencer give an enormous range of control possibilities. The basic steps can be shown as follows:

FROM 10	FROM 10
TO 20	TO 5
	BACK
FROM 25	FROM 70
TO 50	TO 60
REPT 2	REPT 10
	BACK

and any of these can be linked together in the command queue using the THEN command for example:

FROM 15	FROM 100
TO 30	TO 150
THEN	REPT 10
FROM 50	THEN
TO 20	FROM 151
BACK	TO 200

Each line of the above command queues must be terminated by the RET key as they are entered.

The commands can be entered into the queue at any time but can only be erased by deleting the whole queue. This queue system makes the sequencer far more versatile than the average sequencer, and enables you to get the most from your sequencer and synthesiser.

The number of repeats that can be programmed has a maximum of 255. Only a limited amount of space is available for the command queue but it should be sufficient to get at least 8 sequence commands, stacked one after the other.

The THEN command allows stepping from one section of the sequencer's store to another. This will happen automatically, when programmed, at the end of the last repeat of a sequence but it can also be controlled by the footswitch. If a sequence is to be repeated an unknown number of times then the number of repeats can be set to, say, 250 and followed by a THEN command. The next sequence can be started by holding down the footswitch as the sequence comes to its end. The repeat would then be missed and the next sequence will begin.

The tempo of the sequence can be altered with the Tempo control. The FAST key enables you to skip quickly through the sequence at 10 times the normal (slow) tempo while it is held down.

Editing a Sequence

The two edit commands SINS and INS enable you to correct any incorrect notes. The SINS key enables the sequence to be stepped through one note at a time and, when combined with the FORD and BACK keys, in either direction. To set the SINS mode press the SINS key followed by RET. Start the sequence and stop it where required, the notes can then be stepped through by using the RET key. To change direction press the relevant key followed by the RET key then carry on as before. To revert to normal mode press the CONT key. The INS key lets you overwrite the current note stored with the new one. The display should indicate the note number before the one to be overwritten. Press the INS key then set the computer switch to write. Play the correct note and press the RET key. The note will be written into the position displayed after this operation.

Example of Edit sequence:

Say note near 11 was incorrect.
Set SINS mode.
Start sequence.
Stop at about 8.
Press the RET key until incorrect note is reached.
Set the Backwards mode and step back through the sequence noting the number of the incorrect note (say 12).
Set the forward mode and step up to the number before the incorrect note i.e. 11.
Press the INS key.
Set the computer switch on the synthesiser to write.
Press the RET key.
Now the note should be correct so check it by replaying the sequence.

Storing the sequence

The SAVE key is used to put the data on to a cassette tape. To do this, connect the tape recorder to the sequencer and start it recording. Press the SAVE key followed by RET. The data being stored will be shown on the display. At the end of the 'dump' the command prompt will return.

To reload the data stored on cassette, start the cassette playing and when the carrier tone is heard, press the LOAD key followed by RET. The cassette symbol will be displayed (see Figure 12) and then the data will start to appear in the display. The completion of the LOAD will be indicated by the return of the command prompt. If an error occurs in the loading, the error symbol will be momentarily displayed and the data should be reloaded. Once the LOAD routine has been entered you can not escape until the loading is complete. The only way to reset the unit is by switching off. ■

