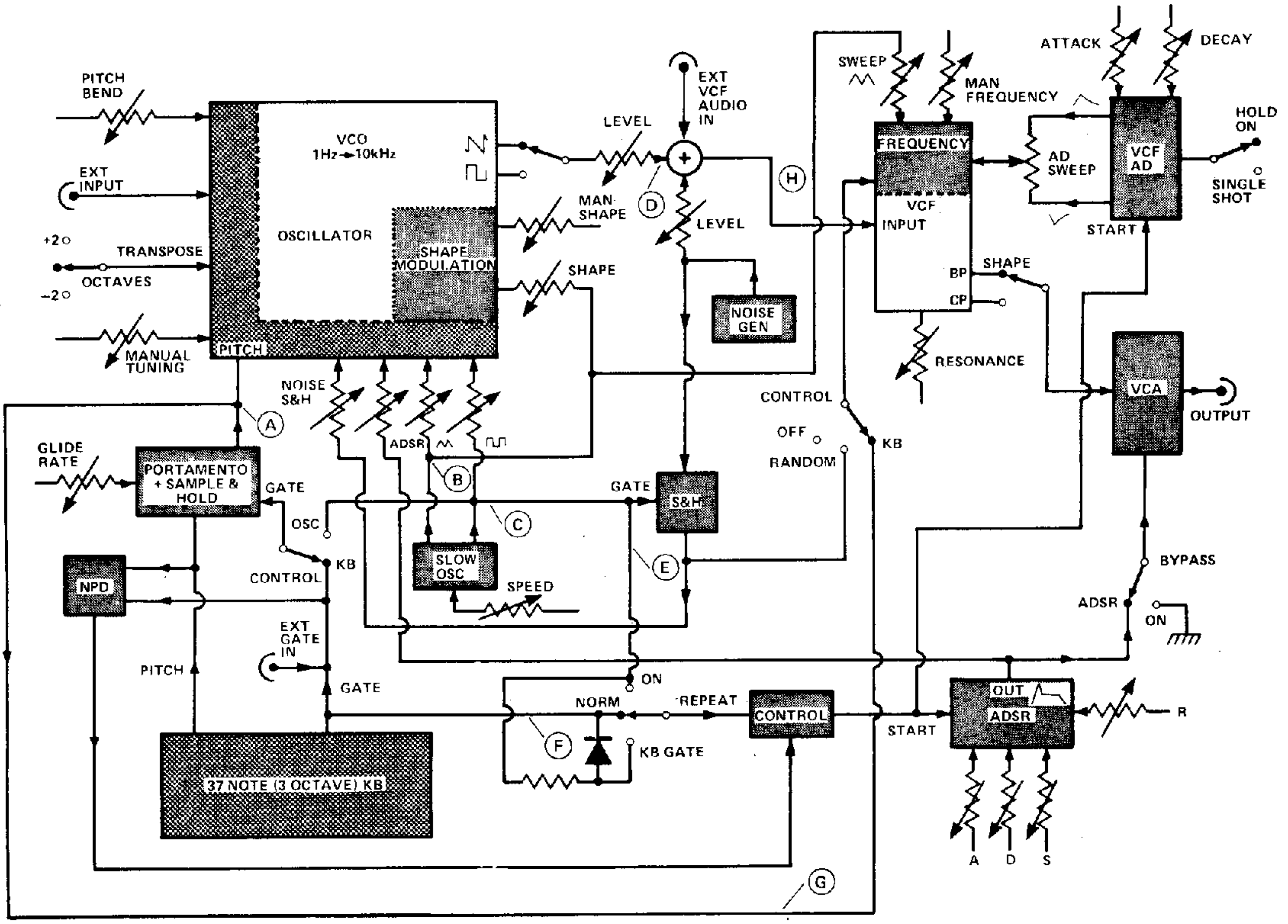


Fig 1. Block diagram for the Transcendent 2000 synthesiser. Each of the separate circuit blocks is described in detail in the appropriate section. The letters in circles correspond to the points where we broke up the circuit to make it easier to understand. These references are also given on each of the block circuits where appropriate. So if you wish to stick the whole thing together you can do so. All the components which make up this block diagram are assembled on a single PCB.

PSU

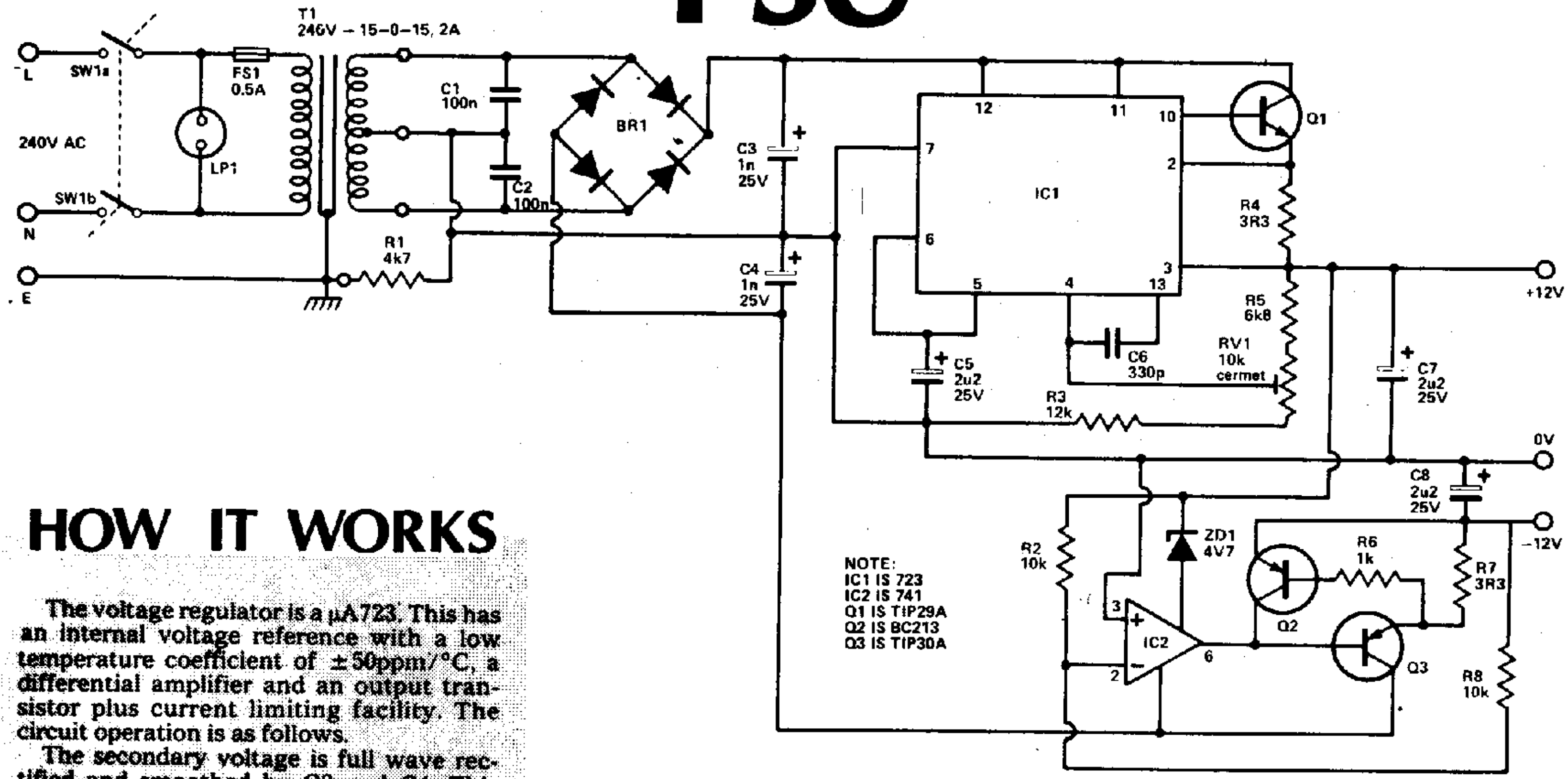


Fig. 2. The circuit diagram for the synthesiser PSU. This is capable of supplying a higher current than is really needed here, in order that it is not 'stretched'. A stable supply is essential in a synthesiser design with any pretensions to quality at all.

The components for this are made up onto their own PCB, and will not appear on the main overlay.

HOW IT WORKS

The voltage regulator is a μA723. This has an internal voltage reference with a low temperature coefficient of ±50ppm/°C, a differential amplifier and an output transistor plus current limiting facility. The circuit operation is as follows.

The secondary voltage is full wave rectified and smoothed by C3 and C4. This provides positive and negative unregulated rails.

IC1 is the voltage regulator. A reference voltage of about +7V5 is fed into the noninverting terminal, pin 5.

An external power transistor Q1 is used to regulate the positive supply rail so that IC1 remains cool. Short circuit current limiting at 200 mA is provided by R4. Either or both output rails may be shorted out without damage.

Negative feedback to the inverting terminal pin 4, IC1 sets the output voltage. C5 reduces noise on the supply, C7 reduces the impedence at high frequencies. RV1 sets the output voltage and this should be set to +12V000! (or as near as you can measure) VR1 is a cermet preset, which has a low temperature coefficient.

The negative rail tracks the positive rail. The power is handled by Q3, the current limiting by Q2 and the feedback by IC2. Resistors R2, 8 determine the negative rail voltage. As they are both 10k, 0.5% tolerance, the negative rail should be the same magnitude as the positive rail to within 0.5%.

A very stable power supply is needed for a synthesiser. A small power supply voltage variance can produce alarming effects on the oscillator pitch. Also, if the machine gets hot inside, the oscillator will drift in pitch. The current drain per rail is only 80 mA and the heat dissipated by Q1 and Q2 is 0.9 watt each. This will not cause any heating problems.

On load the unregulated rail is 23 V (at 250 VAC input), and so the mains can drop to about 190 VAC before PSU drop out occurs. The unregulated ripple is 500mVpp and so the output will be less than 0.5mVpp.

When there is no load on the power supply, a small high frequency sawtooth can be seen on the —12 V output, but this goes away completely when loaded.

