MODULAR SYNTHESISER

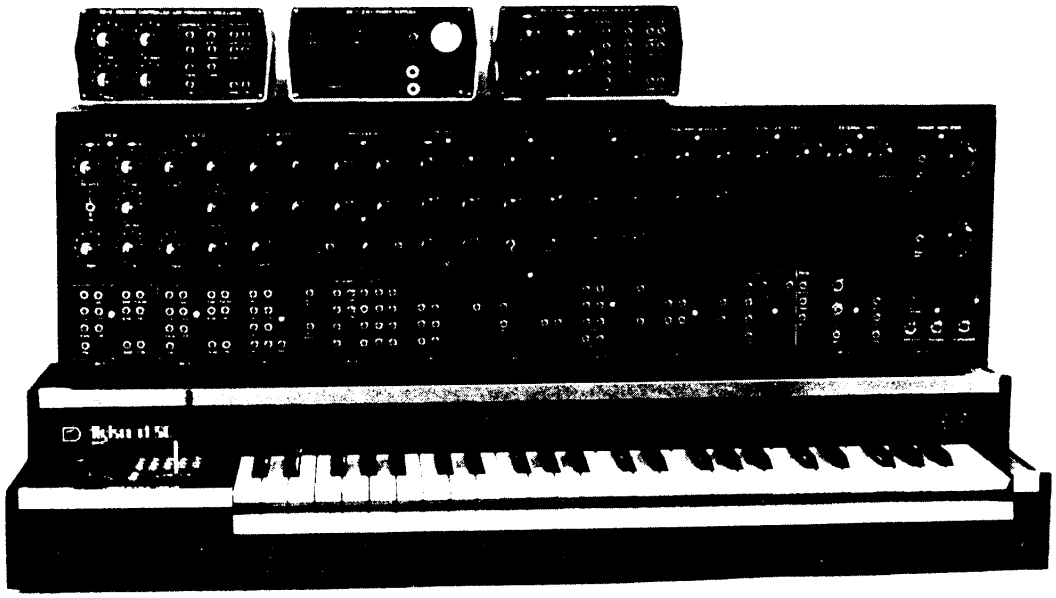
The synthesiser you've been waiting for. Presented as either a full spec., rack mounting, stage instrument or as a set of stand-alone modules, ETI's Project 80 gives you the options. Circuit designs by R. C. Blakey.

One of the fascinating, and sometimes irritating, aspects of electronics is its rate of technological growth. It is the recent development of customised integrated circuits for music applications which justifies another synthesiser project. The use of these devices greatly simplifies construction of stable, accurate and reliable modules, which will be of particular benefit to constructors. These new integrated circuits are equally useful to the musician since they allow greater control of many of the complex 'music-making' parameters.

Design Philosophy

The popular conception of a synthesiser is a musical instrument which can produce all manner of wondrous sounds. In fact a synthesiser is a multi-function machine having sound generators, modifiers and mixers which are electrically compatible with one another. It is the designer who connects the various modules together in a particular manner to produce an integrated musical instrument. He (she) has certain targets of portability, ease of playing and cost – and inevitably these result in compromises in terms of the capabilities of the instrument.

The basis of the current project is that for hobby application and greater exploration of musical expression there is no substitute for a truly modular system inter-connected by patchcords. Of course, patchboards or switches are alternatives to lots of drooping cords, but sooner or later the compromises begin as the cost, or the trouble, of adding more switches or boards arises. Furthermore a patchcord synthesiser is just as easy to play as a pre-set machine.



SPECIFICATION

General Specification
The design features of the modules follow the principles adopted by many of the major manufacturers of synthesisers. These are:-

1. Exponential voltage control. For the basic signal and treatment units (oscillators and filters) this will be the widely used one volt per octave relationship. For some modules the response level may be variable, as with the voltage controlled amplifier.

2. 10 V minimum control range providing a span of 10 octaves without switching.

3. 10 V peak to peak signals.

4. Signal and control inputs via a [illegible]ing op-amp stage. This allows multiple inputs. It is also a simple matter to alter the inputs to make the modules compatible with existing equipment.

5. Normally all inputs will have an input impedance of 100k or a minimum of 47k. This allows a single control signal to drive several modules without adverse loading effects.

