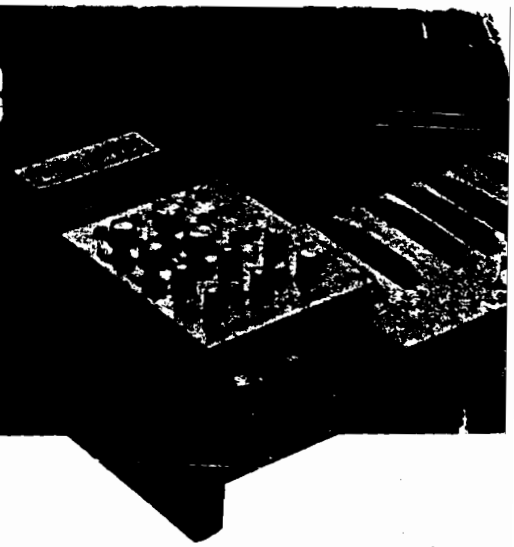
PE Sound Synthesiser 13

KEYBOARD



By G D SHAW

IN this last part keyboard construction will be completed and final tuning described.

KEYBOARD HOUSING CONSTRUCTION

The design of the keyboard housing is based on the use of the four octave Kimber-Allen keyboard. Constructors using keyboards other than the one specified will have to modify some of the dimensional details accordingly. Fig. 13.1, is a composite illustration giving details of the various timber components required to construct the main housing. Since *no* interlocking joints are used it is recommended that all joints be secured with a powerful adhesive such as Araldite together with pins or woodscrews as necessary.

Firstly the end frames, cheek plates complete with battens and baseboard were made according to the figures and lightly tacked together dry, as a check on dimensional accuracy. The housing was then stripped and, with the exception of the faces to be glued and the underside of the baseboard, all parts were finished with two coats of dark grey undercoat and four sprayed coats of matt black paint.

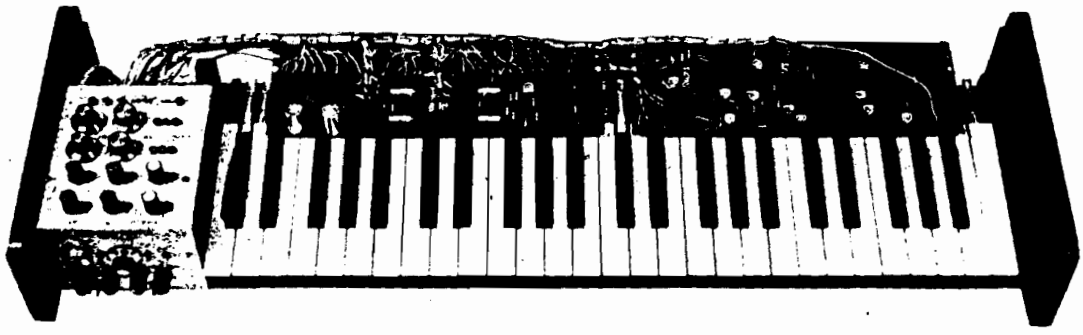
A piece of upholsterer's heavy quality black figured vinyl was then cut to cover the underside and front lip of the baseboard. In cutting the vinyl an allowance of about 38mm should be made for overlapping each of the long edges of the baseboard and, similarly, allow about 50mm on the overall width. Do not attempt to cut out the rectangular opening at this stage.

With the vinyl spread out on a flat surface coat the underside with a thin layer of suitable adhesive leaving about 25mm clear all round. Dunlop "Thixofix" was used in the prototype. The underside of the baseboard should be similarly prepared.

