

SYNWAVE

- * Sounds from swirling sea to cymbal and wood block
- * Easy to build and play
- * Dual trigger operation - percussive/external trigger
- * Touch sensitive

Design - Mike Beecher
Development - Robert Penfold

KIT COST
ONLY
£10.25
inc. VAT



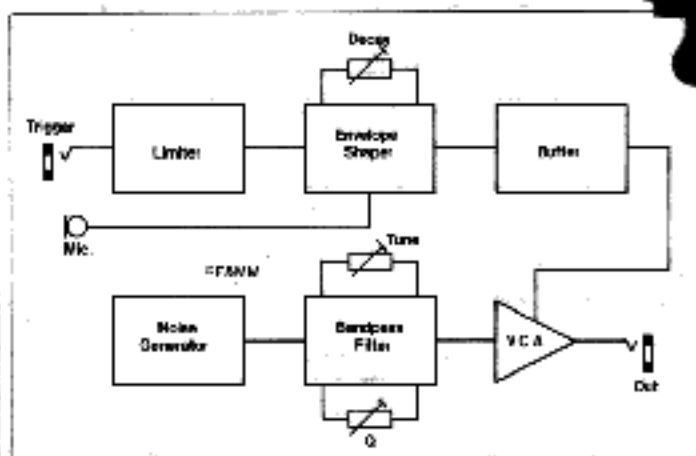
The Synwave continues our series of small projects that produce sounds for use in electro-music by percussive control. The minimum number of controls have been selected to give a wide range of 'sea wave' sounds. In addition, different settings of the controls will produce wind, cymbal and woodblock sounds.

Like the 'Syntom' project shown elsewhere in this issue, the unit can be triggered by tapping the case or by striking a drum (on which the Synwave is mounted). These projects are also ideal for triggering from an external source (e.g. a sequencer synthesiser or micro) and thus a second mode of operation can be from an electronic trigger using a positive-going edge of about 7 to 15 volts in amplitude. Interaction of the two modes of use is possible so that complex rhythms can be made from a steady 'external triggered' beat mixed with hand or drum taps providing syncopation.

The four controls are Volume (with on/off switch), for setting output level; Decay - adjusts the time it takes for the sound to die away; Pitch - sets the frequency range of noise from low to high; Q - a resonance control that narrows and highlights the pitch range selected.

Circuit

The block diagram of Figure 1 shows the general arrangement used in the Synwave. An envelope shaper can be operated by either



an internal microphone or an external trigger signal, or both. The envelope shaper has a fast attack and slow decay, with the latter being adjustable from less than 100ms to about 5 seconds. The output of the envelope shaper is fed to the control input of a voltage controlled amplifier (VCA) via buffer stage.

A simple noise generator feeds a bandpass filter which in turn feeds the input of the VCA. The bandpass filter is tunable from a few hundred hertz to more than 10kHz, and therefore gives considerable control over the sound produced by the unit. The bandwidth of the filter can be varied from a very broad response to a very sharp peaky response by means of the Q control, and again, this permits the output sound of the unit to be varied greatly.

If we now consider the full circuit diagram of the Synwave (Figure 2); C1, R1, D1, D2, and R2 process the trigger signal so that on its rising (positive) edge a brief positive pulse of about 7 volts in amplitude is supplied to the base of TR1. TR1 and TR2 form a Darlington pair emitter followering the brief input pulse to TR1. R3 and R4 provide a discharge path for C2, and the setting of R4 determines the discharge time of C2 (and therefore the length of the output signal).

If crystal microphone X1 is subjected to strong vibrations it will give an output level of several volts peak to peak, and positive going output half cycles will result in C2 being rapidly charged. The output signal level and hence the charge produced on C2 depends on how hard the unit or the drum

to which it is attached is struck, and this gives a degree of touch sensitivity.

