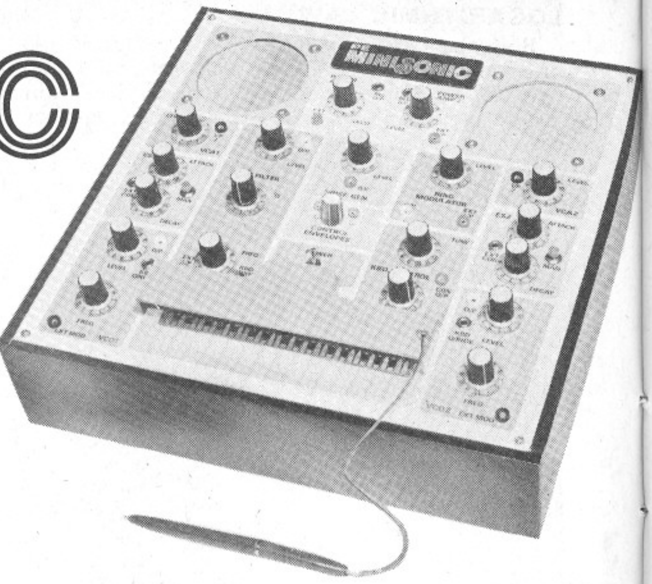
PE MINISONIC



By D. SHAW

PART TWO

- Voltage Controlled Oscillators
- Voltage Controlled Filter and Envelope Shaper
- Voltage Controlled Amplifiers

THIS month we begin the circuit construction of the P.E. Minisonic series by detailing the VCO's, VCF and Envelope Shaper/VCA's.

BATTERY LIFE

The average current drawn by the P.E. Minisonic is about 62mA, so it is estimated that a pair of PP9 batteries will provide up to 50 hours of useful life. Much depends, of course, on the length of the periods during which the instrument is switched on. When usage is restriced to around two to four hours per day then maximum battery life can be expected.

On the current price of PP9's, therefore, the running costs of the P.E. Minisonic are likely to vary between 1·4p per hour and 2·33p per hour depending on usage and this seems, on the basis of comparison with other forms of entertainment, to represent pretty good value for money.

One of the drawbacks of battery operation is that the voltage falls in a manner proportional to the drain and to the charge remaining, and thus circuits which are voltage sensitive could begin to perform in an erratic and unreliable manner.

In the P.E. Minisonic this problem has been overcome by the establishment of voltage reference rails, considerably below nominal battery potential, in order to serve those circuits which are particularly voltage sensitive.

In practical terms the VCO's and VCF will operate without any change in performance down to $\pm 7{\cdot}5$ volts and, indeed, will tolerate supply voltages up to ± 12 volts also without change in performance.

The worst effect of falling battery voltage on these circuits not served by the reference rail is that the gain/attenuation ratio of the VCA's diminishes by between 6 to 8dB and the noise generator will cease to operate at about $\pm 7{\cdot}8$ volts.

The great advantage of battery operation is that the instrument becomes a perfectly safe proposition for the younger enthusiast who can dabble about to his heart's content without the attendant fear of electrocution.

COMPONENTS . . .

VOLTAGE CONTROLLED OSCILLATOR (2 required)

Resistors

R1, R2	6·8kΩ (2 off)
R3–R6	47kΩ (4 off)
R7	22kΩ
R8	1·2kΩ
R9	1kΩ
R10	2·7kΩ
R11	1kΩ (see text)
R12	750Ω
R13	22kΩ
R14	82kΩ (see text)
R15, R16	10kΩ (2 off)

All ±5% ¼W or ⅛W carbon

Potentiometers

VR1	10kΩ skeleton horizontal preset
VR2	10kΩ linear carbon
VR3	100kΩ skeleton horizontal preset
VR4	10kΩ linear carbon

Capacitors

C1	0·1μF
C2	22μF 16V tantalum
C3	3·3pF

Semiconductors

D1	1N914
TR1	BC184
TR2	BC213
IC1, IC2	Type 741 8-pin d.i.l. (2 off)
IC3	Type 748 8-pin d.i.l.