VCO

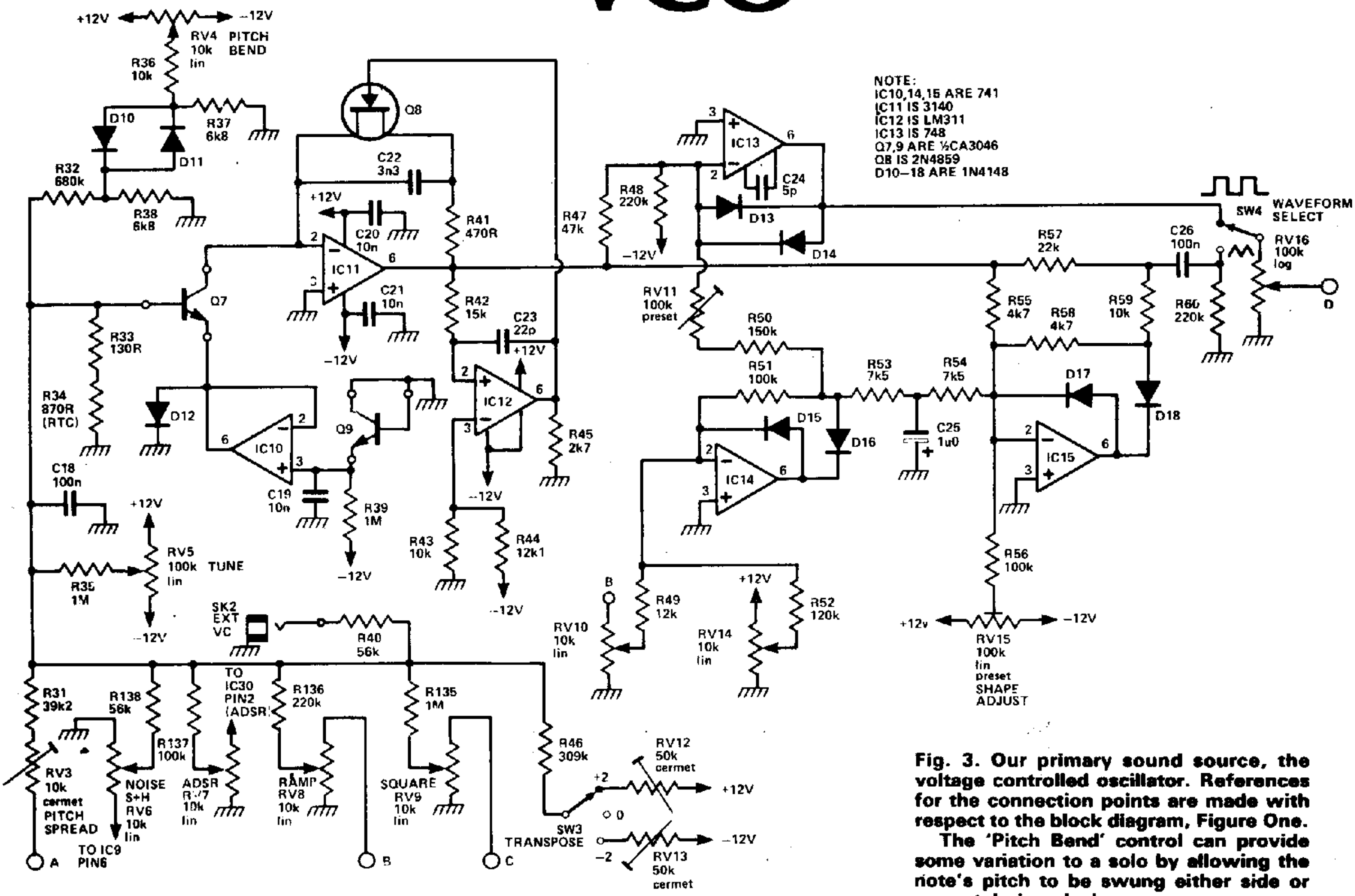


Fig. 3. Our primary sound source, the voltage controlled oscillator. References for the connection points are made with respect to the block diagram, Figure One. The 'Pitch Bend' control can provide some variation to a solo by allowing the note's pitch to be swung either side or correct during playing.

HOW IT WORKS

The VCO is a logarithmic relaxation oscillator generating a ramp waveform. This waveform is then modified to give a square wave or a triangle wave output. The oscillator section is IC10, Q9, IC11, IC12 and Q8.

The voltage coming out of IC11 pin 6 is fed into IC12. This is an LM311, a fast voltage comparator. A voltage of +5V43 is set up on its inverting input, (pin 3) and the ramp from IC11 is fed into its non-inverting input, (pin 2). When the ramp voltage exceeds +5V43, the comparator's output, (which was at —12 V) leaps up to 0 V.

This voltage turns on the FET switch Q8 which shorts out C22 and discharges it to almost 0 V. Q8 has a very low ON resistance and hence the discharge time is relatively short, about 800 nS.

However, once the discharging has started, you would expect the comparator output to drop back to —12 V. Well it would do if it wasn't for the monostable built around it, (C23, R42). This monostable makes Q8 turn on for a fixed period of time, sufficient for the discharge process to be completed.

Note that the power supply to IC11 is locally decoupled to help protect the VCO from pitch jitter caused by fluctuating power supplies. The reset period causes the VCO to go flat at high frequencies.

As the frequency of the VCO increases then so does the C22 charging current. But this current has to flow through R41. This makes the voltage of the ramp, (IC11 pin 6) increase in size as the ramp speed is increased. This in turn means that the ramp is reset prematurely and so the pitch of the VCO will tend to go sharp at high frequencies.

If we get the size of this tendency to sharpness correct, then it can be used to cancel out the reset tendency to flatness. The overall effect will be to maintain the tuning of the keyboard up to a frequency which it could not do without R41.

The current that drives the VCO is sunk by the transistor Q7. This is used to produce the logarithmic law necessary to convert the linear voltage intervals from the keyboard into musical intervals which are logarithmically spaced. A V_{be} increase of about 18 mV will cause the collector current to double, (the VCO goes up an octave), so therefore the voltage per semitone is about IV5. This is a very small voltage indeed.

IC10 is a voltage follower and merely buffers the bias voltage to the emitter of Q7. Should IC10 go berserk, during the power up say, it might try to reverse bias the emitter of Q7 and cause it to zener. This process would corrupt the logarithmic characteristic of the transistor and so destroy its ability to produce musical intervals. D12 prevents this zenering. Q7 has to be run at relatively low currents for two reasons.

Firstly, the log law goes flat at high currents, (1 mA). This is due to the effect of the intrinsic emitter bulk resistor in the transistor. The effective voltage drop across this bulk resistor is subtracted from the V_{be} voltage and so the net effect is less collector current than was expected. Therefore to get a good musical performance, the collector current must be kept as low as possible.

Secondly, large currents will cause self-heating, which will make the VCO pitch drift, although in this circuit the collector voltage is a virtual earth and so the power dissipation is relatively small anyway.

Even though the second transistor compensates for the temperature change V_{be} problems there is another temperature effect to be dealt with. The pitch spread, that is the number of millivolts per octave, is temperature dependent. To compensate for this effect, the resistor pair R33, 34 must have a temperature coefficient, (TC) of +3400ppm/°C. There is no element with this coefficient, although an alloy could be concocted to produce it.

However, it just so happens that copper has a TC of +3900ppm/°C. Therefore a 870R copper wire wound resistor in series with a 130R metal oxide resistor looks like a 1k resistor with a +3400ppm/°C TC. There is an American company, (Tel Labs) that makes a Q81 resistor, 1k 1% made just for the job and this could be used instead of R33, 34, that is if you can obtain them.

This resistor with the special TC is mounted close to the transistor pair so as to be at the same temperature. Some manufacturers actually glue the resistor to the transistor for best thermal contact.

ADSR & VCF AD

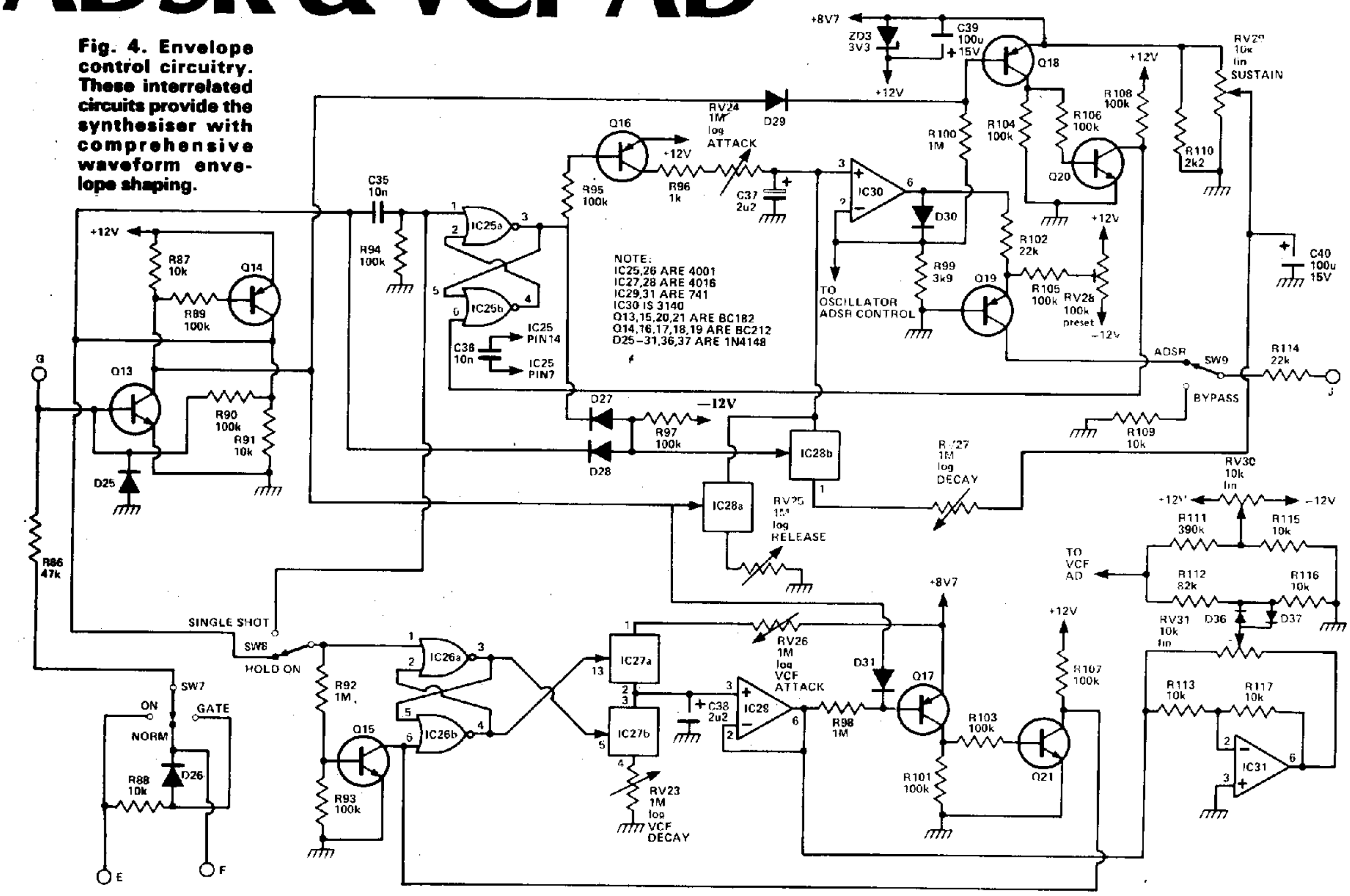


Fig. 4. Envelope control circuitry. These interrelated circuits provide the synthesiser with comprehensive waveform envelope shaping.

