adding the finishing touches to the NEW Elektor synthesiser

the COM module, the power supply and a few constructional hints

The final article on the basic version of the NEW Elektor synthesiser describes the control and output module (COM). This was originally designed for the Formant synthesiser and was fully described in the April 1978 edition of Elektor (page 4-33). It includes a preamplifier with bass, middle, treble and volume controls.
The power supply for the synthesiser is very simple and consists of virtually only two voltage regulator ICs.

The printed circuit board for the Formant COM module, published in April 1978, can be used here with no modifications, although not all the copper tracks need be used. The circuit includes bass, middle and treble controls, a sub-sonic high pass filter, a preset gain facility and a master volume control. The complete circuit diagram of the COM module is shown in figure 1 and the wiring connections for the printed circuit board are given in figure 2. Only four pins of the connector are actually required in this instance. These are: ground; the positive 15 V supply rail; the negative 15 V supply rail; and a signal input, which is connected to the output of a VCA. The tandem potentiometer P1a/P1b prevents the remainder of the circuit from being overmodulated and at the same time ensures that the desired signal is not 'drowned' by noise from the circuitry shown between P1a and P1b.
Depending on the settings of the various synthesiser controls, a brief low frequency signal produced when a key is depressed could cause damage to the loudspeakers. Such detrimental tones are suppressed by means of the low pass filter connected in front of the tone control network. The filter has a cut-off frequency of about 20 Hz and is similar to the rumble filters found in stereo equipment.
The level of treble and bass is adjusted by means of a 'Baxandall' network constructed around opamp A2. The output of the Baxandall stage is fed via a buffer amplifier to a separate 'pre-emphasis' circuit constructed around opamp A3. This section of the circuit controls the 'middle' frequencies.
The gain of the output stage, A4, can be adjusted by means of preset potentiometer P5 between a factor of 1.8 and 11 times depending on the input sensitivity of the power amplifier connected to the COM module. The output signal from A4 is fed to a jack (or DIN-)socket situated on the front panel of the module.
For completeness' sake, the 'old' p.c. board is repeated at the end of this article (figure 10).

How to incorporate the COM module

The bus boards mentioned in the previous articles on the NEW Elektor synthesiser have to be slightly modified in order to accommodate the COM module. As can be seen from figure 3, the pins of the 21-way connector soldered to the COM printed circuit board will not fit into the holes of the corresponding socket, if the latter is mounted on a bus board that has been inserted in the slide-in unit using the 'standard' method. The pins are positioned exactly half-way between the holes. The solution is to turn the bus board 180° before insertion and to remove the first and last pins of the connector with a pair of suitable cutting pliers.

The power supply

The NEW Elektor synthesiser requires a power supply capable of producing + and −15 V and which will maintain a load of 200 mA per rail. Furthermore, the polyphonic extension to be described later requires a +5 V supply. A suitable circuit is given in figure 5 (and a p.c. board layout in figure 11!). Obviously, the components for the +5 V supply need not be mounted yet (IC3 with its heatsink, C7 and C8).
Although it is not strictly necessary, it is a wise precaution to mount the voltage regulators (IC1, IC2 and IC3) on small heatsinks. After all, it is better to be safe than sorry!

How to connect the power supply

For safety reasons, it is not recommended to mount the power supply transformer directly on the printed circuit board. Having a copper track bear the brunt of 240 volts is rather risky to say the least. The transformer should be mounted on a piece of aluminium, about the size of a eurocard, which will also act as a 'screen' from the rest of the circuit – provided the aluminium is grounded.
The power supply and transformer can be wired directly to the connector. A robust, mechanical connection can best be made using long screws and spacers, as indicated in figure 6.

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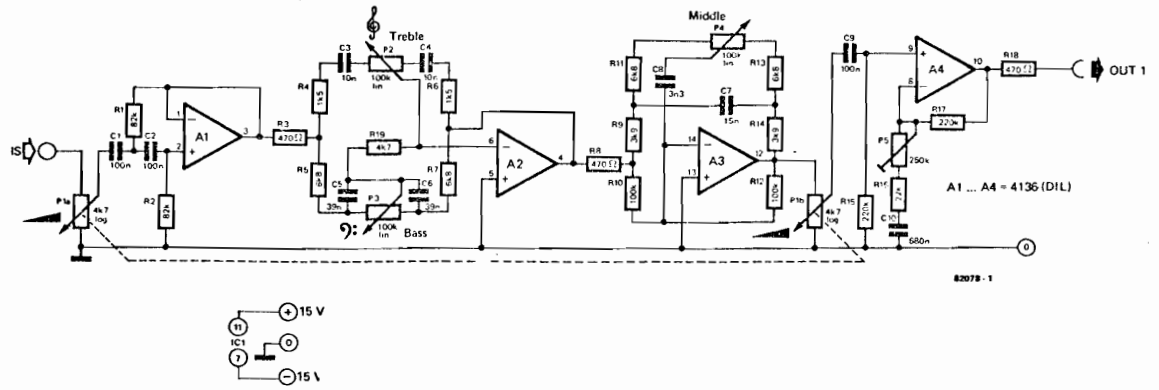

Figure 1. The circuit diagram of the control and output module (COM) is identical to that used in the Formant design.