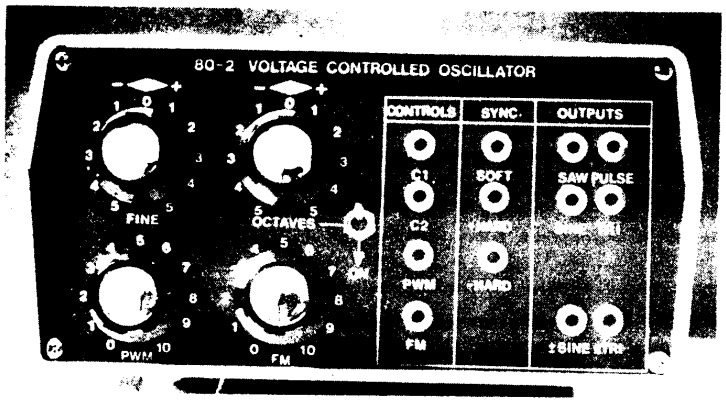
6. Output impedance will be 1k wherever practical, that is, without adding significantly to cost. These outputs may be mixed by shorting them together which results in an average of the mixed signals.

7. DC coupling, except for a few instances where it is essential to avoid errors which may arise from any DC drift and when the use of AC coupling does not result in loss of flexibility.

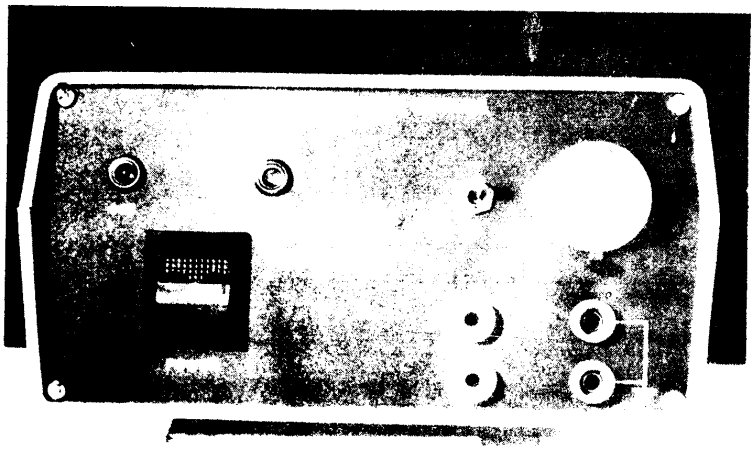
8. ±15 V supplies, common to all modules. Single PSU required.

9. All major features to have voltage control capability, for example, Q control of filters, pulse width modulation, envelope generation and so on.

An important feature of the above is that it allows *anything* to be plugged *anywhere* without fear of causing damage. Where modules are interfaced with external equipment then ¼inch jack sockets are used to avoid problems which may arise from incompatibility. Another aspect that should be noted is that because one signal can control several modules any attenuation of the signal should be made at the input to the modules.



Above and below: the VCO and PSU modules as they appear in their free standing cases. Note the vernier drive on the PSU. This is for calibration of oscillators etc. This case will be standard throughout the series.



Modules To Come

The modules to be described in this series are as follows:

1. Power Supply. ±15 V regulated and trimmed supplies, which, as described above are sufficient to [illegible] all modules.

2. Voltage Controlled Oscillator. Good exponential response over a range from 10 Hz to over 16 kHz. Triangle, sawtooth, pulse and sine outputs of 0 to 10 V amplitude and triangle and sine outputs of ±5 V amplitude. Manual and voltage control of pulse width duty cycle from 0 to 100%. Linear frequency modulation input. Three techniques for synchronising oscillators.

3. Voltage Controlled Low Frequency Oscillator. Same features as the VCO but with a frequency range of 0.2 Hz to 205 Hz with a 10 V control input. The frequency range extends to over 5 kHz with higher control voltage or by manual adjustment of initial frequency. The lower frequency limit is easily altered to suit individual requirements.

4. Processor. The flexibility of the input output structure described above has one main disadvantage, namely, that to take full advantage of it one should have several output jacks for each control source and an attenuating potentiometer on each control and signal input. This can be overcome by having [illegible]

(or panels) which only contain attenuating potentiometers and/or sets of commoned jack sockets for distribution purposes. Such panels are not powered and do not require further description. On the 'processor' module facilities have been incorporated for inverting two of the inputs and also for slowing down control signals by means of a lag circuit. The latter circuit may also be used as a control source by using a foot pedal.

5. Voltage Controlled Mixer. Four input mixer with manual and external voltage control of mix together with a single control for manual and external voltage control of pan.

6. Voltage Controlled Filters. A state variable filter with low pass, high pass, band pass and notch outputs will be described. Also a 24dB/octave low pass filter which is the most widely used type for music applications. Voltage control of Q provided.

7. Voltage Controlled Envelope Shaper. Voltage control over the attack, initial decay and final decay responses of the envelope generator provides opportunity for more realistic envelopes, for example, a change in envelope with pitch. A third generation IC will be used which has many other features allowing control over the formant of the sound.

