the new synthesizer

programmable and portable

The success of the Elektor Formant synthesiser led us to the opinion that there is a great interest among our readers in the field of electronic musical instruments, especially synthesisers. The availability of the new Curtis IC described in last month's issue prompted us to embark on an entirely new design.
Since the size of the Formant did not lend itself to portability it was decided that the new synthesiser should be truly portable without any lack in terms of performance. The new synthesiser is of modular construction and can be expanded into a polyphonic instrument with 'programming' facilities. This, the first article in the series, explains the basics behind the design.

For some time our design team have been exploring the possibilities of a successor to the Formant, the Elektor synthesiser. Following the trend in technology, it was felt that a new concept was needed rather than just a rehash of a basic idea.
As regular readers know, the Curtis ICs have just recently made their appearance on this side of the water. These have been specifically designed for synthesisers and are probably the farthest that any company has dared to venture in terms of musical 'chips' so far. No further prompting was required to look into the possibilities of utilising these new ICs to form the basis of an entirely new synthesiser.

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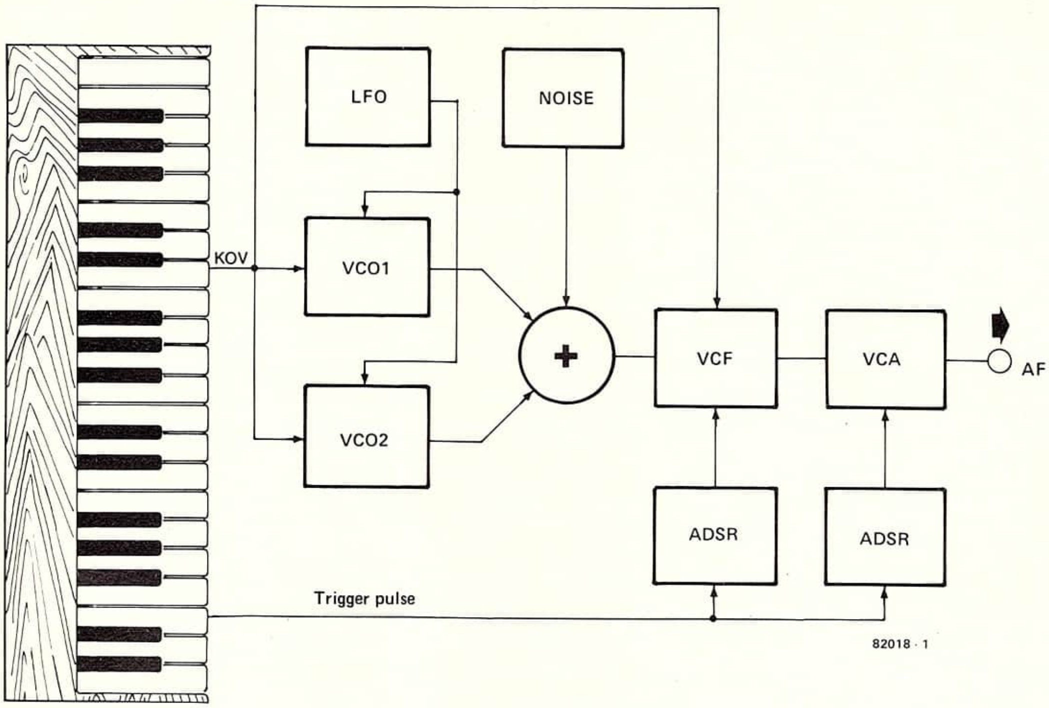
It was felt that a modern synthesiser should take on a new look together with simpler operation. This is the first article in a series describing a truly portable and fully operational instrument that can be constructed in modular form allowing expansion up to a polyphonic keyboard. Further it was decided that the ability to 'program' different sounds was a facility that could be extremely useful.
In this article we begin by discussing the fundamentals behind the new design.
Basically, the concept of the new synthesiser is that of a set of modules which could be combined in various ways leaving the reader free to build four different types of synthesisers using the same basic printed circuit boards. The possibilities are as follows:

1. a simple synthesiser
2. a simple synthesiser including a preset facility
3. a polyphonic synthesiser
4. a polyphonic synthesiser including a preset facility.