Two LEDs on the front panel (connected to the + and −15 V supplies) allow the user to ascertain at a glance whether the power supply unit is working correctly.

Constructional hints

Figure 7 shows all the basic connections for the various synthesiser modules. The boards are linked to the power supply via three supply voltage rails. The signal paths are indicated as thick, black lines.

The output signals from the two VCOs and the LFO are first fed to the mixer input of the VCF, then to the VCA and finally to the COM unit. The gate pulse from the Formant keyboard also controls the vibrato section of the LFO/NOISE module, but not the two envelope generators.

The LFO signal can be used to frequency modulate the VCOs, the VCF or all the modules simultaneously. The ADSR outputs are linked to the control inputs of the VCF and VCA. The KOV inputs of the two VCOs are linked to each other and also to the KOV output of the Formant keyboard (see the article on the VCO published in the December 1981 issue of Elektor, page 12-39).

The various modules can all be accommodated in a 'card frame'. Suitable

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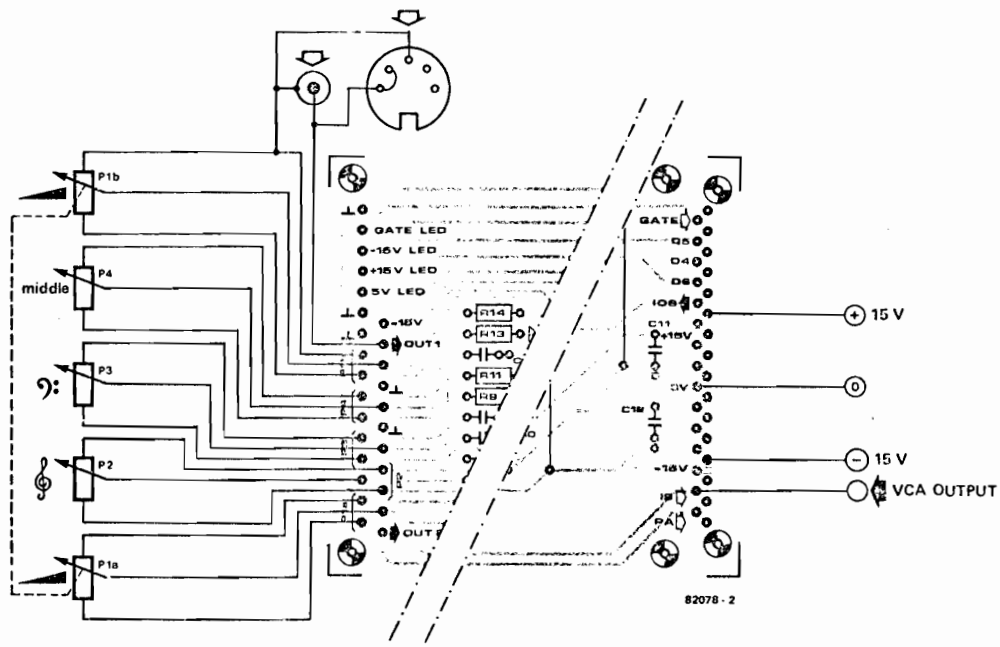

Figure 2. The wiring details of the COM unit.

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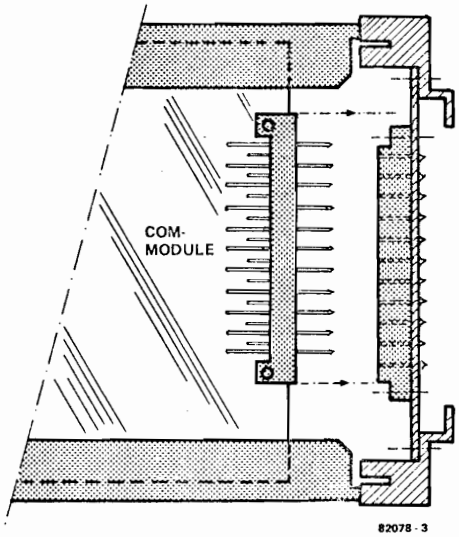