The signal across C2 must be only lightly loaded or the decay time will be greatly shortened by the charge current leaked away through the loading circuit. TR3 is therefore used as an emitter follower buffer stage which couples the output from C2 to the control input of the VCA. The VCA uses a CA3080 transconductance amplifier, and it gives a level of gain that is proportional to the control voltage. The output signal thus rises rapidly to its peak level, and then decays relatively slowly, in sympathy with the envelope voltage across C2. The output of the VCA is coupled to the output socket by way of volume control RV2. Dual balanced supplies are required by the VCA circuitry and a central 0V rail is effectively produced by R10, R11 and C5.

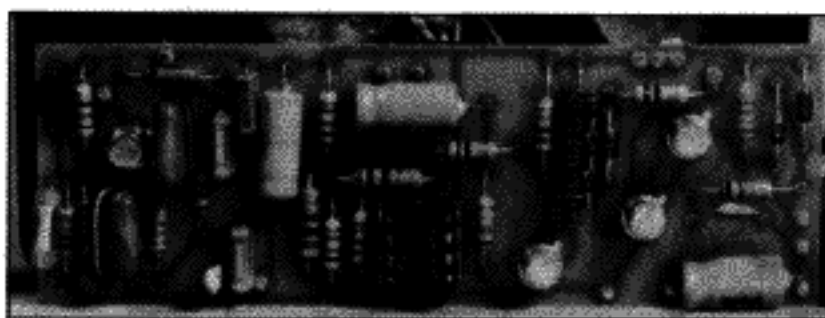
TR5 is used as the noise generator and R18 applies a reverse bias to its base-emitter junction. This junction behaves rather like a Zener diode and like a Zener diode produces noise spikes. This arrangement is preferable to using a Zener diode though, as it gives a higher output at audio frequencies. The high frequency output of the noise generator is



excessive, and so C11 is used to give high frequency attenuation to correct this.

A twin T filter is used as the basis of the bandpass filter, but as a twin T network gives a notch at its centre frequency rather than a peak, the filter network is connected to give negative feedback over a common emitter amplifier. This amplifier features TR4 in a conventional configuration. TR4's emitter circuitry enables a certain amount of negative feedback to be applied to the amplifier and the amount of feedback is controlled by RV4. With the slider of RV4 at or near the lower track connection there is little or no feedback; giving the circuit a high Q value and a narrow, peaky response. Moving the wiper of RV4 towards the upper end of its track gives increased feedback and a consequent reduction in Q together with a broader, flatter response.

RV3 is part of the twin T network, and varying the setting of this component alters the centre frequency of the filter. Ideally all three resistive elements in the filter should be varied when tuning the filter, but this is not really

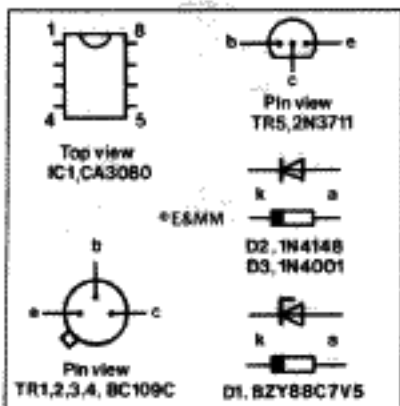


Completed circuit board.

practical. This simple system works quite well though, and the only minor drawback is that the Q of the filter varies somewhat with changes in the setting of the pitch control. At some settings of RV3 it may be found that setting RV4 for a very high Q causes the filter to oscillate at its centre frequency. If desired, this can be avoided by adding a resistor of about 150 ohms in value between the positive terminal of C9 and the upper track connection of RV4. However, as this would limit maximum Q available, especially at the highest and lowest pitch control settings, it would reduce the effectiveness of the unit and is not really worth while.

C13 is needed to prevent the filter becoming unstable due to

stray high frequency feedback. C4 couples the output of the filter to the input of the VCA. The current consumption of the circuit is only about 1.5mA., or a little higher than this when it is triggered.