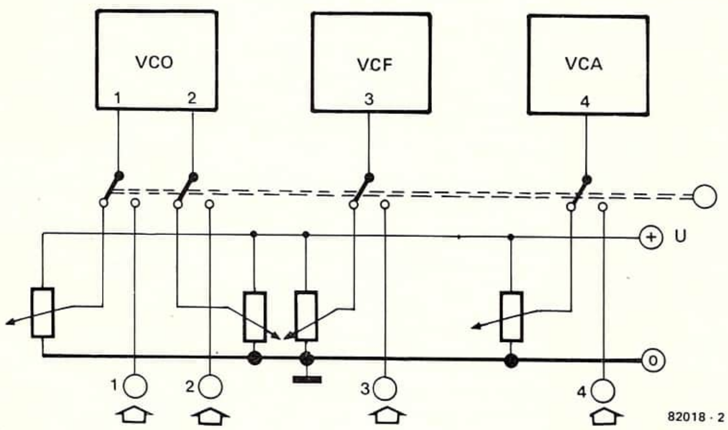
Throughout the series, readers will | expected to be familiar with the stru ture and operation of synthesisers general. However, anyone who is ne to this rather complex field can find the basics in FORMANT Book One.

Why the preset facility?

You only have to analyse the synthe sounds used in Pop, Rock-and-Roll a Jazz to realize that the number different presets required is surprisin few. The audience recognizes t characteristic sound immediately, whi is why a lot of rock bands use o particular sound regularly as a kind 'label'. Furthermore, setting individu modules is extremely time-consumi and, on stage especially, this can be real nuisance. Things can be simplifi by providing a 'manual/preset' swit for all the elements required to produ a complex sound effect: filter fr quencies, attack and decay times, VC resonance factors, the interval betwe two VCOs or the envelope amplitu and so on. This is illustrated in figure where inputs 1 . . . 4 are for the pres control voltages.
Since only very few variations a regularly used in practice, they c easily be stored as 'programs' a 'called' when needed with the aid a single switch or a decimal keyboar If only four situations are required p parameter, say, it is not even necessa to store the exact control volta values in memory. CMOS analog switches can be used to select t desired voltages as shown in figure 3 in effect, this works like the rota switch shown in figure 3b. The on data that must be stored is the 'setti of the switches'.
Obviously, the possibility of full manu control by means of knobs on the fro panel must be maintained as an opti — if only for special effects.
The individual boards belonging to t compact model do not need to modified if the circuit is provided wi a preset facility at a later date. T voltages which control the filter fr quency, attack times, etc. are fed the corresponding modules in t compact model by way of the potenti meters on the front panel.
For the preset option, provision must made to break the connection from t front panel controls, as required, a drive the modules from some fix (preset) voltage instead. As mention above, CMOS switches are the obvio solution. For the VCOs, four differe preset voltages can be selected as show in figure 3. The envelope wavefor from an ADSR module can be 'volta controlled' by passing it through a VC (figure 4), and selecting any desir waveshape from the VCO output only slightly more complicated, illustrated in figure 5.
As can be seen, eight voltage controll switches are needed to select t