HOW IT WORKS

AD generator:

The AD waveform is made up out of two simple CR charge and discharge curves, Q15, Q17, Q21, and IC26, 27, 29, 31 form the generator circuit. The AD is started by the arrival of a positive voltage at IC26 pin 1. This is a SET, RESET flip flop made out of two 2 input NOR gates. A high at pin 1 sets pin 3 low and pin 4 high. These two outputs drive two analogue transmission gates, IC27. A high at the control input (13 and 5) will open the gate, a low will close it. Only one gate is ON at any one time. The event sequence is as follows: IC26 pin 1 goes high, IC26 pin 4 goes high, IC26 pin 3 goes low. C38 is charged up via IC27 pin 1, 2, 13 and RV26 towards a positive (+8V7) reference voltage. RV26 determines the charging up time (ATTACK).

The voltage on C38 is buffered by IC29, a voltage follower. Assuming that the AD generator is in its HOLD ON mode then the capacitor C38 will be charged up towards +8V7 until the gate input is removed.

When this happens the flip flop will change state and the capacitor C38 will be discharged towards 0 V via the other analogue gate and RV23.

The setting of RV23 will determine the discharge time (DECAY). The purpose of Q15 is to generate the HOLD ON by disabling the SINGLE SHOT circuitry, Q17, Q21. Imagine the voltage on C38 is +2 V and charging up. Q17 and Q21 will be turned ON. When the voltage on C38 reaches +8V1, Q17 and Q21 will start to turn OFF. The voltage at Q21 collector, which is the RESET control of the flip flop, will try to rise positively (previously it was at 0 V), but it is prevented from doing so by Q15. Only when the gate input is removed can the flip flop be reset and the decay occur.

When the single shot mode is selected only a positive going pulse is delivered to IC26 pin 1, and so Q15 cannot disable the reset. The waveform charges up to +8 V, resets the flip flop and then discharges. If however the keyboard gate is removed before the attack phase has been completed, the circuit is kicked into its decay mode by diode D31 which resets the flip flop. This means that no matter what mode the circuit is in, it always reverts to its decay mode when the keyboard is released (also true for the ADSR).

The AD waveform is inverted by IC31 and these complementary signals are fed to the AD sweep pot RV30. This waveform is only used to sweep the VCF and does not control anything else. Fast ATTACKS and DECAYS are of the order of 4 mS time constant and slow settings are approximately 2 S.

ADSR:

The circuit is very similar to that of the AD generator. IC25 is a SET RESET flip flop. IC28 and Q16 control the ATTACK, DECAY, RELEASE time constants by enabling the three control pots. A keyboard gate voltage generates a positive going pulse IC25 pin 1, causing IC25 pin 3 to go low. This then turns on Q16 and thus C37 is charged up via RV24, the attack pot. IC30 is a high input impedance voltage follower, which controls the output VCA but which is also linked to Q18 via R100.

When C37 has charged up to 8 V, Q18 begins to turn off and in doing so, turns off Q20. The collector goes high and RESETS the flip flop. Q16 is thus turned off and the analogue transmission gate IC28 pin 1, 2, 13 is turned on via D27.

Now C37 is connected via the decay pot to the sustain voltage, the wiper of RV29 and so it will discharge to that voltage and remain there until the keyboard gate is removed. When this happens the IC28 pin 1, 2, 13 transmission gate is turned off via D28, and IC28 pin 3, 4, 5 is turned on. Now C37 is discharged towards 0 V via the release pot. Also, when the keyboard gate is removed, a RESET is generated by the diode D29, so that the flip flop is ready for another cycle.

The ADSR voltage is used to control the VCO pitch and the signal level at the synthesizer's output. The ADSR is converted into a current by Q19, D30, R102, R99 and is used to drive a CA3080 acting as VCA. The OFF level of this circuit is adjusted using RV28.

The attack, decay, release time constants are variable over a range of 5 mS to 2 S. The sustain QUIET position should provide at least 40 dB attenuation.

VCF & VCA

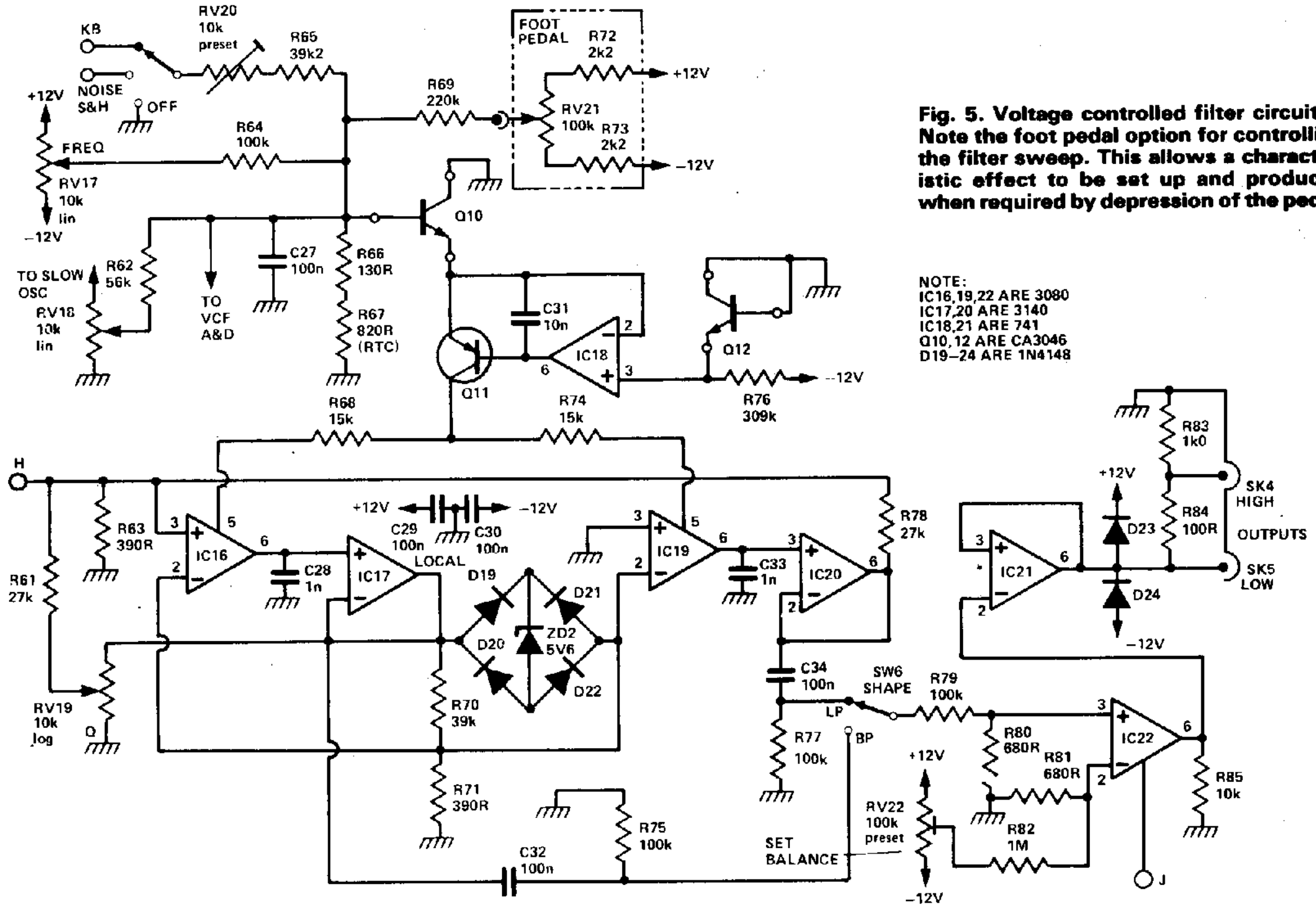


Fig. 5. Voltage controlled filter circuitry. Note the foot pedal option for controlling the filter sweep. This allows a characteristic effect to be set up and produced when required by depression of the pedal.

NOTE:
IC16,19,22 ARE 3080
IC17,20 ARE 3140
IC18,21 ARE 741
Q10,12 ARE CA3046
D19–24 ARE 1N4148

HOW IT WORKS

Voltage Controlled Filter

The VCF is a voltage controlled state variable filter. This particular design generates both low pass and bandpass outputs. It has the same voltage response as the VCO, i.e. it is logarithmic, as opposed to linear. A CA3046 transistor array converts the control voltage into a log current using very similar circuitry to that which was employed in the VCO to minimise temperature effects.

The control current needs to be sourced to the VCF, in fact to pin 5 of IC16 and IC19 which are both at about −11V4. This is accomplished with Q11 and IC18. The current that comes out of the logging transistor flows into the emitter of Q11 and about 99% of it comes out of the collector, the other 1% flows out of base. As long as the h_{fe} doesn't vary too drastically as a function of the collector current, then this source of error will not be greatly significant.

The tracking accuracy of the VCF is much less of a problem than for the VCO. VCF tracking errors will only result in a slight change in tone, not pitch.

IC18 maintains Q12 at a fixed bias voltage of approximately −0V62. The control current that comes out if Q11 collector splits equally down R68, 74 and into IC16, 19 respectively. These devices are CA3080's, a two quadrant multiplier which is used as a variable gain cell to tune the filter resonance.

In fact they are gain controlled integrators, where C28, 33 are the timing capacitors. The outputs are current outputs and are therefore high impedance. IC17, 20 are very high input impedance voltage followers and they unload the outputs of the integrators. IC16, 17, 19, 20, 23 is in fact an analogue model of a second order differential equation, (i.e. a tuned circuit or a mechanical resonator).

The loop gain, which is controlled by IC16, 19, is linearly proportional to the resonant frequency, therefore by varying the current into IC16, IC19 the resonant frequency of the model is controlled. Note that there is both negative and positive feedback around IC16, IC19. The negative feedback is fixed but the positive feedback is variable via the resonance pot RV19.

As more positive feedback is applied the model becomes more resonant, the Q factor increases. Too much feedback and the circuit will oscillate. In fact stable, low distortion sinewave oscillations can be produced by turning the resonance pot fully clockwise. The diode bridge amplitude limits the signal excursions and will thus stabilise the signal level when the VCF is in its oscillator mode.

The VCF can therefore be used as a low distortion oscillator or as a filter. However, the signal level in the oscillator mode is much louder, (about 10 dB) than in the filter mode.

VCA

The CA3080 is used as a two quadrant multiplier. That is the gain of the device is controlled by the current flowing into pin 5 As this current has the same contour as that of the ADSR, then any signal flowing through the VCA will have its amplitude modulated with the ADSR contour. The output is buffered by a voltage follower providing a high level output (typically OdBm) and a low level output (typically −20dBm). By putting a fixed DC current in, a constant output level is produced (BY-PASS ON), unaffected by the ADSR.