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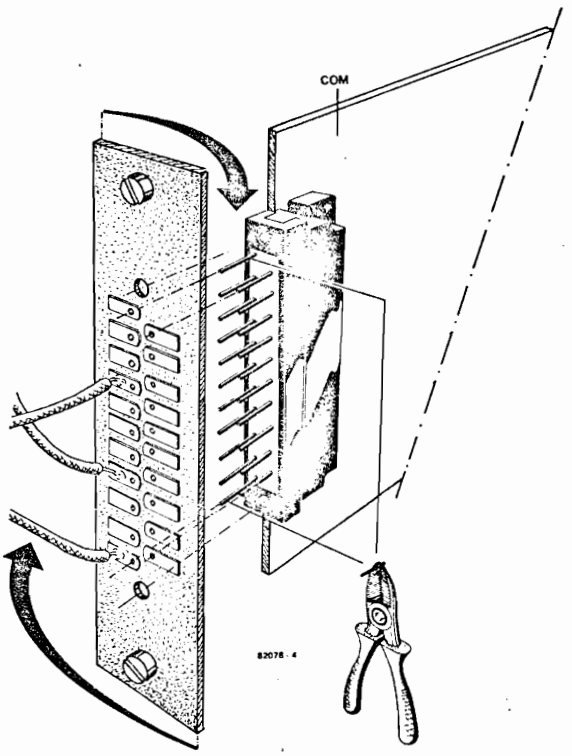

Figures 3. and 4. The connector on the COM board does not line up with that on the bus board. For this reason the bus board must be turned 180° degrees before being installed.

systems can be obtained from most components retailers. For the sake of clarity, the connections between the printed circuit boards and the front panels have been omitted from the drawing in figure 7, only the links between the individual boards are shown.
Figure 8 shows the rear view of a slide-in case with its seven bus boards. Provided the boards are wired from right to left, and each module is checked separately, very little can go wrong. The connecting leads do not have to be insulated. The socket for the keyboard connection can be mounted on a small piece of aluminium the size of a bus board. This can be inserted between the power supply and the bus board of the first VCO.
A suggested layout for the front panels is shown in figure 9 and it also gives an idea of the required measurements. When inserting the modules into a standard case, make sure that the total front panel width corresponds to the sum of the values indicated on the drawing. To be certain that all the potentiometers fit on the various front panels, miniature types with a spindle diameter of 4 mm should be used. Of course, many readers will wish to design their own cases and front panels, in

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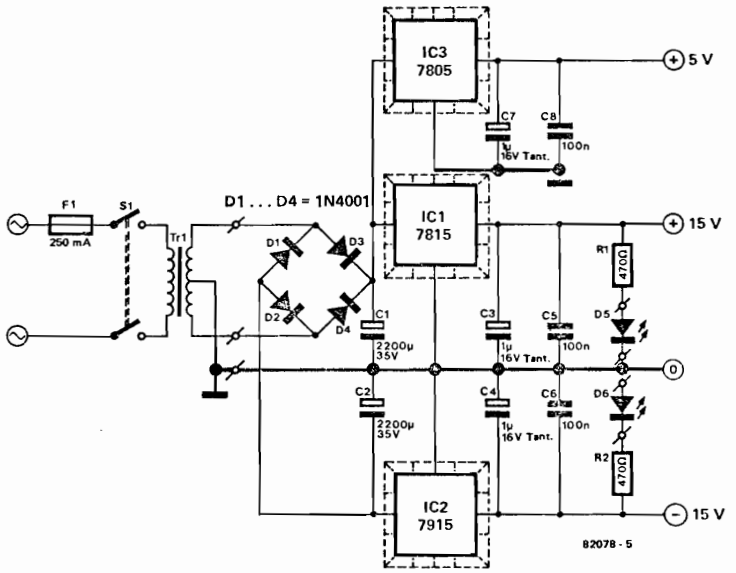

Figure 5. The circuit diagram of a suitable power supply for the Elektor synthesiser.

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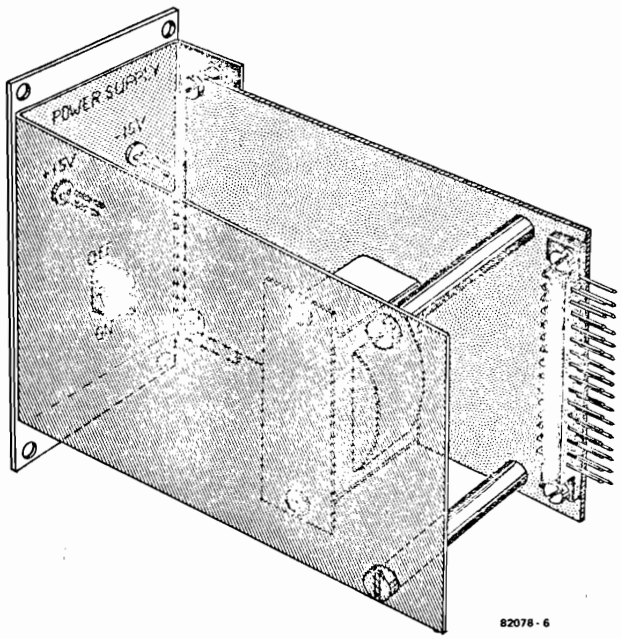

Figure 6. For safety reasons, the transformer is best mounted on a separate piece of aluminium.

which case we would be interested to hear about the results.