Miscellaneous

JK1	3.5mm jack socket
SK1, SK2	2mm sockets (2 off)
0·1in	Veroboard, 115 × 34 holes (This board also carries Keyboard Control, Mixers and Ring Modulator)

LOGARITHMIC LAW

Both the VCO's and the VCF have a logarithmic—or, more accurately—an exponential relationship between the applied control voltage and the control current which, in turn, prescribes the frequency of the VCO and the pass-band of the VCF.

The so-called "log-law" has been adopted because it allows for a considerable simplification in the keyboard and pitch determining systems—an important factor in an instrument which is to be used for musical purposes and which, hopefully, is to remain in tune over relatively long periods.

In simple terms the "log-law" enables linear increments of control voltage to cause frequency changes of one octave in the case of the VCO or passband variations of one octave in the case of the VCF.

In the P.E. Minisonic the control voltage increment required is 600mV per octave but there is provision for adjusting this from about 220mV per octave to 1·2V per octave in order that the instrument may be matched to other synthesiser systems.

Since the control voltage increment is the same value for both VCO and VCF this enables the control node for both circuits to be identical save for two minor variations.

THE CONTROL NODE

The circuit of the control node is shown in Fig. 2.1, which shows the VCO but an almost identical control node is used in the VCF. IC1 is a four-input summing inverter in which two inputs are committed to providing bias and manual control voltages while the remaining two can be coupled to external programming sources.

The overall gain of the inverter is prescribed by VR3 which is used to set the so-called "law" of the system, i.e.—the relation of frequency or pass-band to voltage. VR1 provides a fixed bias to the inverter which serves to set the minimum frequency, or to position the overall frequency range in manual control, while VR2 provides the voltage swing, in manual, required to give a nominal ten octave range.

The input via R5 is coupled through the normally-closed contacts of JK1 to the keyboard controller "hold" circuit (which will be described next month).

Insertion of an open circuit jack plug will override the "hold" input or, alternatively, an external signal wired in to a jack plug may be routed into this input.

The input via R6 is wired to a 2mm socket so that an external programming signal may be employed in combination with the keyboard.

The output of IC1 drives a divider, R7-R8, which sets the bias on transistor TR1—a constant current generator. It is in TR1 that the exponential relationship between control voltage and control current is derived.

TRANSISTOR CHARACTERISTICS

Reference to the characteristic curves of almost any small signal transistor in which V_{be} is plotted against I_C will show that there is a fixed relationship between these factors which extends over a range of three or four decades.

V.C.O.

PERFORMANCE

Frequency Range	10 octaves, nominally 5Hz to 5kHz in manual control
Control Voltage Law	600mV per octave
Waveform	Sawtooth, 400mV p-p
Current Drain	5mA

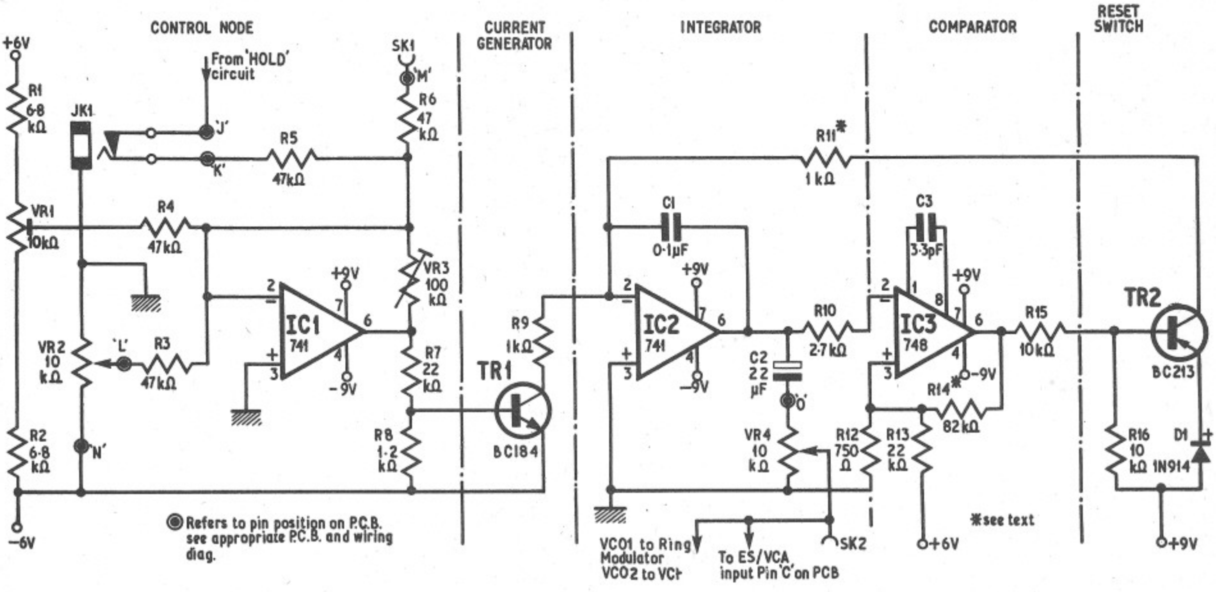
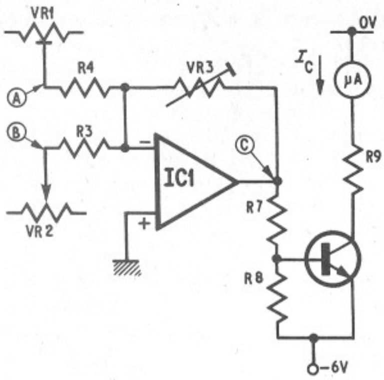