SEQUENCER MAIN PARTS LIST

Resistors — all ⅓W 5% carbon unless specified			
R1,2,3,17	10k	4 off	(M10K)
R4	330R		(M330R)
R5,15	15k	2 off	(M15K)
R6,7,9,18	1k	4 off	(M1K)
R12	120R		(M120R)
R13	12k		(M12K)
R14	4k7		(M4K7)
R16	100R		(M100R)
R19,20	10k (1%)		(T10K)
RV1	22k vert sub-min preset		(WR72P)
Capacitors			
C1 to 12	100nF disc ceramic	12 off	(BX03D)
C13	100uF 10V tantalum		(WW79L)
C14	1000pF ceramic		(WX68Y)
C15,18,19,22,23	10nF polycarbonate	5 off	(WW29G)
C20	150nF polycarbonate		(WW43W)
C21	2200pF ceramic		(WX72P)
C24	47nF polycarbonate		(WW37S)
C25,26	22pF ceramic	2 off	(WX48C)
Semiconductors			
D1	1N914		(QL71N)
IC1	Z80-CPU		(QW00A)
IC2	2716/M3		(QY17T)
IC3,4,5,6	2114	4 off	(QW12N)
IC7	Z80-PIO		(QW03D)
IC8	8279		(YH51F)
IC9	8251		(YH49D)
IC10	74LS32		(YF21X)
IC11	74LS139		(YF54J)
IC12,13	74LS93	2 off	(YF40T)
IC14	NE555V		(QH66W)
IC15	74LS00		(YF00A)
IC16	NE567		(QH69A)
IC17	74LS04		(YF04E)
Miscellaneous			
X1	2.4576 MHz crystal		(FY81C)
	Veropin 2145	102 off	(FL24B)
	40-pin DIL socket	3 off	(HQ38R)
	28-pin DIL socket		(BL21X)
	24-pin DIL socket		(BL20W)
	18-pin DIL socket	4 off	(HQ76H)
	16-pin DIL socket		(BL19V)
	14-pin DIL socket	5 off	(BL18U)
	8-pin DIL socket	2 off	(BL17T)
	Sequencer pcb		(YQ56L)
	Trackpins	6 pkts	(FL82D)
	Bolt 6BA ½in.	4 off	(BF06G)
	Nut 6BA	4 off	(BF18U)
	Washer 6BA	4 off	(BF22Y)
	Spacer 6BA ⅛in.	4 off	(FW33L)

SEQUENCER DISPLAY PARTS LIST

Resistors — all ⅓W 5% carbon			
R1 to 7	10R	7 off	(M10R)
R8 to 11	1k	4 off	(M1K)
Semiconductors			
TR1 to 4	BC213L	4 off	(QB61R)
IC1	74LS47		(QQ52G)
IC2 to 5	7-segment display type 1	4 off	(FR36P)
Miscellaneous			
	Display pcb		(YQ57M)
	Veropin 2145	11 off	(FL24B)
	14-pin DIL socket	4 off	(BL18U)
	16-pin DIL socket		(BL19V)
	Bolt 6BA ½in.	2 off	(BF06G)
	Nut 6BA	2 off	(BF18U)
	Washer 6BA	2 off	(BF22Y)
	Spacer 6BA ⅛in.	2 off	(FW33L)

SEQUENCER ADDITIONAL PARTS LIST

JK1,2,3	Jack socket break	3 off	(HF90X)
SK1	DIN socket 3-pin		(HH32K)
PL1	Multicon plug 9-way		(YX35Q)
PL2	4mm plug black		(HF62S)
	Multicon plug pin	9 off	(YX45Y)
	Case type 501		(XB88V)
	Filter red		(FR34M)
	Multicore 9-way	1m	(XR27E)
	Grommet small		(FW59P)
	Hook-up wire in 5 different colours	each	1m (BL00A etc)
	Bolt 6BA ½in.	2 off	(BF06G)
	Nut 6BA	2 off	(BF18U)
	Washer 6BA	2 off	(BF22Y)

SEQUENCER KEYBOARD PARTS LIST

Resistors — all ⅓W 5% carbon			
R1	22k		(M22K)
R2,3	1k	2 off	(M1K)
RV1	Pot lin 47k		(FW04E)
Capacitors			
C1,2	10nF polycarbonate	2 off	(WW29G)
C3	100nF disc ceramic		(BX03D)
Semiconductors			
D1	1N916		(QL72P)
IC1	NE555V		(QH66W)
IC2	74LS90		(YF38R)
IC3	74LS00		(YF00A)
Miscellaneous			
S1 to 15	Keyboard switch	15 off	(FF61R)
	Keytop 1	15 off	(FF62S)
	Veropin 2145	19 off	(FL24B)
	8-pin DIL socket		(BL17T)
	14-pin DIL socket	2 off	(BL18U)
	Keytop print		(RK32K)
	Keyboard pcb		(YQ58N)
	Bolt 6BA ½in.	4 off	(BF06G)
	Nut 6BA	4 off	(BF18U)
	Washer 6BA	4 off	(BF22Y)
	Spacer 6BA ⅛in.	4 off	(FW33L)
	Collet knob black		(RX16S)
	Collet nut cover		(RX18U)
	Collet cap black		(WL45Y)