WHAT DOES WHAT AND WHERE

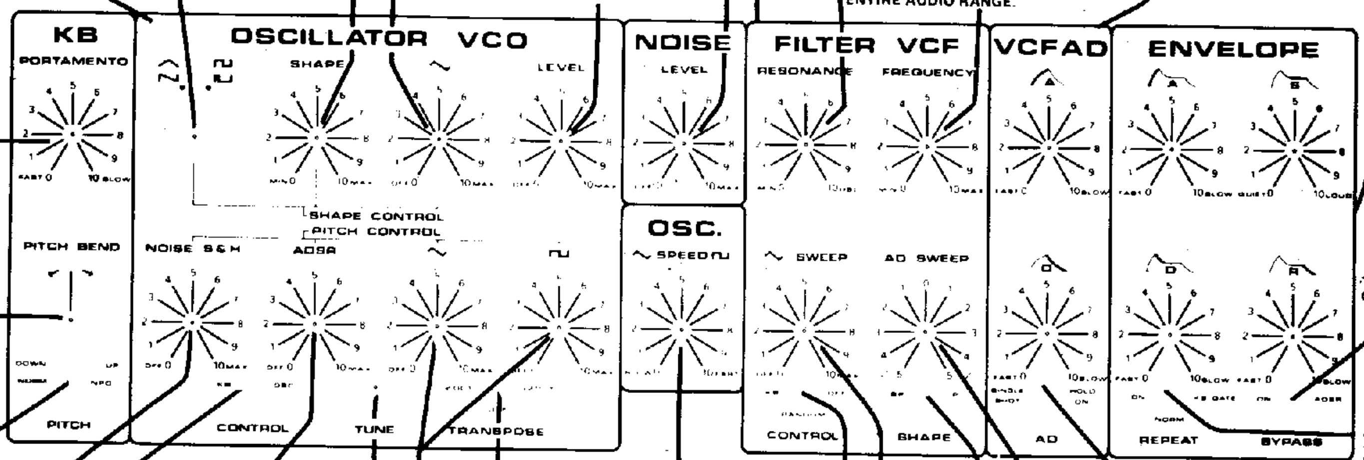
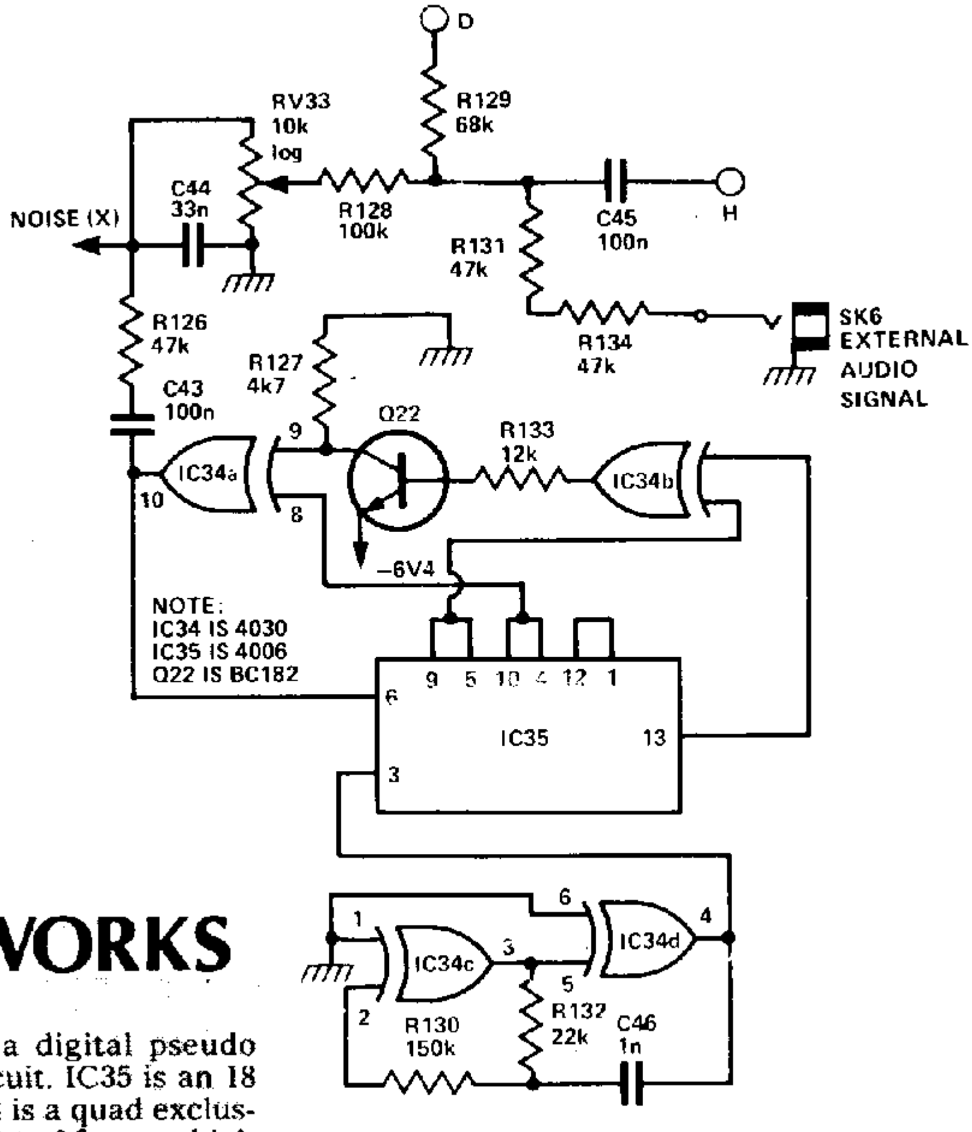


Fig. 6. The front panel layout and what to do with it. This drawing should show the newcomer to sound synthesis what to expect from the various circuit blocks, and give the expert an idea of the versatility of the Transcendent 2000 design. The keyboard, a 37 note unit, is not shown, but reference is made to its control effects where appropriate.

NOISE GENERATOR



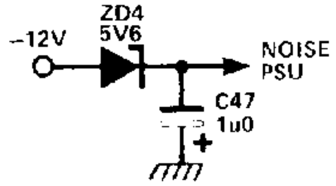


Fig. 7. The digital noise circuit is locally decoupled by C47, and the supply rail stabilised by ZD4 as shown right. The external audio signal level should be about 1V for best results.

HOW IT WORKS

The noise generator is a digital pseudo random shift register circuit. IC35 is an 18 bit shift register and IC34 is a quad exclusive OR device. IC34, pins 1 to 6 forms a high frequency (30 kHz) oscillator which is used to clock the shift register. IC34 pins 8 to 13 provide feedback around the shift register and are so arranged as to jumble up the data that is circulating. What happens is that a continuous repeating sequence of 'O's and 1's flows around the register but the sequence is so very long that it only repeats about once every second. This repetition is inaudible. However the output has the characteristics of a noise source with a fairly flat spectrum.

The noise output is mixed into the audio input of the filter (RV33) and is also taken to the Random sample and hold. The noise is the signal that is sampled and the gate is generated by the slow oscillator. The output is a sampled DC signal of random voltage, the sampling rate being that of the slow oscillator. This random voltage can be used to control the frequency of the VCO and VCF.

SLOW OSCILLATOR

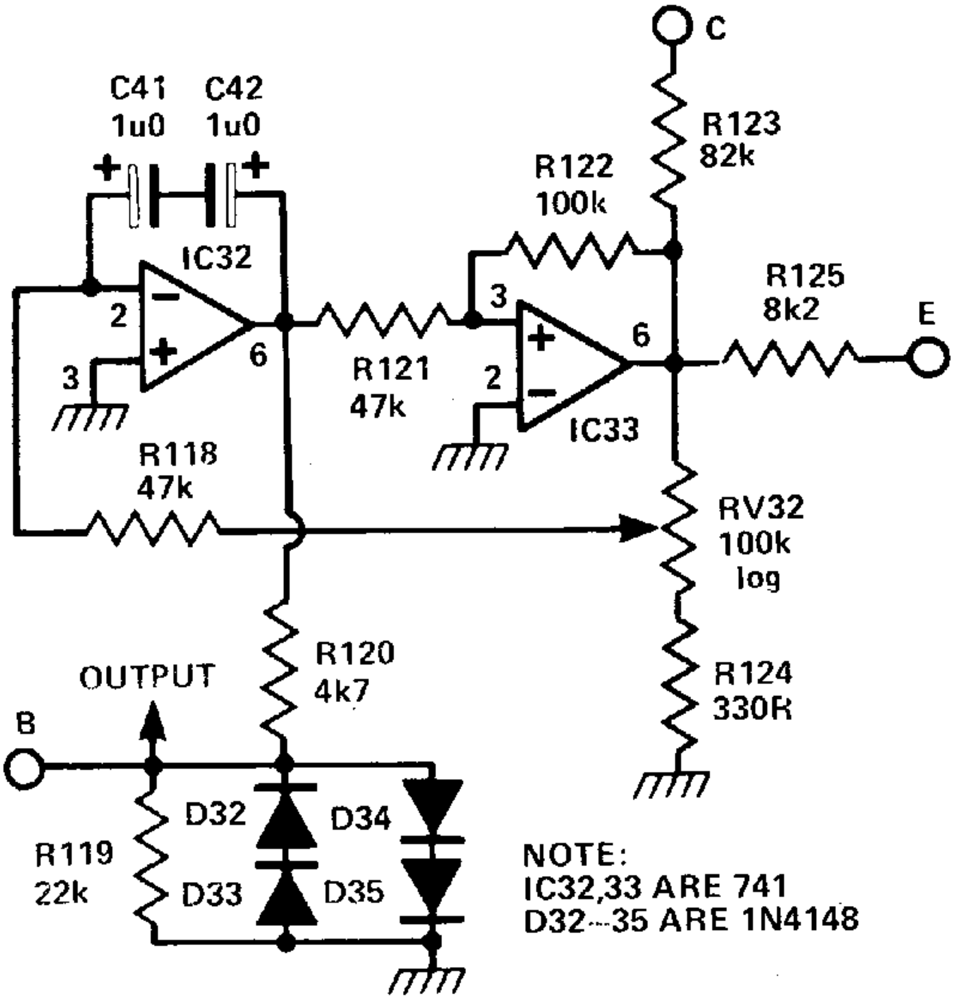


Fig. 8. Full circuit diagram for the slow oscillator block. Although very simple on paper, this circuit has a great deal of influence on the performance of the machine as a whole. The range is about 300 to 1, and the oscillator exercises control over the voltage controlled oscillator pitch, the VCO waveform modulation, the keyboard sample and hold function, the voltage controlled filter sweep rate and the ADSR repeat facility.