Fig. 2.1. Circuit diagram of the Voltage Controlled Oscillator. Letters in inverted commas refer to connections from the Veroboard panel to the front panel



Voltage readings with A at —1·4V and C at 0·95V

B(−V)	0	0·6	1·2	1·8	2·4	3·0	3·6	4·2	4·8	5·4	6·0
I_c(μA)	—	—	0·5	1·0	2·0	4·0	8·0	16·0	35·0	82·0	190·0

Fig. 2.2. Simplified circuit of the control node used in both the VCO and the VCF. The table shows typical current readings for different settings of VR2. Note that tolerance on R7 and R8 can cause significant departures from values shown. These may be compensated by adjustment of VR1. The important relationship is between the voltage at B and I_c

Fig. 2.3a. The integrator output with resistor R11 removed

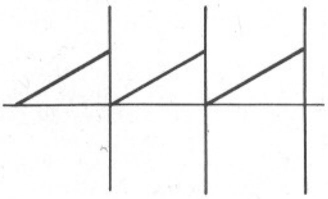


Fig. 2.3b. Output of the integrator showing large spikes during the reset period. These are too fast to be audible

Above a minimum level of V_{be}, the collector current will double for each successive increment in V_{be} of the order of 20 to 25mV. Over the straight line portion of the curve, if it is assumed that the V_{be} increment is 24mV, then increments of 2mV will cause the collector current to increase successively in the ratio 1 : 12 $\sqrt{2}$ — which musicians will immediately recognise as being identical to the ratio in pitch between any two consecutive notes in an equal tempered scale. Indeed, this relationship serves to explain why the "log-law" circuit is so much more useful in a musical sense than its linear counterpart.

SETTING-UP PROCEDURE

The efficiency with which the VCO's and VCF function relative to their respective control voltages is entirely dependent upon the accuracy with which the setting-up of the control node is accomplished.

The principal aim is to ensure that successive increments of 600mV supplied by VR2 result in successive doublings of the current through the constant current generator TR1. Fig. 2.2. illustrates a simplified control node together with a table of typical results obtained with the prototype instrument.

With the wiper of VR2 at ground potential, VR1 should be adjusted so that the wiper is at −1·4V. VR3 should now be adjusted so that the output of IC1 is at +0·95V. These adjustments will set the operating points of the control node to within close limits of the required values.

A multimeter switched to the microamp range should now be connected between R9 and the 0V rail and VR2 swung through the range of values shown in the table.

It should be noted that the current readings recorded will not necessarily correspond exactly with those quoted in the table since tolerance variations in R7 and R8 can cause significant differences.

During the first swing of VR2 it is almost certain that errors will be present and it is important, at this stage, to determine whether the current through TR1 is greater or less than the doubling required for each increment of 600mV at the wiper of VR2.