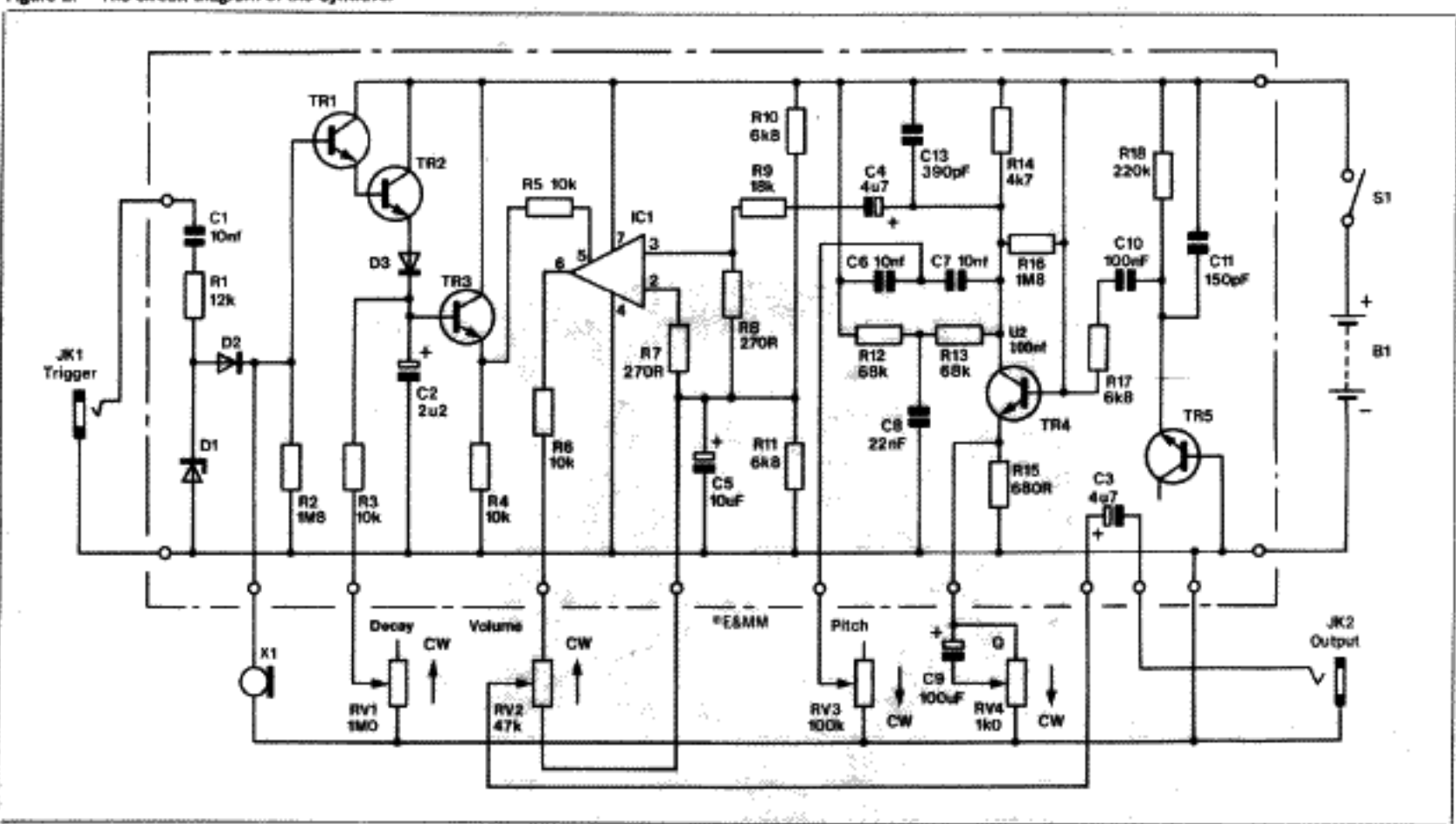


Construction Details

Except for C9 all the resistors, capacitors, and semiconductors are fitted onto a printed circuit board. Fit the semiconductors last, and make quite sure that the electrolytic capacitors and semiconductors are connected the right way round. The printed circuit board fits into the mounting rails of the specified case, but this leaves insufficient room for leads to be taken around the board to the controls, battery clip, microphone, and sockets. This makes it necessary to fit Veropins to the board at the points where it connects to these components, or if preferred, these leads can simply be soldered direct to the copper tracks. Details of the printed circuit board are provided in Figure 3.