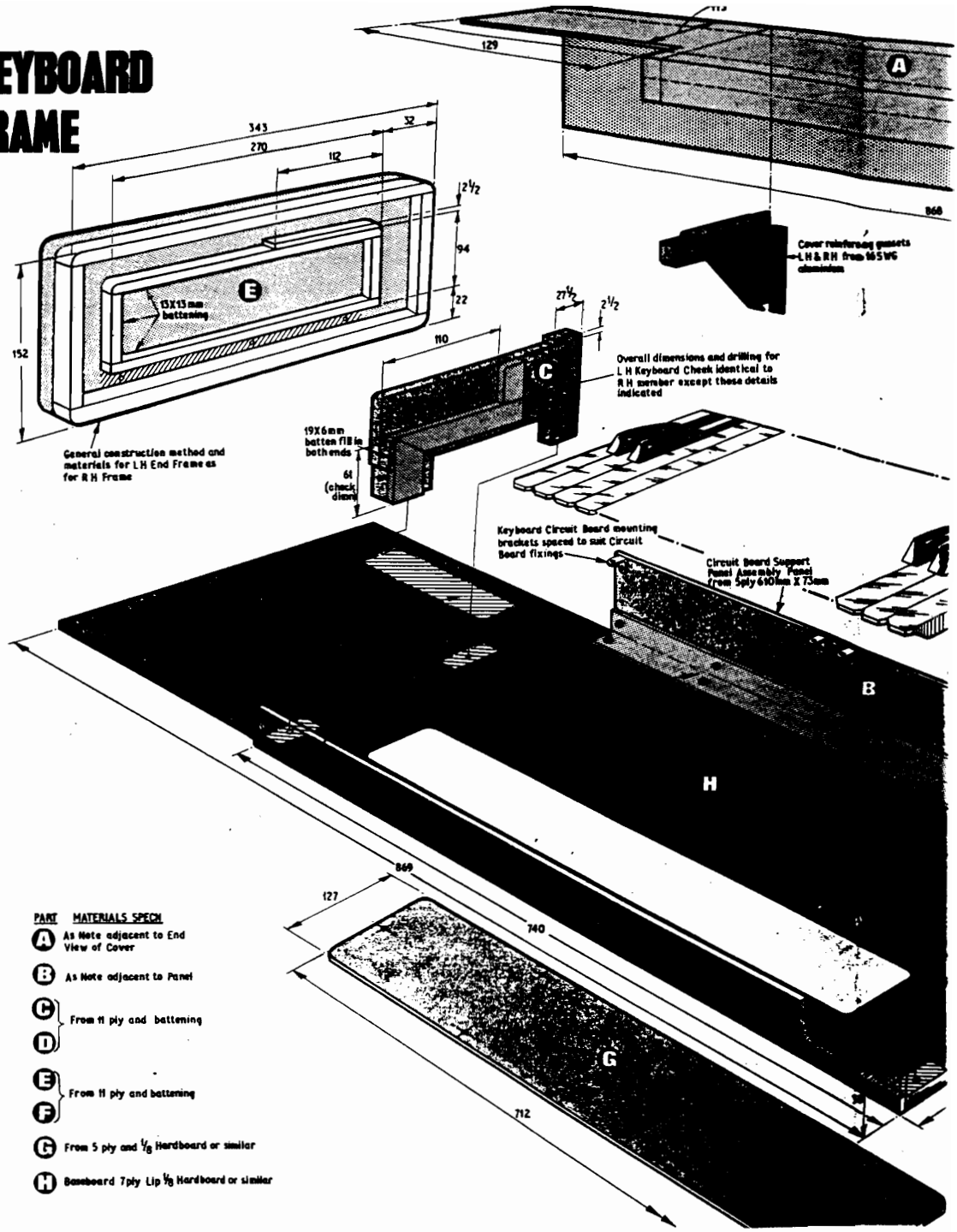
When the adhesive appears dry to the touch place the baseboard, glued side up, on a table and cover lightly with a sheet of greaseproof paper or similar. Place the vinyl over the baseboard, glued side down, and adjust its position to allow for the overlaps. When correctly positioned gradually slip the paper from between the two glued surfaces and roll the vinyl onto the baseboard. A wallpaper joint roller would be suitable for this purpose.