As far as legends on the front panels are concerned, the (pre-drilled) front panels can be marked with rub-on lettering (available from stationers and electronics retailers). The panels can then be covered with a thin layer of transparent adhesive foil and the various holes cut out with a sharp knife. The foil should be slightly larger than the front panel in question, so that it can be wrapped around it and will not peel off easily.

Alternatively, the panels can be sprayed with a suitable laquer after the legends have been applied. With a little time and patience, the panels can be made to look very professional.

Principal settings for the synthesiser

Now that the NEW Elektor synthesiser has been completed, it is time to try out a few sounds. Admittedly, the choice of modules is rather limited compared to the Formant, but then the whole point of the new system was to make it easier to produce synthesiser music on stage, which meant reducing the vast array of knobs and buttons used in the Formant

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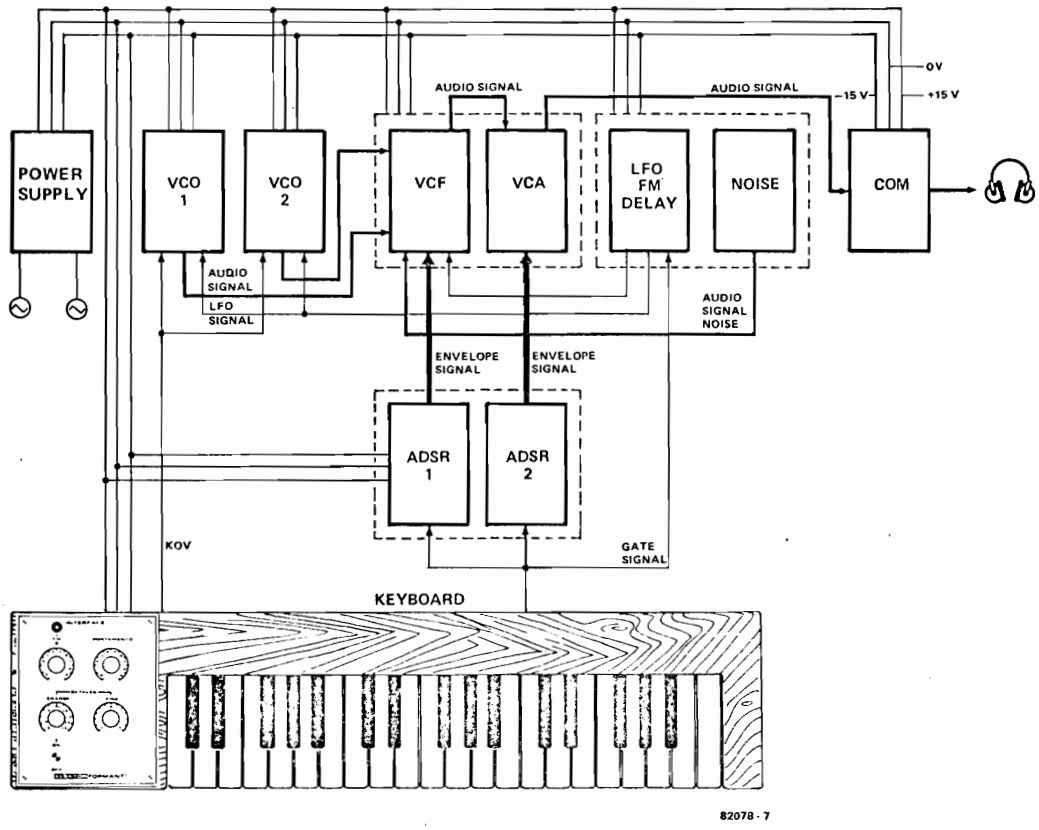

Figure 7. How the various modules of the synthesiser are interconnected.

system to an absolute minimum. The remaining 28 controls still offer plenty of musical possibilities. The following settings can be combined as desired:

1. with or without glissando
2. one or two VCOs
3. in the case of two VCOs:
   a. both with the same frequency
   b. with an octave between them
   c. with a fifth, a fourth or a third between them
4. filter with envelope control
   a. percussive sounds: attack/decay curves, attack time = 0
   b. wah-wah and brass instruments: attack time not equal to 0, ADSR curve
5. filter without envelope control
6. tracking filter
7. VCA envelope: this must be tuned to the VCF envelope. A short VCF attack and decay time will not go into effect, for instance, if the VCA attack time is long. The VCA plays an important role, whenever the filter is not modulated by way of the envelope generator and the cut-off frequency is somewhere in the audio range (see point 5).
8. additional mixing of LFO and noise

A few examples:
(The names given below to the various sound effects are purely fictional and do not claim to be official terms.)