SEQUENCER INTERFACE PARTS LIST

Resistors — all ⅓W 5% carbon			
R1 to 8, 12 to 21	47k	18 off	(M47K)
R9,10	10k	2 off	(M10K)
R11	1k		(M1K)
Capacitors			
C1	47uF 10V tantalum		(WW75S)
C2 to 4	100nF disc ceramic	3 off	(BX03D)
Semiconductors			
D1	1N916		(QL72P)
IC1	uA78L05AWC		(QL26D)
IC2 to 5	40109BE	4 off	(QW67X)
Miscellaneous			
	Interface pcb		(YQ59P)
	Veropin 2145	36 off	(FL24B)
	16-pin DIL socket	4 off	(BL19V)
	Bolt 6BA ½in.	4 off	(BF06G)
	Nut 6BA	4 off	(BF18U)
	Washer 6BA	4 off	(BF22Y)
	Spacer 6BA ⅛in.	4 off	(FW33L)
SKT2	4mm socket black		(HF69A)

SEQUENCER PSU PARTS LIST

Capacitors			
C1,2	100nF minidisc ceramic	2 off	(YR75S)
C3	2200uF 10V axial electrolytic		(FB89W)
C4	10uF 35V pc electrolytic		(FF04E)
C5	100nF suppression cap		(FF56L)
Semiconductors			
D1,2	1N4001	2 off	(QL73Q)
IC1	uA7805UC		(QL31J)
Miscellaneous			
T1	Min transformer 9V		(WB11M)
FS1	Fuse 20mm 500mA		(WR02C)
	Safuseholder 20mm		(RX96E)
	Grommet small		(FW59P)
	PSU pcb		(GA65V)
	Veropin 2145	5 off	(FL24B)
	Bolt 4BA ½in.	2 off	(BF03D)
	Nut 4BA	2 off	(BF17T)
	Washer 4BA		(BF21X)
	Tag 4BA		(BF28F)
	Bolt 6BA ½in.	2 off	(BF06G)
	Nut 6BA	2 off	(BF18U)
	Washer 6BA	2 off	(BF22Y)
	Spacer 6BA ⅛in.	2 off	(FW33L)
	Min mains cable	2m	(XR01B)

A complete kit of all the above parts is available.
Order As LW66W. Price £125
Please check current price after 14th August 1982.

AMMENDMENTS FOR SEQUENCER

1) R13 on main pcb may need to be changed to give required frequency due to component tolerances. Select value of R13 on test.

2) C1 on the keyboard should be 100nf polycarbonate - <u>not</u> 10nf.

3) The first note played when writing a sequence is not replayed - It is used as a timing mark. eg: Record - start at 9
Play - start st 10

4) When single stepping - the numbers of the notes are altered by 1 when the step direction is changed. (This should not cause any problems if indicated method of editing is used).

5) When testing display board connect supply via a 47R resistor.

6) The last note of a recorded sequence should be followed by a dummy note to ensure the correct timing for the last note.

7) Long notes and long rests are acceptable and will be recorded as played even if the note fills a number of locations or the rest fills a number of locations.

8) Tempo control (RV1) operates in both record and playback modes, so normally set to mid position for recording to enable the tempo to be increased or decreased on playback.

9) Pin 18 of IC2 should be shown connected to ground in fig 1.

10) Fig 5 - S3 shown incorrectly wired (shown correctly in fig 8).

11) Fig 1. LK1B next to IC2 should go to +5V (note that pcb is correet).

12) A heatsink is included in the kit, to be fitted onto IC1 (ua7805UC) on psu pcb, although it has been omitted from the parts list.