8. Dual Voltage Controlled Amplifier. Exponential and linear control for increased flexibility and variable gain of both. Ability to partially bury the envelope so as to reduce the exponential final decay of the envelope which in imitative synthesis can be a problem. Provision for stopping the VCA so that when used in conjunction with other instruments it does not continue playing when the rest of the group has finished.

9. Dual Ring Modulator. Based on a single IC and having a wide dynamic range and high signal to noise ratio.

10. Noise Generator and Sample & Hold Module. White, pink and red (random) noise sources. The sample and hold unit allows creation of sounds from a variety of sources.

11. External Input. Pre-amplifier to increase external signals to a level compatible with the other synthesiser modules. Includes an envelope follower with a variable threshold level to generate trigger pulses.

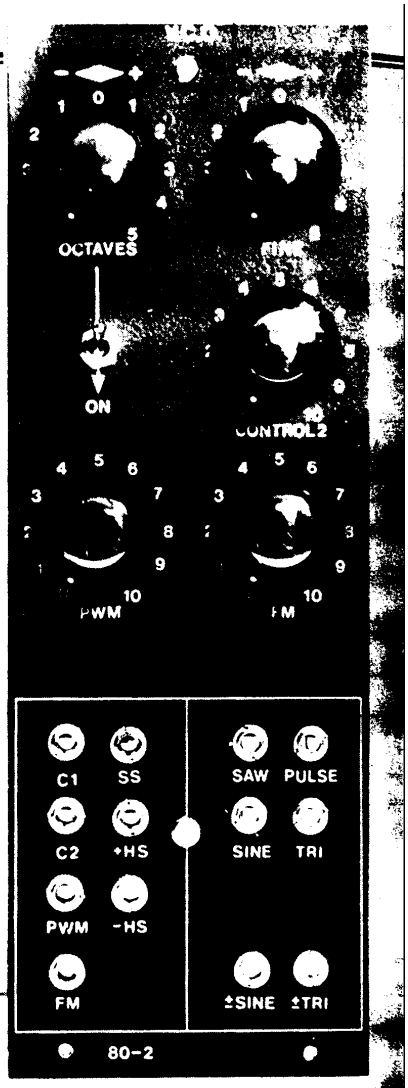
12. Power Amplifier. Two speaker channels and headphone output. It is not advisable to use the domestic Hi-Fi for synthesisers since the tweeters can be destroyed by continuous tones at an output above a few watts. A pair of good quality speakers is a worthwhile investment. A separate power supply is used for the power amplifier.

13. Keyboard Controller. Digitally scanned keyboard capable of controlling a five octave keyboard. Sample and hold with portamento. Precise octave shift over range of −2 to +3 octaves. Gate and trigger pulses. Pitch bend with variable bend level. Suitable for standard monophonic synthesiser and microprocessor compatible for polyphonic capability.

Construction

Each module is designed for both panel mounting or for housing within a standard low cost plastic case. The use of a case serves a number of purposes, one of these being a neat packaging of the modules for those who wish to construct them for other applications. The cased units are also appropriate for teaching and learning purposes, for example, the beginner should start by thoroughly exploring the functions and capabilities of each module. If electronic music is approached in this systematic way it becomes a relatively simple matter to create specific sounds at a later date. Furthermore one should not have any pre-conceived notions on the format of a synthesiser and a methodical study will enable the user to determine his approach to electronic music.

The panels are 228 x 76 mms. (9 x 3 inches). This size is widely used by commercial manufacturers of patchcord synthesisers. Such a panel will comfortably accommodate at least six control potentiometers or rotary switches with control knobs of an easily manipulated size. Standard quarter inch jack sockets are used on most of the professional equipment but their physical size limits the number of inputs and outputs per panel and it is back to compromises again. This project uses 3.5 mm jack sockets and up to twenty may be fitted onto the panel along with the six rotary controls. These miniature jack sockets should be of good quality. Screened patchcords are used to reduce the likelihood of crosstalk or noise. A major



advantage of panels is their ease of construction which also applies to the case to house the panels. 1.2 mm aluminium sheet provides adequate strength and a professional appearance can be obtained by spraying and the use of transfers for the markings. The cabinet can be constructed from a proprietary laminated blockboard assembled with 'Lok-Joint' fasteners. With this type of shelving a maximum of twelve modules per row is advised unless intermediate supports are used. 9.5 mm hardwood beading along the edges of the shelves allows the panels to be mounted using small woodscrews and if only a small pilot hole is made then the panels can be repeatedly removed without refilling the holes. The panel approach provides flexibility in lay-out and virtually unlimited scope for expansion.