The removable lid of the case is used as the rear panel in this application, and the two sockets are mounted on this panel. The front panel is drilled to take the four potentiometers and the microphone is mounted on the right side of the case (as viewed from the front). The microphone is

Figure 2. The circuit diagram of the Synwave.



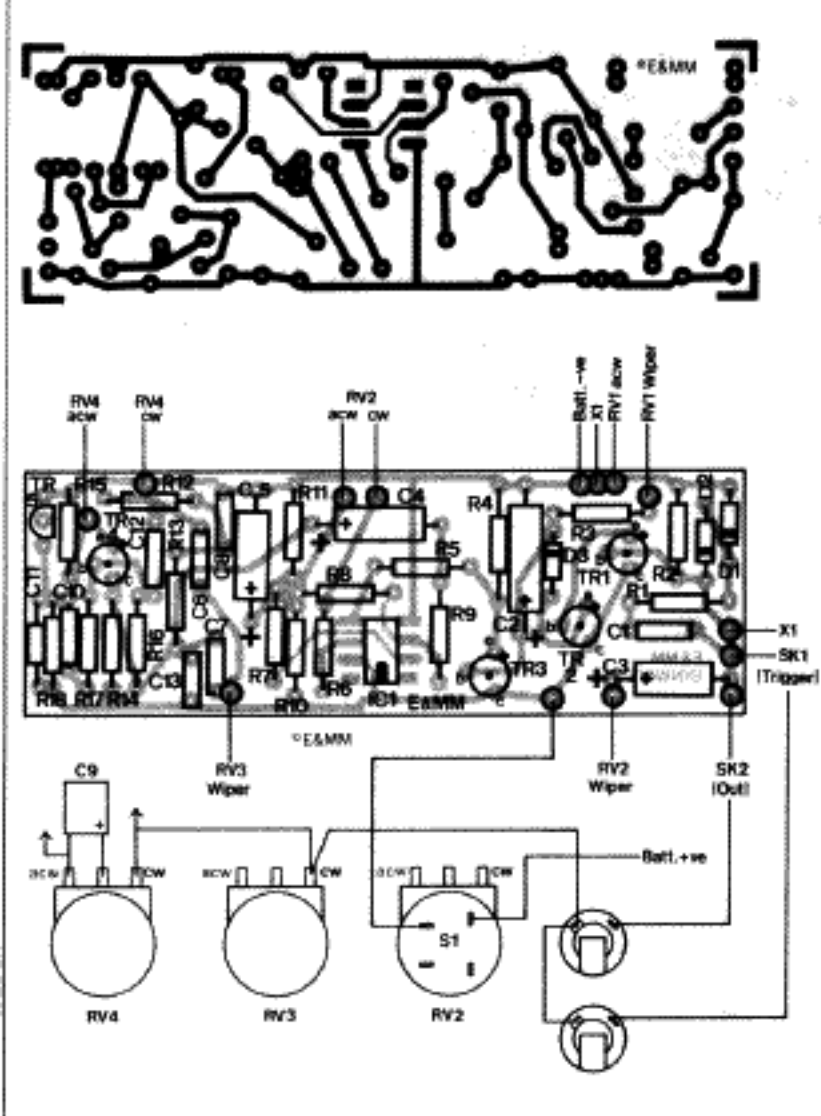


Figure 3. PCB track, component layout and wiring details.