HOW IT WORKS

IC32 and IC33 form a triangle square wave oscillator. IC32 is an integrator the output of which ramps up and down between the hysterysis thresholds set by the schmitt trigger IC33. The square wave output of IC33 is fed back to the integrator via RV32 which determines the oscillator frequency, providing a range of 0.06 Hz to 20 Hz (300 to 1). The triangle is bent by D32-35 to form a sinewave which is used as a frequency shape modulator for the VCO. The squarewave output is used to perform a repeat function with the AD and ADSR circuits. Also it is used to frequency modulate the VCO and to provide sampling pulses for the two sample and hold circuits.

HOW IT WORKS

The keyboard generates two outputs. A pitch output and a gate voltage. This is then fed via R14, C12 (reduces contact bounce), to a schmitt trigger IC4. When a key is pressed the output of IC4 goes high, when it is released it goes low. This gate voltage is used to operate the keyboard sample and hold and the AD and ADSR units.

The keyboard voltage is generated by passing a constant current through a precision resistor chain. Thus a series of precise voltages is set up along the chain which can be picked off by the keyboard contacts. The constant current is generated by IC3, R9. R9 puts 2.526 mA into the node at IC3 pin 2. This then adjusts its output so that almost exactly 2.526 mA flows down the resistor chain.

When a key is pressed, a voltage appears which tells the synthesiser which key has been pressed. If more than one key is pressed, then the voltage is (2.526x27.4 x N) mV where N is the number of resistors between the top note pressed and IC3 pin 2.

Thus the keyboard always generates the voltage of the highest note selected, and this is fed via R13, RV2, Q4 to C13 where it is stored. Q4 is a FET switch which has an on resistance of a few hundred ohms and a Pinch off resistance of a few hundred megohms.

It is turned on and off by the keyboard gate voltage. The sequence of operation is as follows.

The keyboard is pressed. A pitch voltage is selected. A gate voltage is produced. Q4 is turned on and C13 is charged up to that voltage via R13 RV2. The keyboard is released, the gate voltage dies, Q4 is turned off, and the voltage on C13 remains where it is. IC6 is a very high input impedance (1000 M), voltage follower, and so buffers the voltage on C13 to the rest of the electronics.

A PCB guard ring surrounds C13 so that surface leakage droop rate was about 0.1 mV/S which means that it would take 6922 seconds to drift one semitone or 8305 seconds for an octave.

The measured droop rate was about 0.1 mV/S which means that it would take 692 seconds to drift one semitone or 8305 seconds for an octave.

Portamento effects are obtained by varying RV2, anticlockwise the charging time of C13 is about 0.2 mS, when clockwise this becomes 330 mS, and the effect is to produce a slewing between notes.

If the keyboard contacts are badly out of alignment, a pitch change at the start of notes can be produced. If the first contact to close is the gate pair then this might cause a problem. The sequence of events is as follows:

The gate contacts close. An envelope with the VCO at the previous pitch is produced. Then 10 or 20 mS. later the pitch contact is made and the sample and hold, and hence the VCO jumps to the correct pitch. The result is a pitch 'hiccup' at the start of some notes. If this is noticeable on any notes then the gate contact should be carefully bent so that it doesn't make contact before the pitch contact.

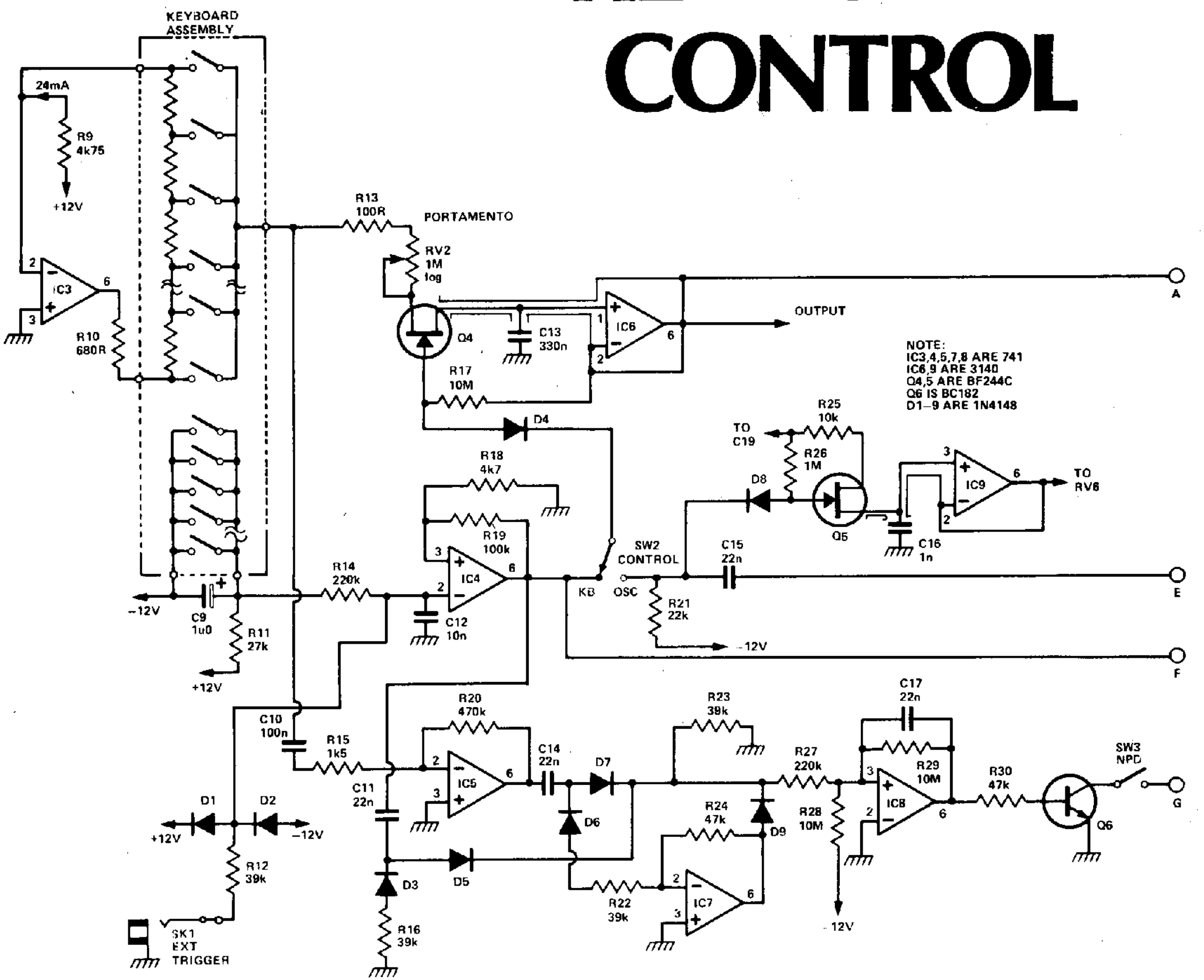
New Pitch Detector Circuit

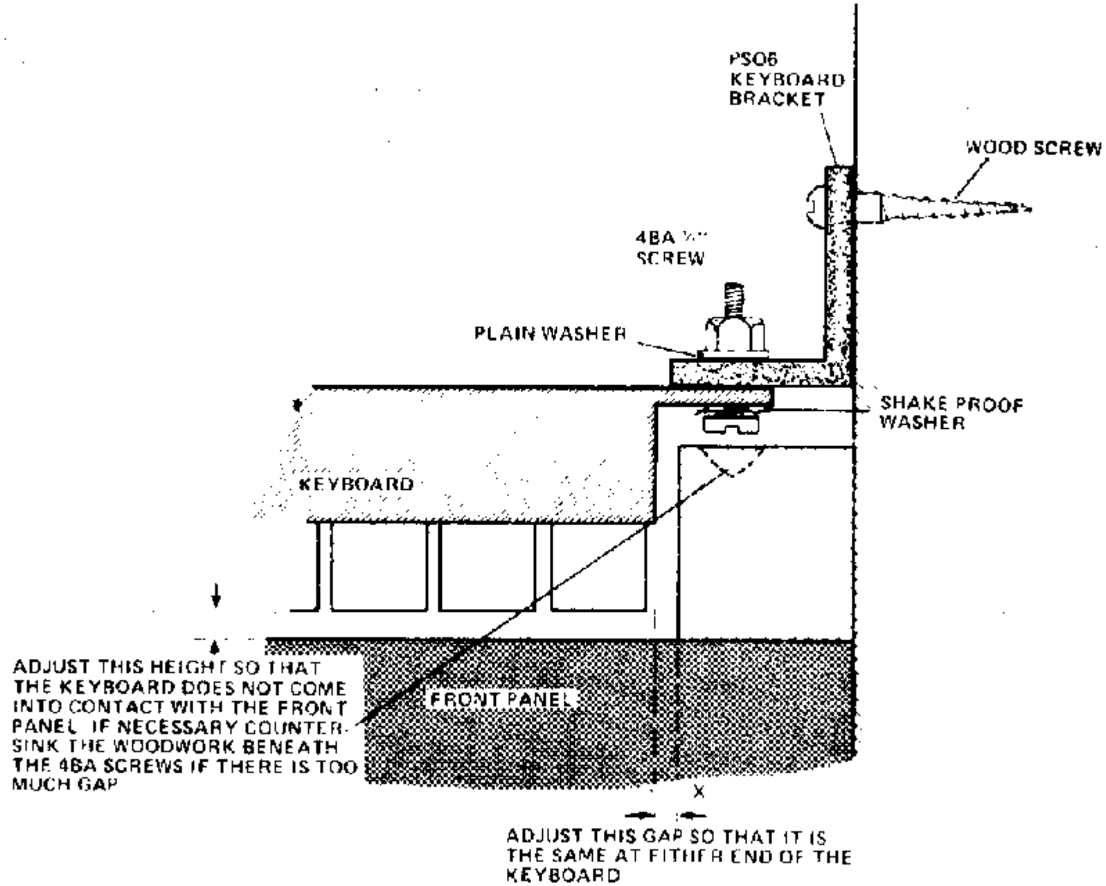
This circuit decides whether or not a new higher note has been played, even though the gate output signal (IC4 pin 6), has remained high all the time. IC5 is a high gain amplifier which looks at the voltage on the pitch contacts. If the pitch changes, the AC component of this change will be amplified by IC5.