For this purpose it is best to carefully record the current readings obtained over a range of input voltages—say from 1·2V to 4·8V—in order to establish whether the error is consistent.

If the current through TR1 is greater than the doubling required for each 600mV increment then the gain of IC1 has to be reduced by adjustment of VR3. Conversely for less than the required doubling.

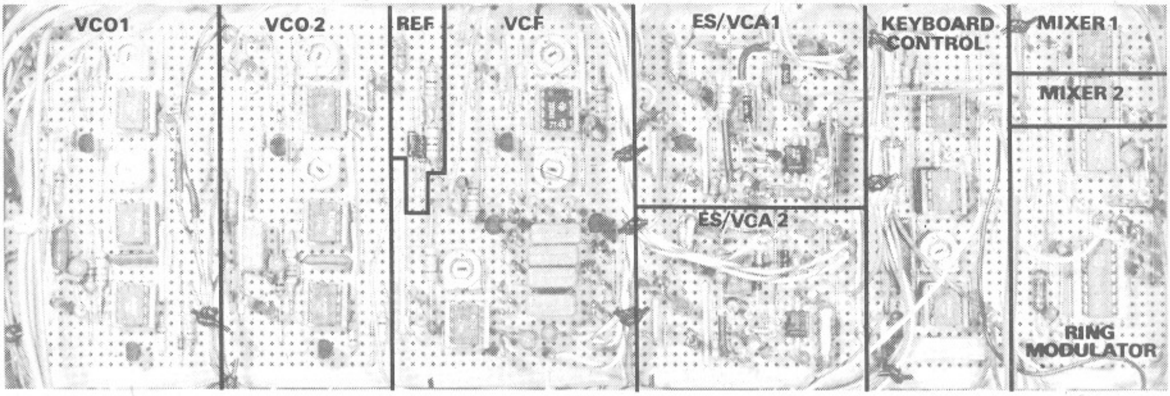
When the required relationship has been established the control nodes for the VCO's may be matched by making a further adjustment to VR1 so that, for a given voltage supplied by VR2, the current through TR1 is identical in both nodes.

It should be noted that the current/voltage relationship in the control nodes need not be precisely 600mV per current doubling. Indeed the range of adjustment afforded by VR3 allows that the relationship may be set at any value lying between aproximately 220mV and 1·2V. What is important however is that the relationship adopted should be *exactly* the same for all control nodes. If it is not then the circuits will not track accurately and the overall performance of the instrument will be marred.

The design of the Keyboard Controller is such that it can accommodate any voltage/current relationship which it is possible to set up with the component values given for the control nodes.

THE VOLTAGE CONTROLLED OSCILLATOR

The complete circuit of the VCO is illustrated in Fig. 2.1. Apart from the control node and current generator the VCO comprises a linear integrator around IC2, a comparator around IC3 and a reset switch TR2.



Photograph of complete board on which VCO's, VCF, Voltage Reference and ES/VCA's are mounted. (Note: some minor changes have been made to this layout)

HOW IT WORKS

If we assume that the reset cycle has just completed, the output of IC2 will be zero volts, the output of IC3 will be positive due to the voltage applied by divider R12-R13, and TR2 will be hard off. C1 although nominally uncharged will, in fact, have a charge in relation to the negative rail and thus TR1 will draw on that charge at a constant rate thereby causing the output of IC2 to ramp in a positive direction.

The maximum positive level of the ramp is determined by two factors. Firstly there is a positive threshold voltage set by divider R12-R13 which is equal to:

$$\frac{750}{22750} \times 6 = 200\text{mV}$$

Secondly there is a positive feedback factor applied to IC3 by R14. This has the effect of determining a further threshold value on the basis of the currents applied differentially to IC3 through R10 and R14.

If x be a voltage at the output of IC2 then the secondary threshold value is determined by:

$$I_{R10} = \frac{x}{2700} = \frac{8}{82000} = I_{R14}$$

i.e. approximately 250mV.

The overall threshold value is thus theoretically 450mV. Although the 450mV threshold could be derived from divider R12-R13 alone the adopted method is preferable because it has the effect of speeding up the switching process.