1. Spherical sound: two sawtooth signals of the same frequency/glissando.
Filter envelope set on zero/Q value on zero.
Adjust the filter cut-off frequency to allow the entire frequency spectrum to pass/
VCA: attack: zero
sustain: maximum
release: 1.2 seconds
2. By using two symmetrical VCO squarewave signals while keeping the other modules in the same setting, an effect similar to that in 'Lucky Man' by Emerson, Lake and Palmer is created.
3. Disco sound: VCO setting as in 1/no glissando. Set the filter cut-off frequency to zero and the envelope amplitude to maximum. Adjust the Q factor to zero.
Filter envelope: attack = 0, sustain = 0.
Using different decay times, a great variety of percussive effects can be produced, some of which sound like the staccato accompaniment often used in disco numbers. The effect is enhanced by separating the two VCO frequencies by a fifth. Remember that melodies with parallel intervals do not always combine well with accompaniment chords played on a different instrument.
4. 'Sound the trumpet':
VCOs: sawtooth or squarewave, same frequency or a third, fifth or octave interval between them.
Filter settings as in point 3.
Filter envelope: attack time not equal to zero, sustain equal to 100%, release very brief, but not zero.
5. Woodwind instruments:

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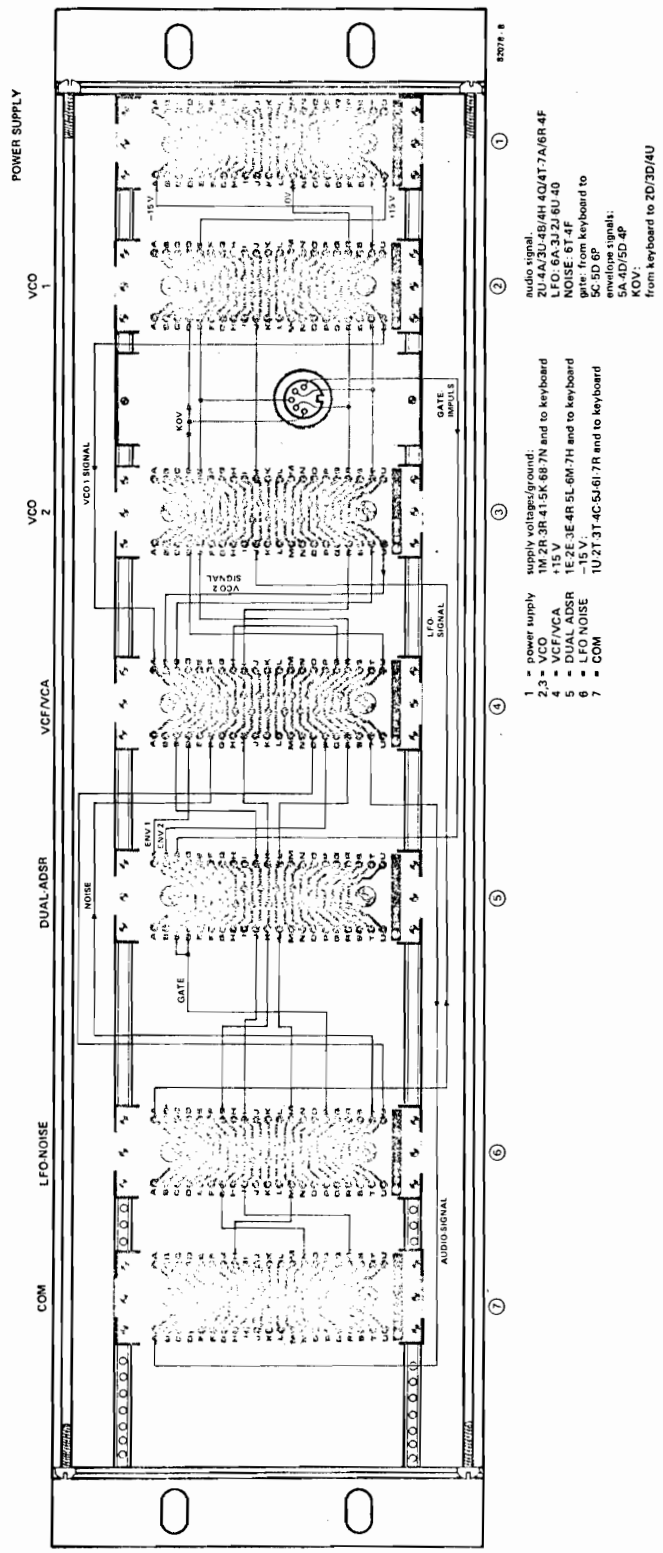

Figure 8. Rear view of the completed synthesiser.