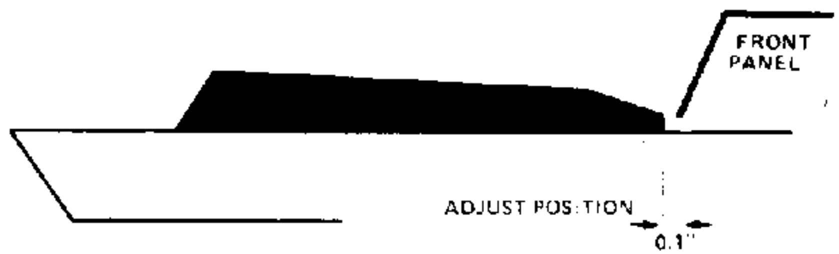
If the output goes positive, a pulse is produced which passes through C14, D7 and ends up across R23. If the output of IC5 goes negative, the pulse goes through C14, D6, is inverted by IC7 and passes through D9 into R23, again as a positive pulse. This pulse then drives IC8 which is a schmitt trigger. Its output is normally low, and the arrival of the pulse makes it go high for a short while and then returns to its low state. Thus an ascending or descending scale of notes will cause a series of short pulses (at IC8, pin 6) to be generated, one per new note. When the last note held down is removed there is no pulse produced. When the same note is repressed, the pitch not actually being any different, a pulse is generated (this is what is wanted) via C11 from IC4 pin 6. This route only generates pulses on +ve edges, that is the start of a new gate voltage. The pulse output from IC8 is used to turn Q6 on and off. This in turn is used to momentarily turn off the AD and ADSR circuits. Thus the NPD can be used to provide a retrigger of the AD and ADSR circuits.

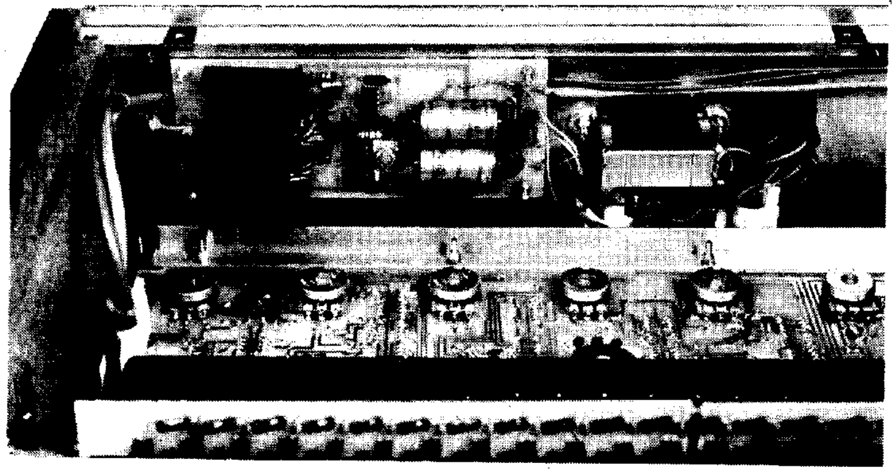
Fig. 9. On the right is shown the circuitry associated with the keyboard functions. Note the resistor chain for the keyboard is mounted remotely to the main PCB and fits into the contact block mounting board. The Ext Trigger input allows a sequencer to be wired to the synthesiser.

KEYBOARD CONTROL

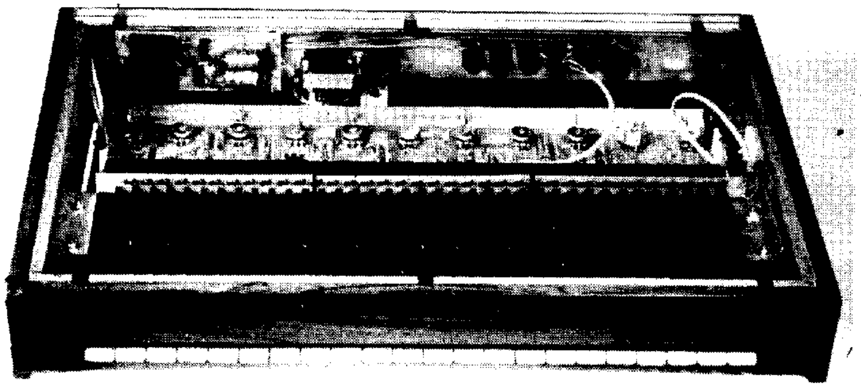


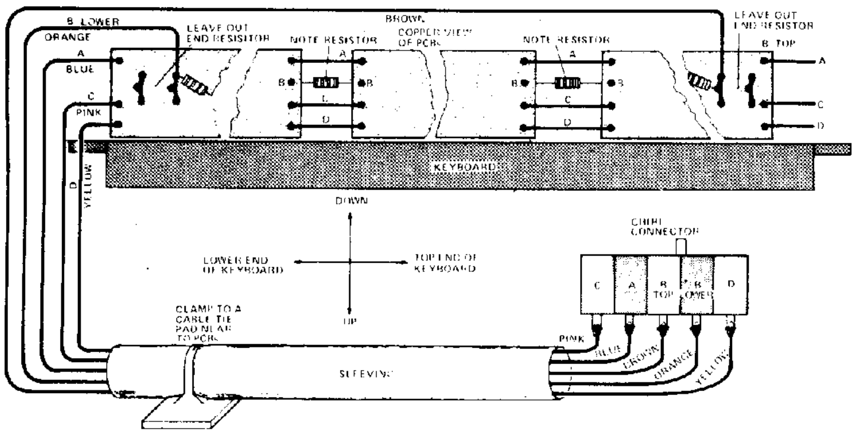

PSO6
KEYBOARD
BRACKET
WOOD SCREW
4BA ½"
SCREW
PLAIN WASHER
SHAKE PROOF
WASHER
KEYBOARD
FRONT PANEL
ADJUST THIS HEIGHT SO THAT
THE KEYBOARD DOES NOT COME
INTO CONTACT WITH THE FRONT
PANEL IF NECESSARY COUNTER-
SINK THE WOODWORK BENEATH
THE 4BA SCREWS IF THERE IS TOO
MUCH GAP
X
ADJUST THIS GAP SO THAT IT IS
THE SAME AT EITHER END OF THE
KEYBOARD

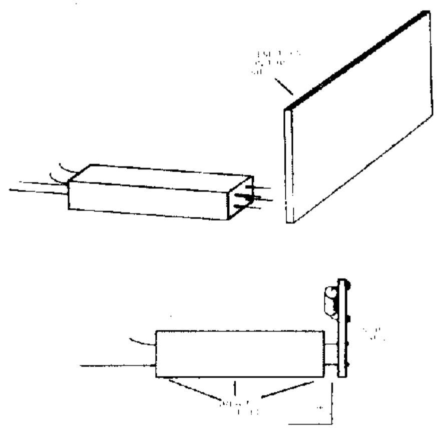

FRONT
PANEL
ADJUST POSITION
0.1"



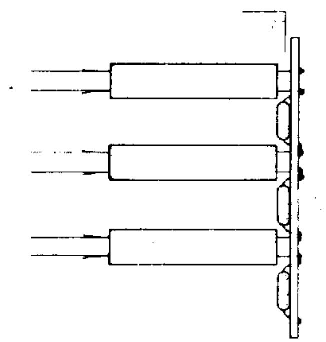
Above: close up of the PSU board mounting within the case. Positioning the transformer is important to reduce the risk of hum. Mount this as low down, away from the board, as possible. In the foreground the resistor chain for the keyboard can be seen. Below: overall view of the machine, to give an idea of what goes where in the box. Note the three Chiri connectors which fit onto the PCB on the end of these wires snaking across the photo. The black area to the front is the line of keyboard contact blocks.







Contact blocks and resistors and where to put 'em. Follow the drawing above to fit the block to the PCB, and then line up the angle as shown below. On the lower left is the keyboard wiring diagram which shows the connecting together of the boards and the placing of the two spare resistors. The photograph shows what it all looks like when you've finished.



Main overlay for the Transcendent 2000 synthesiser design. As you may notice only a little over half the board is shown here. The other half you'll find over the page.

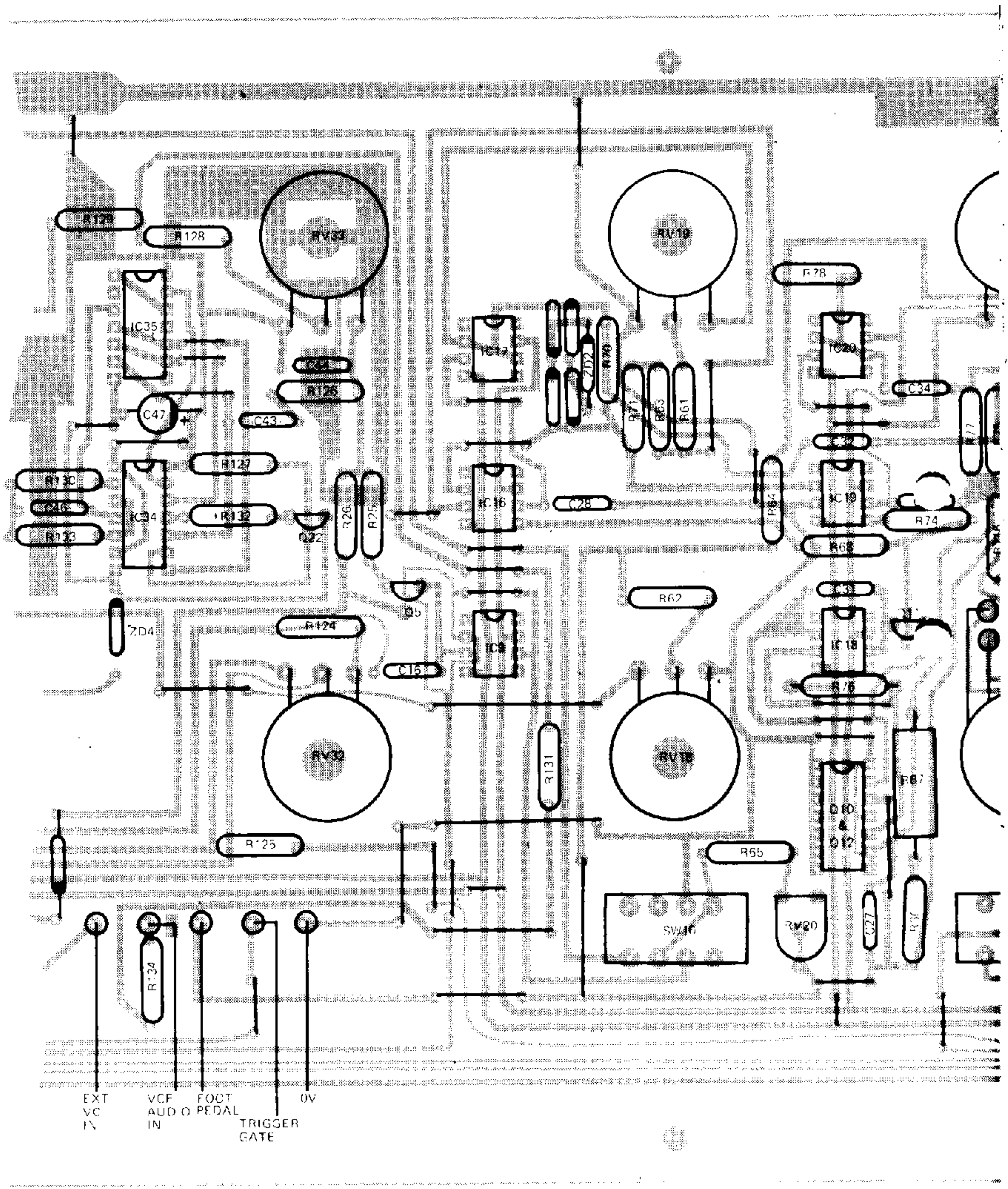
The reason for this is simply that with a PCB of this size our pages are too small to hold the diagram and still have it readable.