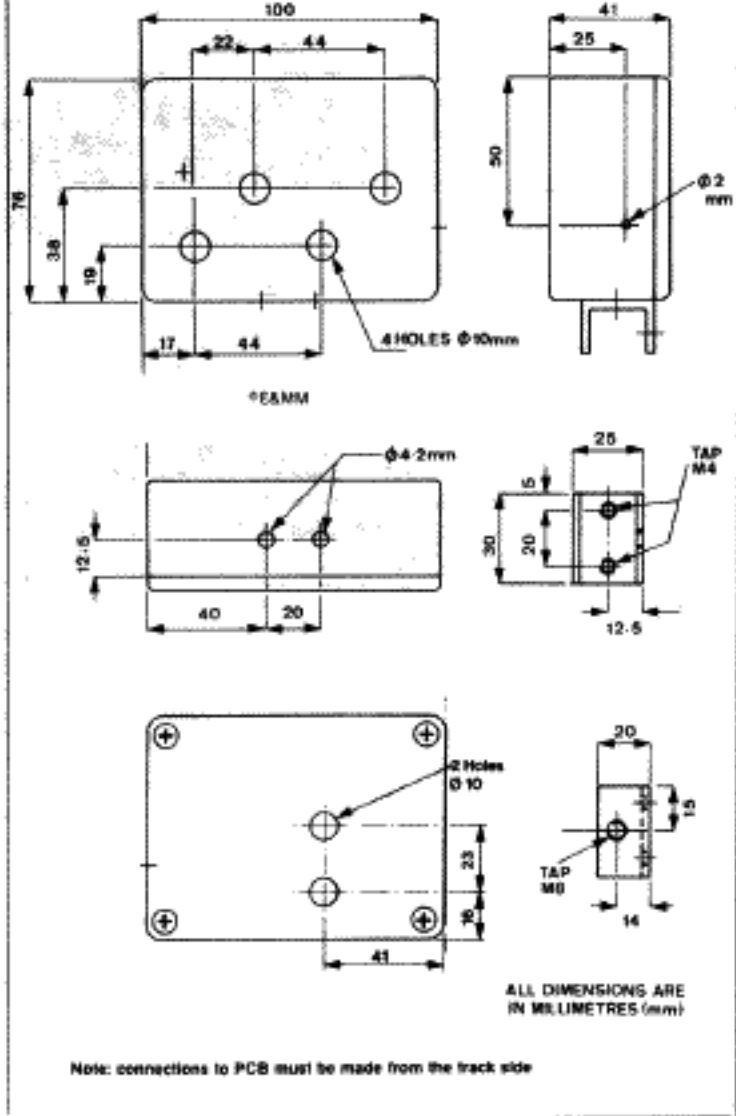
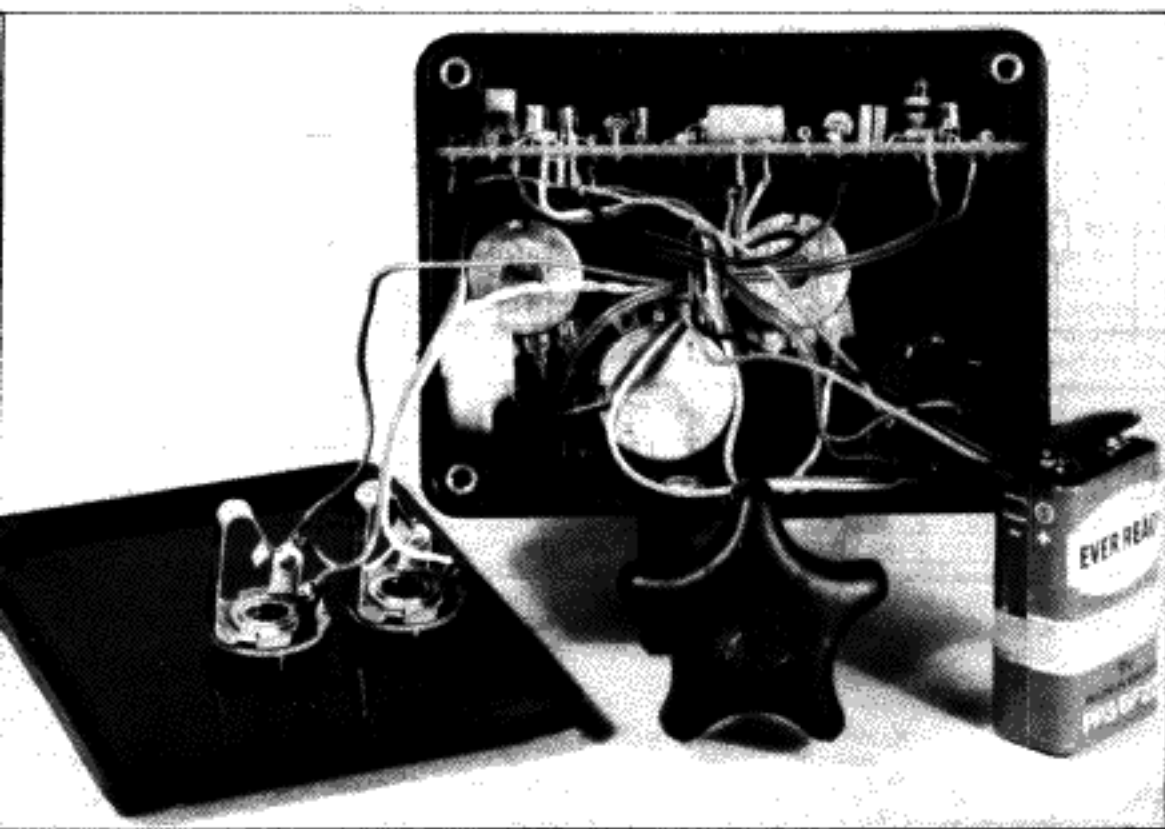