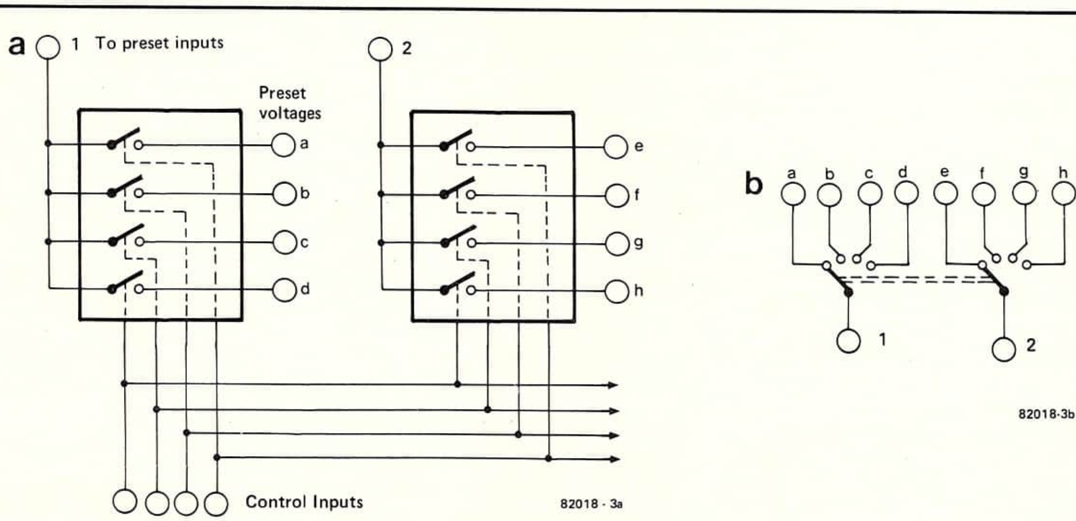


ȷure 1. A block diagram of the most straightforward version of the new synthesiser. Two VCOs, a VCF a VCA and two ADSR units are all that ıeeded for a 'bare-bones' system. With the addition of an LFO, which only produces a triangle signal, and a noise generator, a large number of ferent sounds can be achieved.



ure 2. The control inputs 1 . . . 4 on the various boards can either be linked to the wipers of potentiometers on the front panel or to external control voltage inputs.

waveforms (but if a 4066 is used, only 2 ICs are necessary). The principle is fairly straightforward. When the preset/ manual switch S2 in figure 5 is in position A, S1' in IC2 will be closed. The waveform can now be selected with S1. Since the analogue switches in IC3 are switched 'off' when the manual/ preset switch S2 is in position A, the data at the BCD inputs will have no effect on switches S2' . . . S4' in IC2. Resistors R6 . . . R10 make sure the switches are held fully 'off' when no voltage is applied to the control inputs. With S2 in position B, however, external data at the BCD inputs of IC3 will select the output waveshape.
As can be seen in figure 5, the octave 'range' switch and the fine tuning



ure 3. The circuit in figure 3a is little more than an electronic version of the rotary switch shown in figure 3b.

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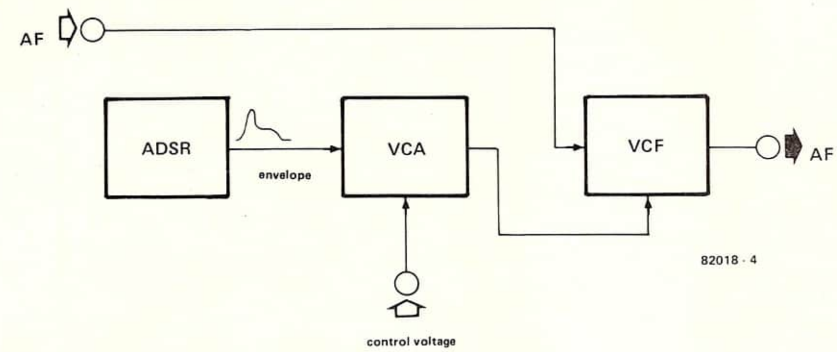

Figure 4. A VCA can be used to control the amplitude of the ADSR signal.

potentiometer are connected to th
VCO control input via IC4, in th
'manual' mode. When S2 is switched
'preset', the pre-programmed contr
voltage is selected instead.

Driving the preset inputs

Since the synthesiser is made up
individual modules it can be controlle
with the aid of external voltage
That's all very well, but how can this b
put into practice? As an exampl
let's assume that sixteen preset voltag
are required for any given settin
Corresponding digital information ca

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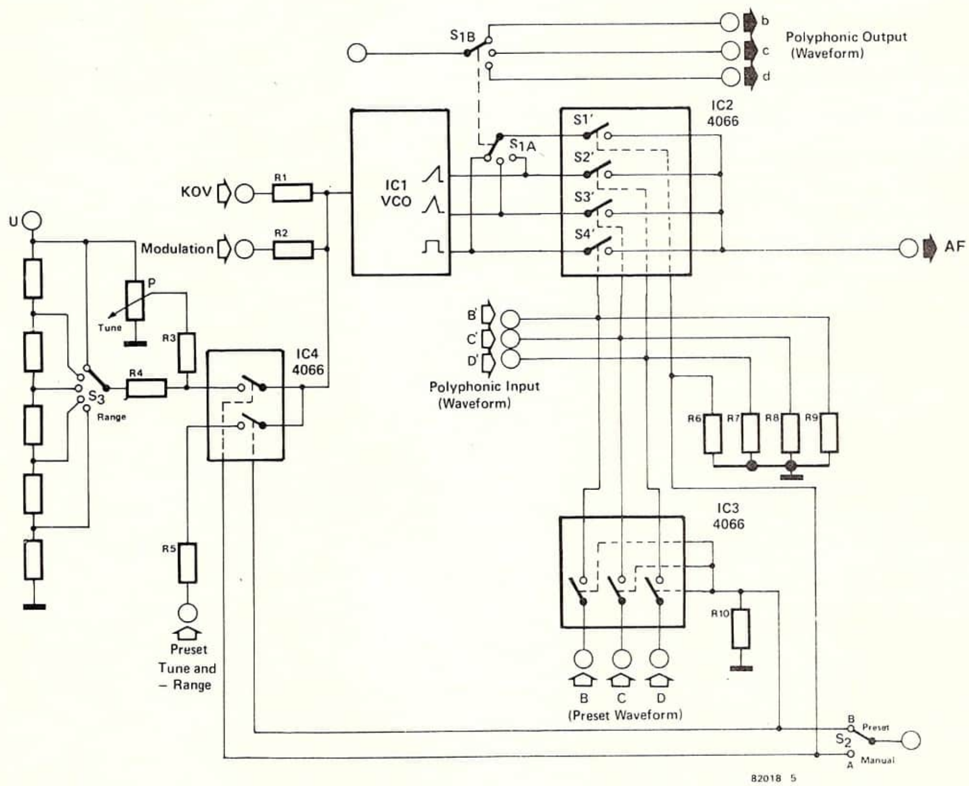