Ensure that the vinyl goes on without wrinkling but do not attempt to apply any degree of stretching otherwise shrinkage will occur at a later date. The vinyl may, however, be pulled tight over the batten on the front lip of the baseboard. When this stage has been reached reverse the position of the baseboard and apply a layer of adhesive to both long edges of the vinyl, baseboard, rear face of the batten and in a 38mm strip around the rectangular opening.

With a sharp knife, and following the contour of the opening, cut out a rectangle leaving an overlap of about 38mm all round. Make three or four cuts into the radiused corners of the opening as shown but leave a gap between each cut and the timber edge. Roll down each of the overlaps in turn pulling the vinyl tightly over the edges of the baseboard. In the case of the opening set down the corners first of all before attempting the long edges.



KEYBOARD FRAME



PART	MATERIALS SPECN
A	As Note adjacent to End View of Cover
B	As Note adjacent to Panel
C, D	From 11 ply and battening
E, F	From 11 ply and battening
G	From 5 ply and ⅛ Hardboard or similar
H	Baseboard 7ply Lip ⅛ Hardboard or similar

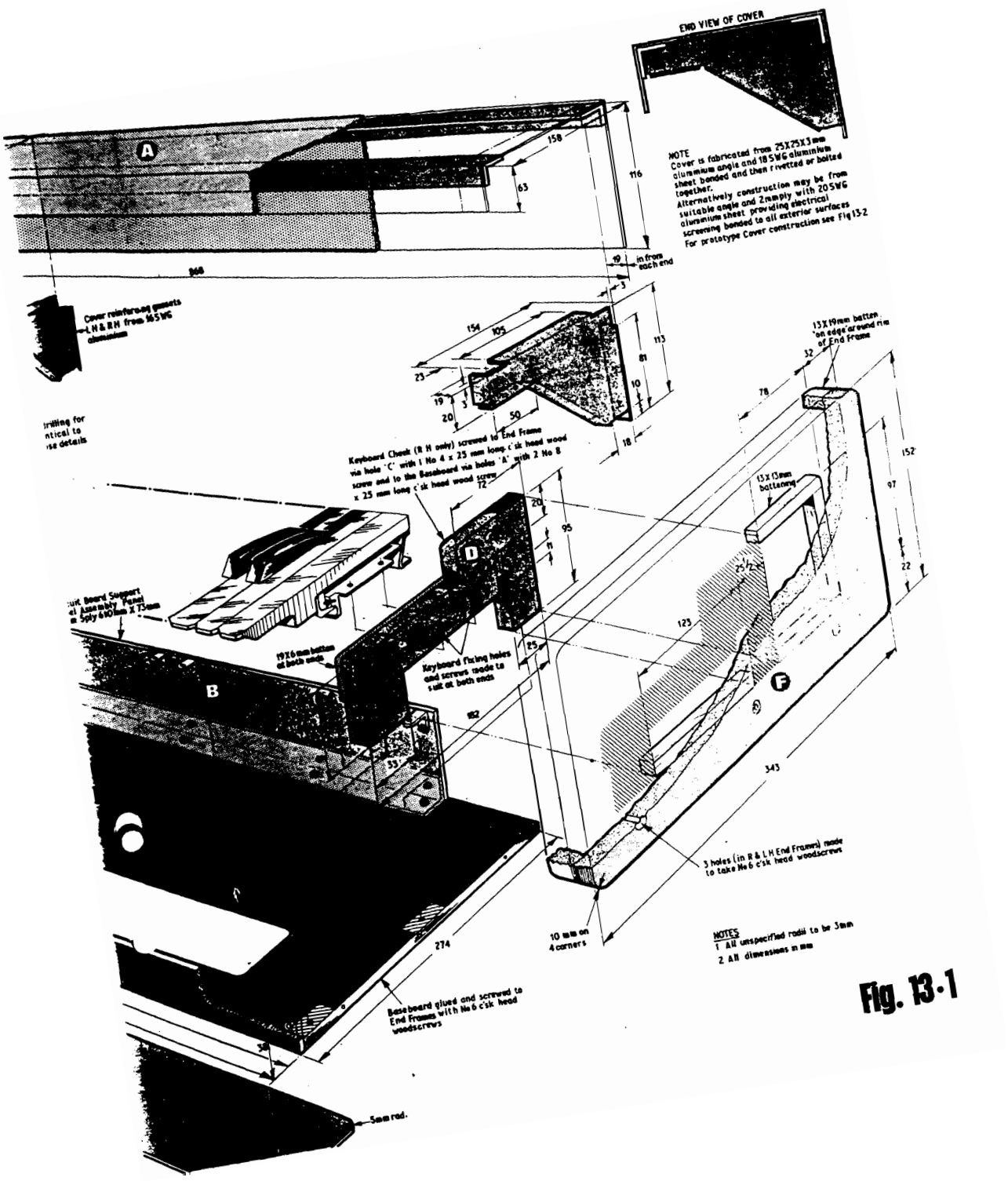

END VIEW OF COVER
NOTE
Cover is fabricated from 25X25X3 mm aluminium angle and 18 SWG aluminium sheet bonded and then rivetted or bolted together.