Figure 4. Case and bracket construction.



Synwave with wiring completed and PCB board inserted in case.

actually a crystal earphone having the earpip unscrewed. The small screw at the rear of the earphone is removed, and this is then used to fix the earphone to the case. Figure 4, shows the drilling of the case, and it is advisable to follow this as accurately as possible since there is not a great deal of excess space inside the case and it might otherwise be found that all the parts cannot be fitted into the case.

Next C9 is connected to RV4 and the other wiring to the off-board components is completed. Figure 3 gives details of all this wiring. The printed circuit board fits into the upper set of mounting rails in the case with the component side uppermost. The battery fits vertically into the case in the space between the two sockets and the microphone. A piece of foam material can be glued to the rear panel of the case to keep the battery firmly in place.

If the Synwave is to be fitted onto a drum it is necessary to fit the unit with a mounting bracket. This can consist of a piece of

25mm aluminium channel section which is fixed to the case using a couple of 6mm M4 bolts. A large bolt is used to clamp the Synwave onto the drum, and the bracket is drilled and threaded on one side to take this bolt. A handwheel bolt is ideal for use in this application, but an ordinary type can be used of course. It is advisable to fit a small pad of rubber on the part of the bracket opposite the mounting bolt as this will help to prevent the rim of the drum from becoming scratched when the Synwave is fitted in place.

To complete your project use our smart brushed aluminium panel with electric blue legend and sticky back as shown.

Testing and Use

Connect the Synwave to an amplifier via SK2 and switch on with the Volume control set to midway. Set Decay to maximum, Pitch to minimum and Q to midway. Give the unit a sharp tap or use a suitable trigger signal (applied to SK1) and a 'seawave' should be heard.

Using short Decay and high Pitch and Q, the woodblock sound can be obtained. Cymbal effects require high Pitch and Q with slightly longer Decay.

PARTS LIST

Resistors -- all 1% 0.4W metal film unless specified.