Figure 5. The complete VCO block diagram. The wiring of the CMOS switches gets rather complicated, since provision must be made for switching both the control voltage input and the output waveshape.

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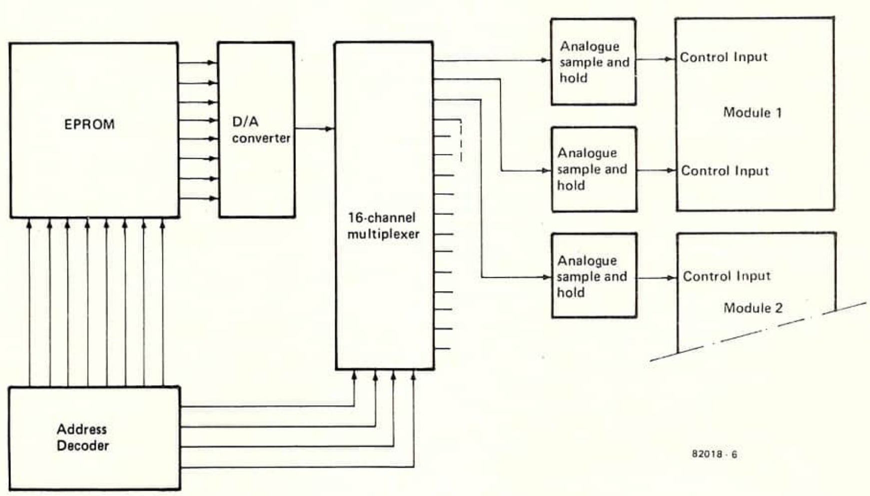
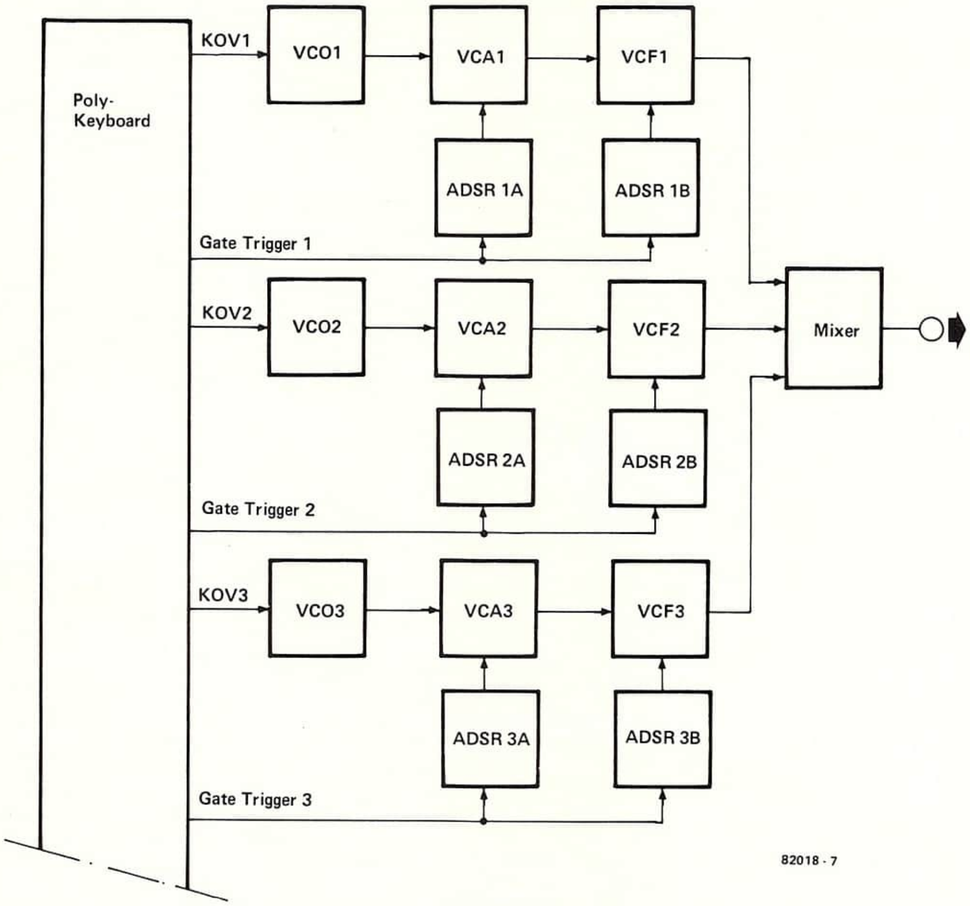