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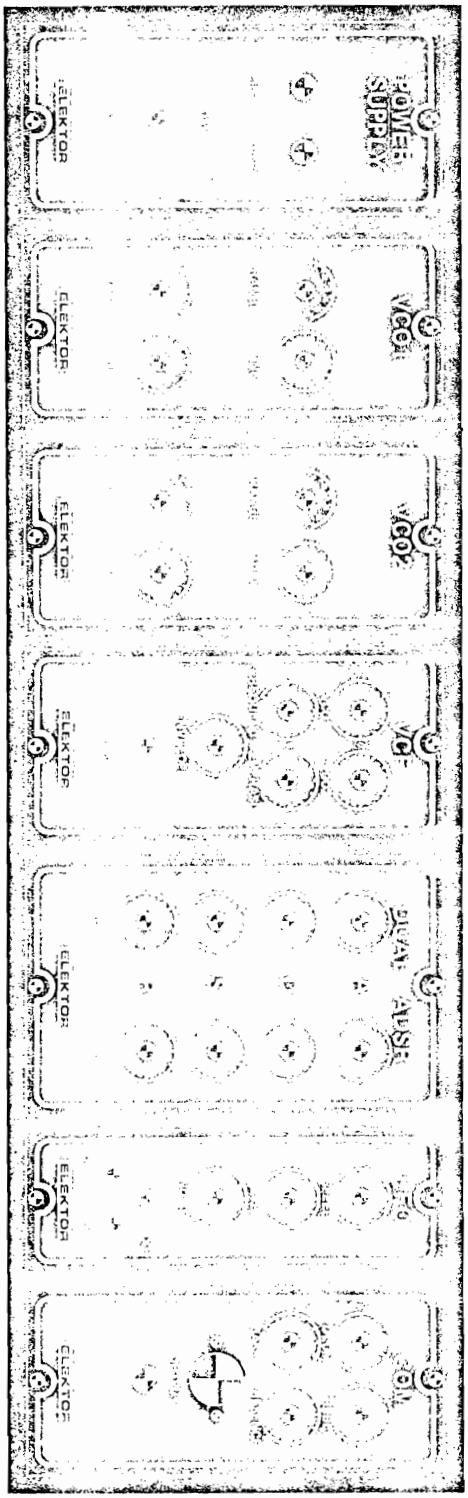


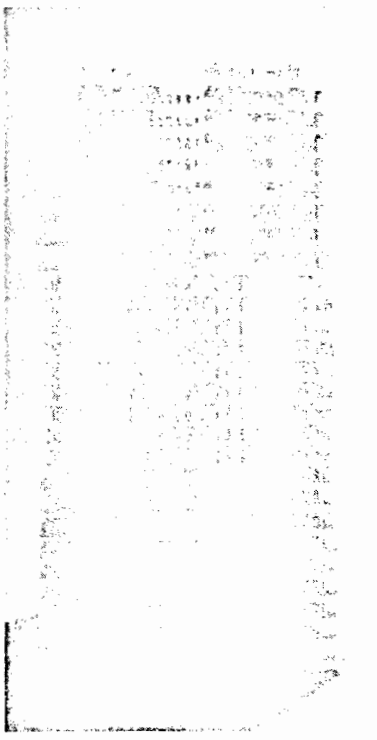
Figure 9. A suggested front panel layout for the various modules.

A single VCO with a squarewave signal.
Filter envelope: see point 4.
Filter envelope amplitude: low.
Try out different cut-off frequencies!

6. Sinewave sound:
VCO with triangle signal.
Switch on tracking filter operation and set the cut-off frequency to match the VCO frequency.
Filter envelope = 0
VCA: see point 1.

We will not go into all the possible sound effects that the synthesiser is capable of producing, as this would fill several issues! In any case, it is much more fun to experiment and find out for oneself. After a certain amount of practice readers should be able to discover all sorts of novel and interesting combinations and settings. This obviously involves a little more than aimlessly twiddling the knobs. The tones obtained using this method are likely to be cacophonic, if anything. Thus, a systematic approach and fine tuning are an absolute must when operating the synthesiser.

This completes the series on the basic version of the NEW Elektor synthesiser. The forthcoming sequel will describe how to construct a polyphonic keyboard and how to connect it to the existing modules.