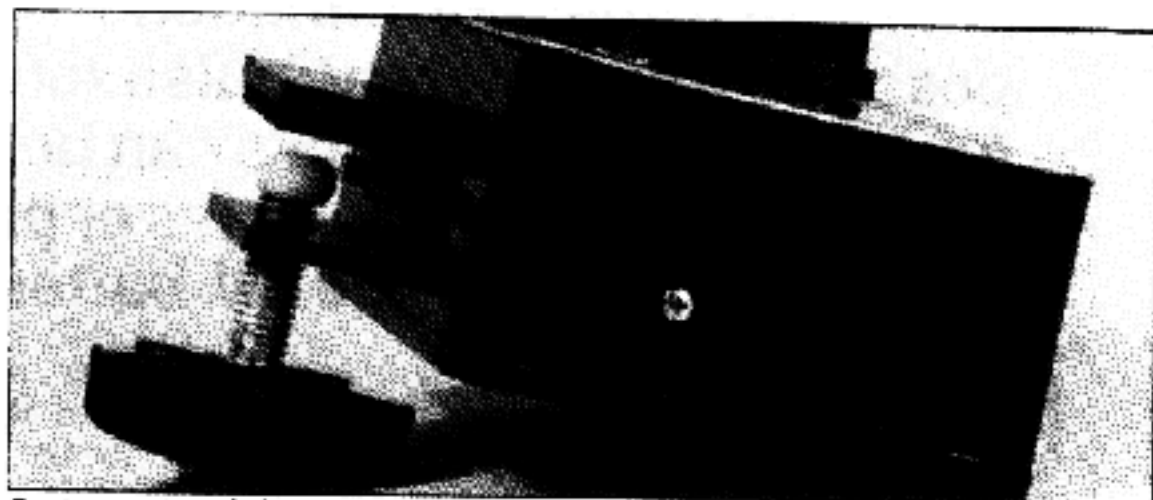
R1	12k	(M12K)
R2,16	1M8 (10%)	2 off (M1M8) ~
R3,4,5,6	10k	4 off (M10K)
R7,8	270R	2 off (M270R) ~
R9	18k	(M18K) ~
R10,11,17	68k	3 off (M68K) ~
R12,13	68k	2 off (M68K)
R14	4k7	(M4K7)
R15	560R	(M560R)
R18	220k	(M220K) ~
RV1	1M lin. pot.	(FW08J)
RV2	47k log. pot. with switch	(FW65V)
RV3	100k lin. pot.	(FW05F)
RV4	1k lin. pot.	(FW00A)
Capacitors		
C1	10n ceramic plate	(WX77J)
C2	2u2 63V axial electrolytic	(FB15R)
C3,4	4u7 63V axial electrolytic	2 off (FB18U)
C5	10u 25V axial electrolytic	(FB22Y)
C6,7	4n7 polycarbonate	2 off (WW26D)
C8	10n polycarbonate	(WW29G)
C9	100u 10V PC electrolytic	(FF10L)
C10,12	100n polyester	2 off (BX76H)

C11	150p polystyrene	(BX29G)
C13	390p ceramic plate	(WX63T)
Semiconductors		
IC1	CA3080, 8-pin, DIL	(YH58N)
TR1,2,3,4	BC109C	4 off (QB33L)
TR5	2N3711	(QR34M)
D1	BZY88C7V5	(QH11M)
D2	1N4148	(QL80B)
D3	1N4001	(QL73Q)
Miscellaneous		
X1	Crystal earpiece	(LB25C)
SK1,2	Mono jack socket (open type) 2 off	(HF91Y)
	Case MB2	(LH21X)
	Handwheel bolt	(YL23A)
	M4 6mm bolts	(BF33L)
	Printed circuit board	(GA35O)
	PP3 connector	(HF28F)
B1	PP3 battery	
	1mm Verocins	(FL23A)
	Knobs	4 off (YG40T)
	Knob cap blue	(QY01B)
	Knob cap grey	(QY03D)
	Knob cap red	(QY04E)
	Knob cap yellow	(QY06G)
	Front panel	(BX99H)

Note. A complete kit (LW87U) of all parts listed is available from Maplin Electronic Supplies at a price of just £10.25 inc. VAT and P&P. The kit does not include batteries.

In addition, the Q control can put the filter into oscillation and Pitch will then vary the frequency. Of course, this effect may not be desirable, especially as the volume increases substantially, and is simply removed by reducing the Q control or inserting a resistor as mentioned earlier.

A little experimentation with the controls will soon give an idea of the wide range of useful effects that can be produced.



Synwave external view with bracket.