Figure 6. A simplified view of the preset circuit which can be included in an extended version of the synthesiser.



ıre 7. The block diagram of a polyphonic synthesiser. A polyphonic keyboard provides various control voltages (KOV) and gate pulses which ı control a complete unit (VCO, VCA, VCF and two envelope generators).

stored in EPROM, as shown in ıre 6. The locations for any given ;ing can be scanned in rapid suc- ;ion and passed through a D/A verter and 16-channel (analogue!) ltiplexer to sixteen sample-and-hold ts. These, in turn, drive the control ıts of the various modules.

e polyphonic version

the polyphonic version (figure 7) number of basic units required ıends on the number of keys that are ɔe played at the same time. Each key to be provided with a VCO, a VCF, 'CA and the corresponding envelope erators. All the parameters are ıtrolled centrally either by the knobs l switches on the front panel or by stored preset information. This ans that when the synthesiser is ıanded into a polyphonic instrument re is no need to modify the front ıel. This has the advantage that the r does not have to buy everything at ;e; instead, the monophonic unit can extended by adding other boards. It mportant however to have a poly- ɔnic keyboard with separate control tage outputs. ◄

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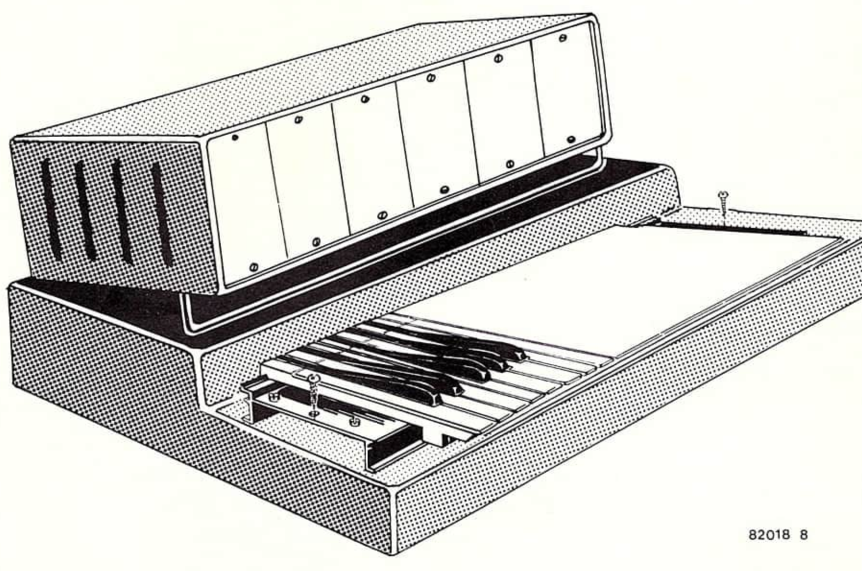

Figure 8. The compact synthesiser version can be housed in a small case and is truly portable. The expanded version will require a second case which is connected to the first by way of a multicore cable. For monophonic purposes the FORMANT keyboard can be used.