Alternatively construction may be from suitable angle and 2 mm ply with 20 SWG aluminium sheet providing electrical screening bonded to all exterior surfaces
For prototype Cover construction see Fig 13-2
A
158
116
63
868
19 in from each end
3
Cover reinforcing gussets L H & R H from 16 SWG aluminium
154
105
113
81
10
23
19
3
20
50
18
13 X 19 mm batten 'on edge' around rim of End Frame
32
78
152
97
22
Keyboard Cheek (R H only) screwed to End Frame via hole 'C' with 1 No 4 x 25 mm long c'sk head wood screw and to the Baseboard via holes 'A' with 2 No 8 x 25 mm long c'sk head wood screws
12
20
95
51
D
13 X 13 mm battening
25½
125
25
Keyboard fixing holes and screws made to suit at both ends
B
F
152
33
343
3 holes (in R & L H End Frames) made to take No 6 c'sk head woodscrews
10 mm on 4 corners
274
Baseboard glued and screwed to End Frames with No 6 c'sk head woodscrews
5mm rad.
NOTES
1 All unspecified radii to be 3mm
2 All dimensions in mm

Fig. 13.1

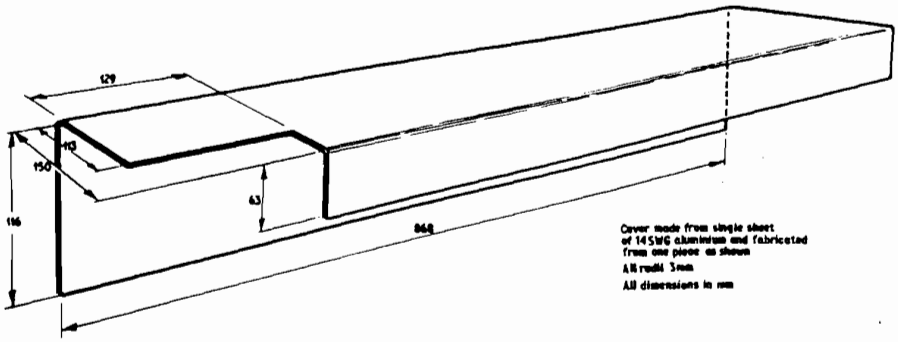


Fig. 13.2. Prototype bending and cutting detail of keyboard cover plate

After allowing the baseboard to settle overnight the excess lengths of vinyl may be trimmed off with a sharp knife.

The baseboard may now be glued and screwed to the endframes of the keyboard housing using round head screws, with washers, to prevent wrinkling of the vinyl. Set aside for the glue to set, ensuring the endframes are square with the baseboard.