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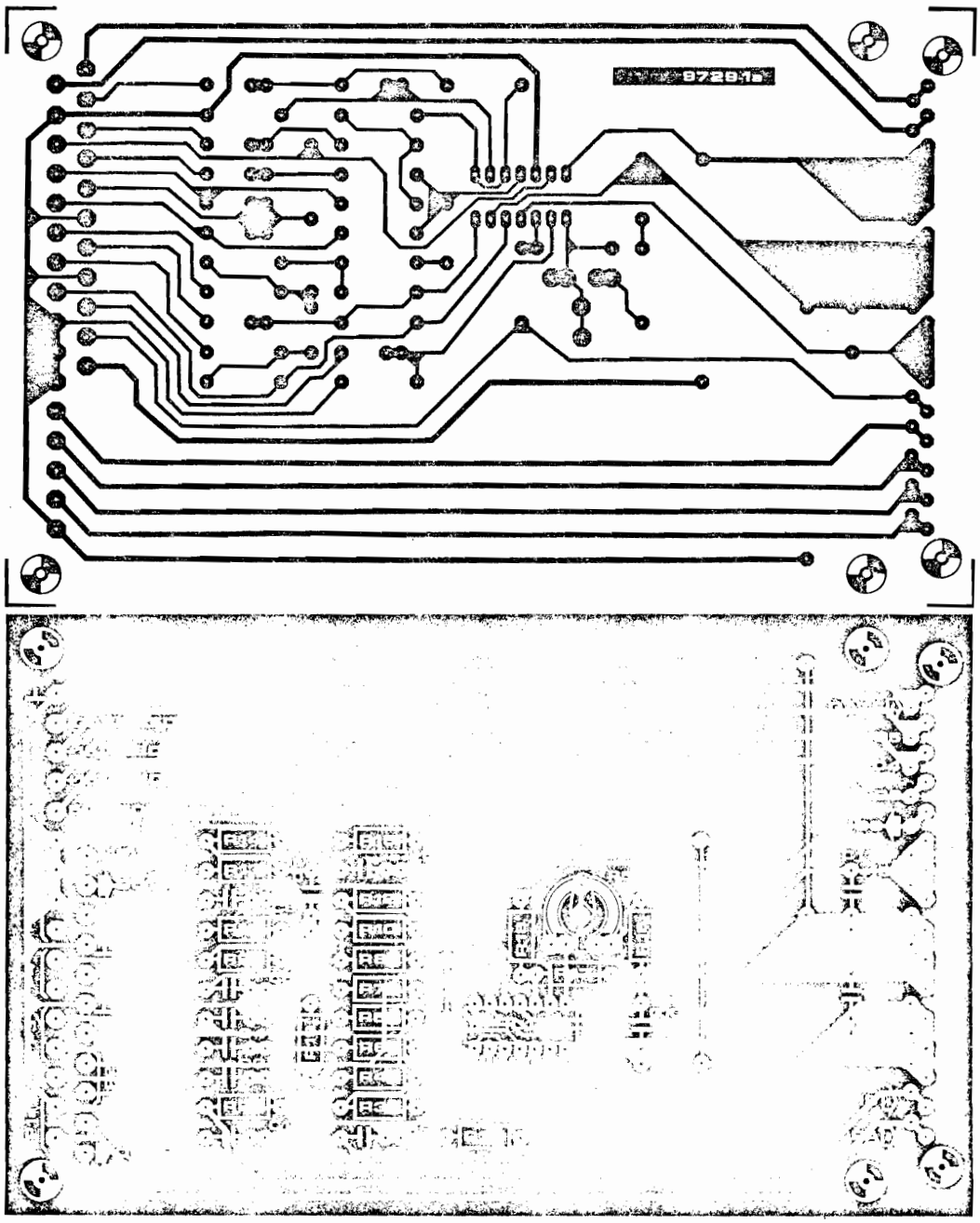

Figure 10. Copper track pattern and component overlay of the COM module.

Parts list for the COM module

Resistors:
R1,R2 = 82 k
R3,R8,R18 = 470 Ω
R4,R6 = 1k5
R5,R7,R11,R13 = 6k8
R9,R14 = 3k9
R10,R12 = 100 k
R15,R17 = 220 k
R16 = 22 k
R19 = 4k7

potentiometers:
P1a,P1b = 4k7 log. ganged pot.
P2,P3,P4 = 100 k lin.
P5 = 220 . . . 270 k preset

Capacitors:
C1,C2,C9 = 100 n
C3,C4 = 10 n
C5,C6 = 39 n
C7 = 15 n
C8 = 3n3
C10,C11,C12 = 680 n