When the output of IC2 reaches the threshold value the output of IC3 will try to go negative. However, the biasing on TR2 is such that when the output of IC3 has moved about 200mV, TR2 turns on and sends a relatively large pulse of current into C1 in order to restore the original state.

At this point the output of IC2 moves rapidly in a negative direction and when it falls to below 200mV, i.e. below the minimum threshold value on IC3, then IC3 will switch to positive saturation again before the output of IC2 actually reaches its minimum level. At this point the cycle repeats.

The overall effect is to provide a very rapid reset which results, in relation to the integrating rates employed, in a sawtooth waveform of almost perfect shape.

The reset time occupies a period of approximately 8μs. On most oscilloscopes the reset pulse will be invisible at low frequencies and its presence will generally only be detectable at frequencies of the order of 5kHz and greater.

RESET TIME

Resistor R11 sets a limit on the reset current supplied by TR2 and thus has an effect on the reset time. With R11 significantly greater than 1kΩ it will be found that the reset will terminate at a point about +100mV or so above zero volts, at which point integration will re-commence.

With R11 removed altogether the output of IC2 will go hard negative at each reset resulting in an output waveform as shown in Fig. 2.3a and a very slow rate of oscillation.

The ideal situation is when the value of R11 is such that the reset, as measured at the output of IC2, terminates on the zero volt rail. The output waveform of the integrator is shown in Fig. 2.3b.

Resistor tolerances being what they are there could, in a worse case, be as much as 20 per cent variation in the integrator output waveform peak-to-peak value between oscillators. This means that, with matched control nodes and for a given control voltage, the VCO with the greater amplitude waveform will run at a proportionately lower frequency.

Fortunately this error is constant over the whole frequency range and may thus be compensated for by adjustment of the bias control VR1. It is more elegant however to make the adjustment on the VCO itself so that the greater level in output waveform will not introduce any impairment of performance in relation to the sound treatment circuits.

Resistor R14, in view of its value and position on the circuit board is the most convenient resistor to adjust. Any adjustment should be directly proportional to the error variation in output waveform level, i.e. if the output waveform is 10 per cent high in relation to the other VCO then the value of R14 should be increased by 10 per cent—to 91kΩ say—and vice versa.

From Fig. 2.3b it will be seen that the integrator output waveform exhibits a substantial positive and negative going spike at the reset point. This is due to the differentiation of the reset pulse by C1.

Although rather unsightly, the spike is too fast to have any effect on the audio output.

V.C.F.

PERFORMANCE

Passband	3Hz to 15kHz (—6dB)
Dynamic Range	—54dB (referred to peak output signal)
Resonance Range	5kHz to 25kHz
Current Drain	4mA (min), 8mA (max)