ASSEMBLING THE KEYBOARD

Attention may now be given to the keyboard itself. Drill two holes 10mm in from each end of the aluminium extrusion which forms the main frame of the keyboard together with coincident sighting holes in each of the cheekplates. Secure the cheeks to the frame with No. 8 round-head woodscrews. Make sure that the aluminium frame is barely flush with but does not protrude beyond the cheeks. The keyboard may now be turned upside down resting on the left cheek and with a suitable block of wood placed beneath the right cheek. Trim the length of the contact strip so that it fits easily into the space to the rear of the actuators.

Place a contact assembly at each end of the strip such that the front of the assembly is flush with the leading edge of the strip, and then manœuvre the strip so that the plain wires on the contact assemblies slightly protrude above and beyond the actuators. When satisfied with the positioning carefully remove the contact assemblies and mark the position of the strip relative to the actuators. The contact strip may now be removed and prepared for permanent fixing.

The contact assemblies themselves will be secured to the strip by means of adhesive and thus the upper surface of the strip has to be prepared by thoroughly roughening the surface by means of coarse grade emery or glass paper.

The contact strip may be secured to the keyboard frame by means of adhesive or by means of screws. In the former case the lower surface of the strip must also be thoroughly roughened together with its mating face on the mainframe of the keyboard. In the latter case a minimum of three screws will be required (each end and centre) and the appropriate drillings made through the contact strip and frame. Note that if the latter method is employed keys will have to be removed in line with each drilling. The contact actuators can be removed by a straight upwards pull after which the key spring will have to be disconnected before the key can be removed.

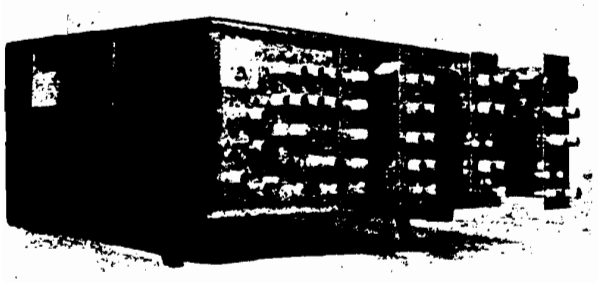
The contact assemblies may now be fixed into position with the front face of the assembly flush with the edge of the strip and with the long, plain wires centred squarely over their respective actuators.

WIRING THE KEYBOARD

The first stage in wiring up the contact assemblies is to fan out, in a vertical plane, the lead out wires common to each unit. With the keyboard inverted and, facing the rear of the assembly, key 1 at the left end is the lowest C while key 49 at the extreme right is the highest C. Starting with the lead-out wire nearest to the contact strip wire all these together from key 1 to 49 inclusive. 24 s.w.g. tinned copper wire is suitable for this purpose. This row will form the −15V busbar and an insulated wire should be connected to row 1 key 1 for subsequent coupling to the −15V rail. Although not absolutely essential it is a good idea to use short lengths of insulated sleeving on the bare sections of connecting wire between contact assemblies.

Row No. 2 forms the envelope shaper triggering busbars. Link together all No. 2 wires from key 1 to key 18 inclusive and attach an insulated wire to key 1 row 2 for subsequent attachment to the link switch (S2b). A similar procedure is adopted for key 19 to 49 inclusive with an insulated wire attached to key 19 row 2.

Row No. 3 is wired in an identical manner to Row No. 2 except that the busbars so formed will be carrying V.C.O. control voltages and the insulated lead-out wires will be connected to S2a.



CODED KEY WIRES

The contact assembly wires in row No. 4 are individually hard wired direct to the keyboard divider circuit board. It is best to ensure that each key in any octave has its own distinctive wire colour.

Loosely bunch tie the octave wire groups together so that there is less likelihood of confusion when wiring into the divider board.