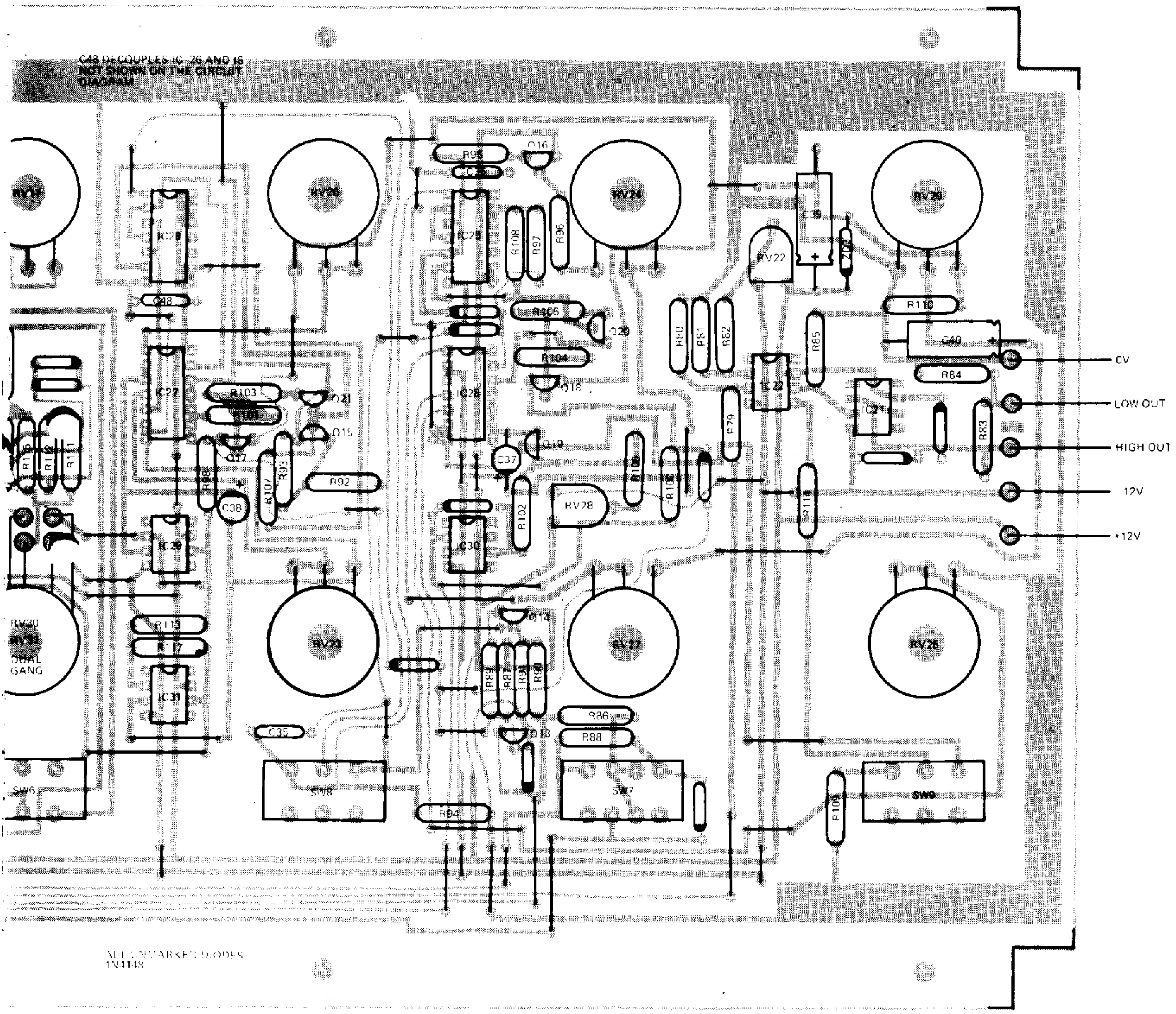
Foil patterns are not shown here, and the PCB is available from Powertran — see BUYLINES for details.

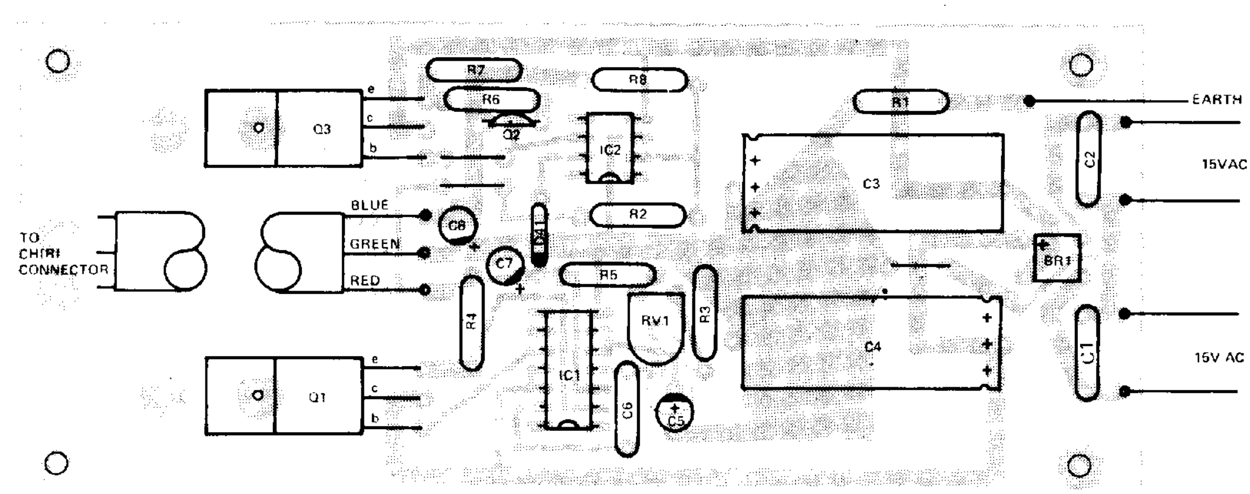
The two sets of contacts shown are mated with the Chiri connectors from the back panel wiring. Make sure the pins are straight, and that no solder has run down from the board, or the plug will not fit properly.

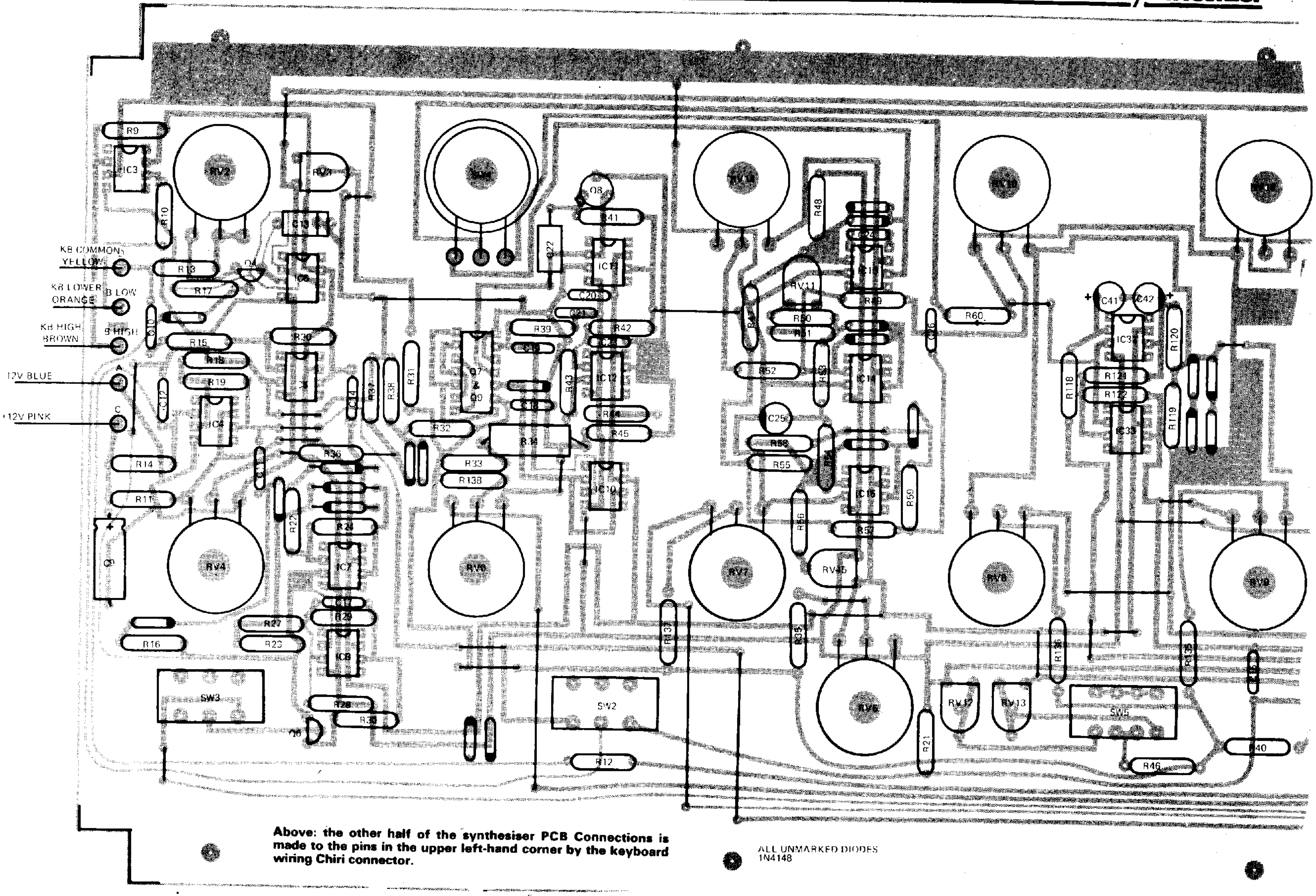
On the lower right is shown the PSU board overlay. Note that Q3 and Q1 require to be heatsinked for correct operation.

Both the boards should be checked very carefully during assembly, and make sure you use the switch spacers on the main PCB. Cut the pot spindles *before* mounting them.




C48 DECOUPLES IC 26 AND IS NOT SHOWN ON THE CIRCUIT DIAGRAM
0V
LOW OUT
HIGH OUT
12V
+12V
RV30
RV31
DUAL GANG
ALL UNMARKED DIODES 1N4148


EARTH
15VAC
15V AC
TO
CHIRI
CONNECTOR
BLUE
GREEN
RED



Above: the other half of the synthesiser PCB Connections is made to the pins in the upper left-hand corner by the keyboard wiring Chiri connector.