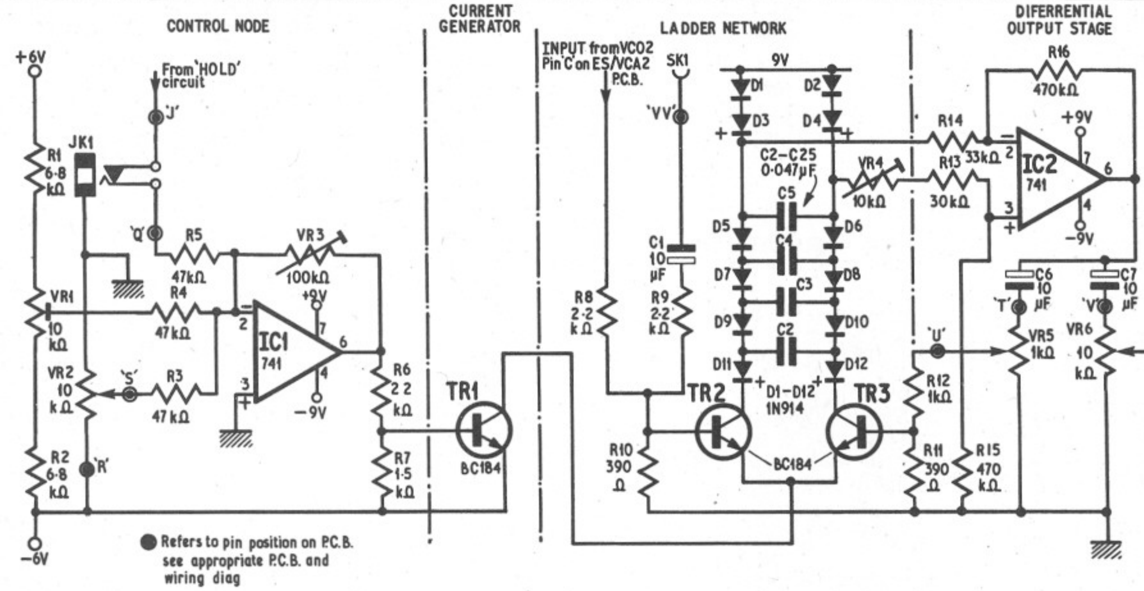


Fig. 2.4. Complete circuit diagram of the Voltage Controlled Low-pass Filter

VOLTAGE CONTROLLED LOW-PASS FILTER

The complete circuit of the filter is shown in Fig. 2.4 and comprises, in addition to the control node and current generator, a ladder network and a differential output stage. The ladder network, in which the filtering action takes place, is based on the design by Dr R. A. Moog.

The diode may be considered to be an impedance which varies inversely as the current through it, i.e. at low currents the impedance is high and vice versa. The a.c. signal is superimposed on to the diode current flow as shown in Fig. 2.5 which represents the lower half of the ladder network.

The ladder terminates in transistors TR2 and TR3 which are effectively biased on by referring their bases to the 0V rail. Thus any current drawn through the network by means of the constant current generator passes, without restriction, through these transistors.

If an a.c. signal is now applied to the base of TR2 there will be a proportional variation in the current through the transistor and thus also a voltage variation at each diode junction in the ladder.

This applies over virtually any current drawn by the constant current generator so that, for a given level of a.c. signal, the smaller the current through the network, the smaller will be the proportional variation induced by the signal. Thus the concept of variable impedance is, in fact, due to the combined effect of diode, transistor and current generator.

FILTER PERFORMANCE

The range extends over several decades and, in the circuit given, the −6dB passband at maximum is from 3Hz to 15kHz.

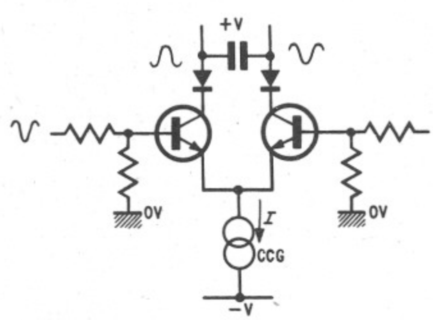


Fig. 2.5. Simplified circuit diagram of the lower section of the VCF showing how the a.c. signal is superimposed on the ladder current

Four filter stages are cascaded in the ladder network and since each stage has a theoretical roll-off of 6dB per octave the maximum roll-off of the filter should be 24dB per octave. Efficiency in this respect can only be achieved, however, if every precaution is taken to prevent loading the network both at the point of entry of the a.c. signal and also at the point of extraction.

In the interests of simplicity and economy the buffer stages have not been included in the circuit but, even so, the roll-off possible is around 12 to 15dB per octave and, for the majority of purposes, this will be found to be quite sufficient.

FEEDBACK

The output from the filter network is amplified differentially by IC2, with VR4 being employed to cancel out any d.c. imbalance due to variations in

COMPONENTS . . .

VOLTAGE CONTROLLED FILTER

Resistors

R1, R2	6·8kΩ (2 off)
R3–R5	47kΩ (3 off)
R6	22kΩ
R7	1·5kΩ
R8, R9	2·2kΩ (2 off)
R10, R11	390Ω (2 off)
R12	1kΩ
R13	30kΩ
R14	33kΩ
R15, R16	470kΩ (2 off)

All ±5% ¼W or ⅛W carbon

Potentiometers

VR1	10kΩ skeleton horizontal preset
VR2	10kΩ linear carbon
VR3	100kΩ skeleton horizontal preset
VR4	10kΩ skeleton horizontal preset
VR5	1kΩ linear carbon
VR6	10kΩ linear carbon

Capacitors

C1	10μF 6·3V tantalum
C2–C5	0·047μF (4 off)
C6, C7	10μF 6·3V tantalum (2 off)

Semiconductors

D1–D12	1N914 (12 off)
TR1–TR3	BC184 (3 off)
IC1, IC2	Type 741 8-pin d.i.l. (2 off)

Miscellaneous

JK1	3·5mm jack socket
SK1, SK2	2mm socket (2 off)

diode characteristics. The output signal from IC2 is capacitatively coupled into two potentiometers. VR6 is simply the output level control while VR5 is the feedback or *Q* control.