When the contact wiring has been completed the keyboard assembly may be mounted into the main housing and secured. Fit the circuit board supporting panel and mount the two large circuit boards into the positions shown in the sketch. In the prototype Vero brackets were used for this purpose and secured to the circuit boards by means of nylon screws and nuts. The wiring to the divider should be led through the gap between the panel and circuit board, trimmed to length and soldered to their respective pins.

Place the control panel temporarily in place on the keyboard housing and slide the envelope shaper sub-chassis into position making sure that the control shafts protrude through their respective holes in the control panel. Secure the sub-chassis to the baseboard by means of suitable woodscrews.

FINAL TUNING

With the installation of the power supply unit or connection of the umbilical cable the final tuning of the keyboard unit may be accomplished.

Having already matched the performance of the v.c.o.s the final tuning consists quite simply of matching the setting of the fixed span control (VR3) to suit the requirements of the oscillators. Constructor/musicians will find this to be a relatively easy matter since it is only necessary to play, consecutively, two notes an octave apart and adjust VR3 until the required pitch difference is achieved. For those constructors who do not possess the keen "pitch ear" of the practised musician it will be necessary to revert to the use of the oscilloscope.

Using one oscillator only and monitoring the output signal, adjust the tune control so that, with middle C depressed, the frequency is exactly 250Hz. Next depress the C above middle C and note the frequency, adjusting VR3 until it stabilises at 500Hz. The adjustment to VR3 will have caused the lower frequency to move so it will now be necessary to go back to middle C again and re-adjust the tune control so that it is once again 250Hz. Further adjustment to VR3 and the tune control are made until such time as the frequency ratio between middle C and its octave is exactly 1 : 2.

Very close octave spans may be achieved by taking the lowest and highest C's on the keyboard for the purpose of tuning. If the lowest C is set at 50Hz by means of the tune control then the upper C will require to be set to 800Hz corresponding to a frequency ratio of 1 : 16.

Once VR3 has been set, the tune control may be adjusted over quite a wide range without disturbing the octave frequency span. This feature presents a number of advantages because it allows the four octave register of the keyboard to be positioned almost anywhere within the audio frequency spectrum without the necessity of retuning. Similarly it allows the natural notes, normally the key of C, to play in any other key designation.

The variable span control may be switched in as required in order that the keyboard may be matched with acoustic instruments which may be slightly out of tune. At extreme settings the variable span control can reduce the frequency span of the keyboard to a semitone or less or extend the frequency such that one octave on the keyboard covers about three octaves of frequency. These latter possibilities will perhaps be of greatest interest to those musicians wishing to explore the realms of micro and macro tone compositions.

MODULATION AMPLIFIERS

Modulation amplifiers are provided to enable the setting up of relatively complex relationships between oscillators without the necessity for complex circuitry. The simplest use for the modulation amplifiers lies in the provision of vibrato modulation. In this case V.C.O.2 is switched off and its frequency adjusted to about 7Hz by means of its manual control. S6(1) is then closed and the depth control VR7(1) adjusted until the desired degree of vibrato is achieved. The characteristics of sine, triangular and square wave induced vibrato are quite different and many interesting effects are possible by simply varying waveform and modulation depth.

Some of the most interesting effects however occur when both the v.c.o.s are cross modulating one another, and it is possible to simulate a number of conventional acoustic instruments even to providing very realistic bell tones when the appropriate envelope characteristics are combined with a degree of reverberation. In this latter mode of operation extreme settings of the depth controls can provide a series of very bizarre effects in which key positions appear to be juxtaposed and with a number of keys providing grunting, warbling or twittering sounds.

The synthesiser is still a relatively young instrument, having been available to the public for about five or six years. As a creative tool it is without equal but there is still a great deal of development to be done and constructors who have followed the project so far will not only be amongst the first synthesiser owners but will find themselves in the unique and exciting position of perhaps being able to make some contribution towards the further growth of the instrument. ★

An Invitation to a Lecture . . . see page 178