Semiconductors:
IC1 = 4136 (DIL package) EXAR, Fairchild, Raytheon or Texas

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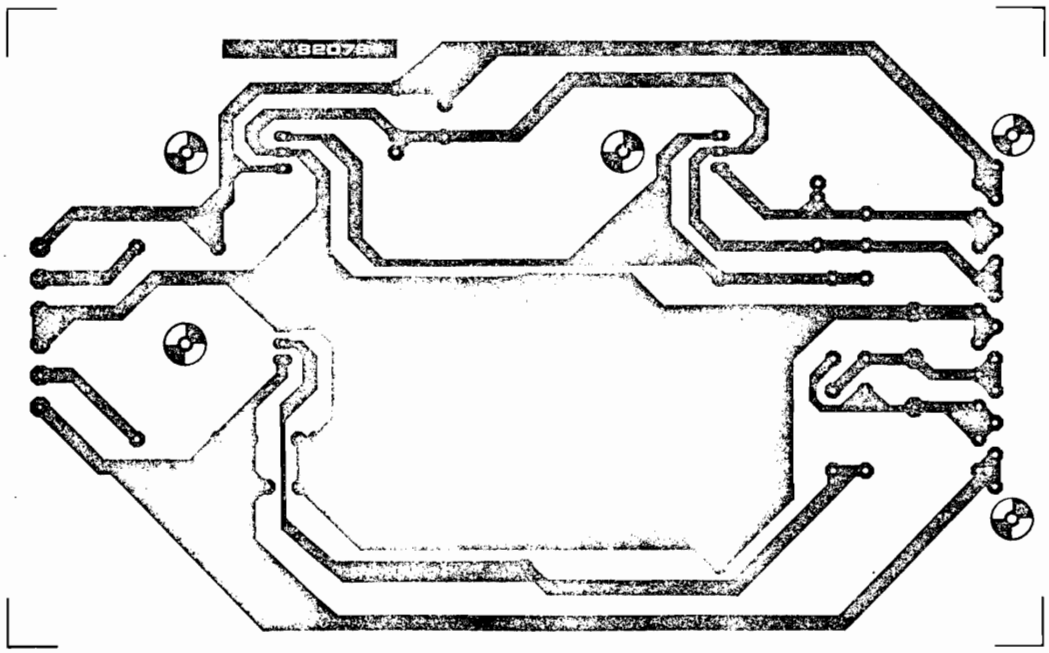

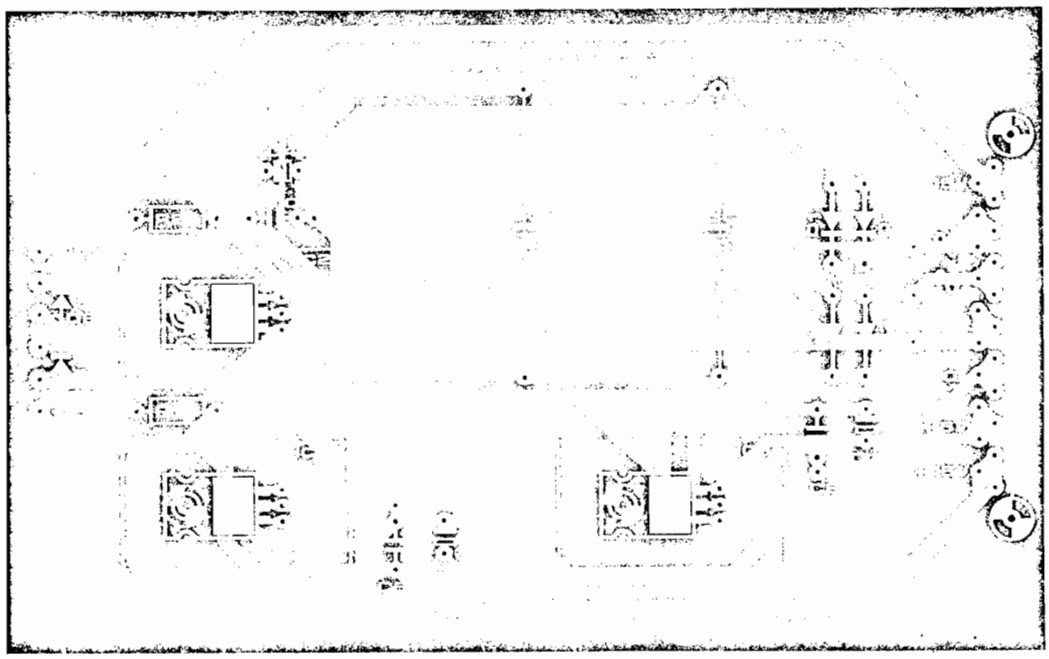

Figure 11. Copper track pattern and component overlay of the power supply.

Parts list for the power supply

Resistors:
R1,R2 = 470 Ω

Capacitors:
C1,C2 = 2200 µ/35 V
C3,C4,C7* = 1 µ/16 V tantalum
C5,C6,C8* = 100 n

Semiconductors:
IC1 = 7815
IC2 = 7915
IC3 = 7805
D1 . . . D4 = 1N4001
D5,D6 = LED

Miscellaneous:
Tr = 2 x 18 V/500 mA (centre tap) transformer
S1 = dp toggle switch
F1 = 250 mA slow fuse
21-pin connector
heat sinks for IC1 . . . IC3

* not required for monophonic version without preset facility