PARTS LIST

RESISTORS (all ¼W 5% unless stated)

R1, 18, 55, 58, 120, 127	4k7	
R2, 8, 43	10k	(0.5%)
R3, 49, 133	12k	
R4, 7	3R3	
R5, 37, 38	6k8	(1%)
R6, 83, 96	1k0	
R9	4k75	(1%)
R10, 80, 81	680R	
R11, 78, 61	27k	
R12, 16, 22, 23, 70	39k	
R13, 84	100R	
R14, 27, 48, 60, 69, 136	220k	
R15	1k5	
R17, 28, 29	10M	
R19, 51, 56, 64, 75, 77, 79, 89, 90, 93-95, 97, 101, 103-108, 122, 128, 137	100k	
R20	470k	
R21, 57, 102, 114, 119, 132	22k	
R24, 30, 47, 86, 118, 121, 126, 131, 134	47k	
R25, 36, 59, 85, 87, 88, 91, 109, 113, 115-117	10k	
R26, 35, 39, 82, 92, 98, 100, 135	1M0	
R31, 65	39k2	(1%)
R32	680k	
R33, 66	130R	
R34	870R	(RTC)
R39	1M	(0.5%)
R40, 62, 138	56k	(2%)
R41	470R	
R42, 74	15k	
R44	12k1	(1%)
R45	2k7	
R46	309k	(0.5%)
R50, 130	150k	
R52	120k	
R53, 54	7k5	
R63, 71	390R	
R67	820R	(RTC)
R68	15k	
R72, 73, 110	2k2	
R99	3k9	
R111	390k	
R112, 123	82k	
R124	330R	
R125	8k2	
R129	68k	
Keyboard chain (37 off)	27R4	(0.5%)

POTENTIOMETERS

RV1, 3	10k	cermet
RV2, 23-27	1M	log
RV4, 5, 15, 21	100k	lin
RV6-10, 14, 17, 18, 28, 29	10k	lin
RV11, 22, 28	100k	lin preset
RV12, 13	50k	cermet
RV16, 32	100k	log
RV19, 33	10k	log
RV20	10k	lin preset
RV30, 31	10k	lin (ganged)

CAPACITORS

C1, 2, 10, 18, 26, 27, 29, 30, 32, 34, 43, 45	100n	polyester
C3, 4	1000u	25V electrolytic
C5, 7, 8, 37, 38	2u2	25V tantalum
C6	330p	polystrene
C9	1u0	25V electrolytic
C11, 14, 15, 17	22n	polyester
C12, 19-21, 35, 36, 31, 48	10n	polyester
C13	330n	polystyrene
C16, 28, 33, 46	1n0	polystyrene
C22, 44	3n3	polystyrene
C23	22p	ceramic
C24	5p0	ceramic
C25, 41, 42, 47	1u0	25V tantalum
C39, 40	100u	25V electrolytic

SEMICONDUCTORS

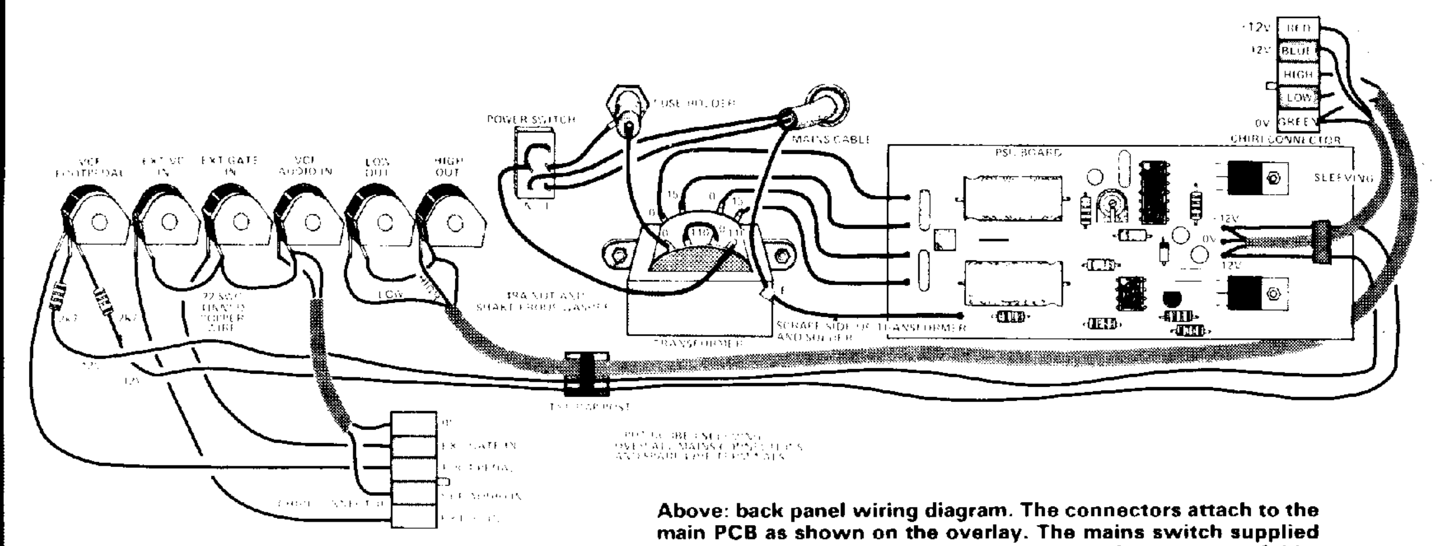
IC1	uA 723C	
IC2, 3-5, 7, 8, 10, 14, 15, 18, 21, 29, 31-33	741	
IC6, 9, 11, 17, 20, 30	CA 3140	
IC12	LM311	
IC13	748	
IC16, 19, 22	CA3080	
IC25, 26	CD 4001	
IC27, 28	CD 4016	
IC34	CD 4030	
IC35	CD 4006	
Q1	TIP 29A	
Q2	BC 213	
Q3	TIP 30A	
Q4, 5	BF 244C	
Q6, 13, 15, 20-22	BC 182	
Q7, 9, 10, 12	CA 3046	(2 off)
Q8	2N 4859	
Q11, 14, 16-19	BC 212	
D1-37	1N 4148	
ZD1	4V7	400mW
ZD2, 4	5V6	400mW
ZD3	3V3	400mW
BR1	RS 261 772	(1A at 400V)

SWITCHES

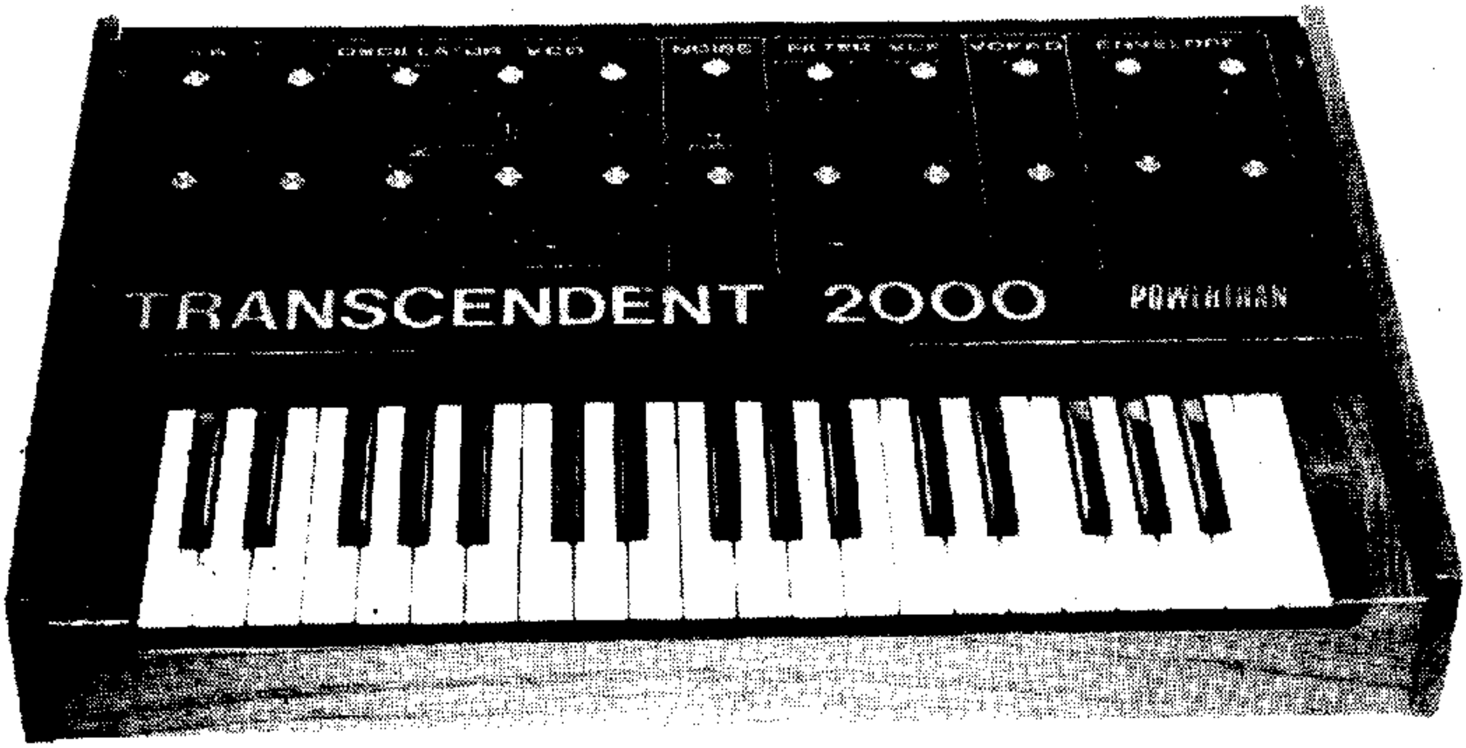
SW1	DPDT 250V AC
SW2, 3, 6, 8, 9	single pole slide changeover
SW4	1 pole (2 way) rotary
SW5, 7, 10	double pole slide changeover

MISCELLANEOUS

Five ¼" mono jack sockets, one ¼" stereo jack socket (all panel mounting), 37 note keyboard with contact blocks, woodwork and case to suit, PCBs, three core mains lead, knobs to suit, 0A5 fuse with holder, 240V to 15-0-15V at 200mA transformer, three five-pin Chiri connectors, eight spacing blocks for switches, one foot pedal unit with cable (optional), grommets.



Above: back panel wiring diagram. The connectors attach to the main PCB as shown on the overlay. The mains switch supplied with the kit contains a neon and the wiring takes account of this. If you use a different type of switch, the wiring will be different.


TRANSCENDENT 2000