With the *Q* control at zero the base of TR3 is referred closely to the 0V rail and thus TR2 and TR3 behave essentially as a differential pair. The output of IC2 is therefore nominally in phase with the input signal at the base of TR2.

As VR5 is advanced from zero a proportion of the output signal appears at the base of TR3 thereby tending to induce a signal in the collector circuit which is 180° out of phase with the signal which is already there due to the effect of the signal on TR2. The result is that the output signal will become significantly attenuated except at the frequency whose period is equal to the adjusted time-constant of the network.

At this critical frequency the output of the filter will peak up, the bandwidth of the signal depending on the degree of feedback applied.

Further application of feedback will cause the filter to oscillate. The frequency of oscillation is proportional to the current through the ladder network and the oscillation, which is of sine form, will be superimposed on the filter output signal. The P.E. Minisonic filter oscillates over the range 5kHz to 25kHz.

The filter may be operated in a number of modes each of which finds a place in the tone colour spectrum of the synthesiser. An outline of the various possibilities will be given in a later part of the series.

SETTING-UP THE VCF

The setting up of the control node for the VCF should follow exactly the same procedure as the VCO with the exception that, having established the correct voltage/current relationship, VR1 is adjusted so that the maximum current through TR1 with an applied voltage of −6V at VR2 should be of the order of 3mA instead of the 190μA quoted in the table shown in Fig. 2.2.

In order to achieve this result the value of R7 in the VCF is 1·5kΩ instead of the 1·2kΩ specified for R8 in the VCO control nodes. Increasing the value of R7 requires that the gain setting of IC1 be reduced by adjustment of VR3 and, in relation to an initial setting at VR1 of −1·4V, the output of IC1 should be approximately +0·84V at the commencement of the setting-up procedure.

The setting-up of the filter proper is essentially concerned only with providing the optimum balance between extreme d.c. conditions arising in the ladder due to current variations. With a high resistance voltmeter directly monitoring the output of IC2, VR5 at zero, and with the audio inputs uncommitted, the frequency control (VR2) should be moved from one extreme to the other.

The meter readings at extreme settings of VR2 should be noted and VR4 adjusted to reduce the voltage swing at the output of IC2 to a minimum. It may require several iterative adjustments to get the best possible balance.

This adjustment is not too critical since the output of IC2 is capacitatively coupled although, if the filter is being programmed by a fairly rapid envelope, any significant change in d.c. level at the output of IC2 can be differentiated by the coupling capacitor and induce an unpleasant click on to the audio signal.

THE ENVELOPE SHAPER AND VOLTAGE CONTROLLED AMPLIFIER

Two distinct but very closely related circuits are covered by this section. The first is the envelope shaper which is of considerable importance in the scheme of the synthesiser since, by variation of just two controls, a whole range of differing characteristics can be imparted to an otherwise uninteresting sound.

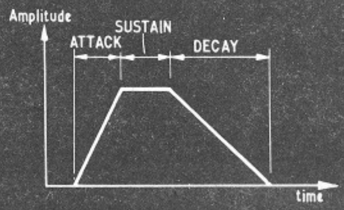


Fig. 2.6a. Typical Envelope Shaper output waveform showing the three variable parameters: attack, sustain and decay

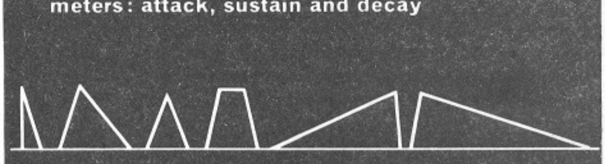
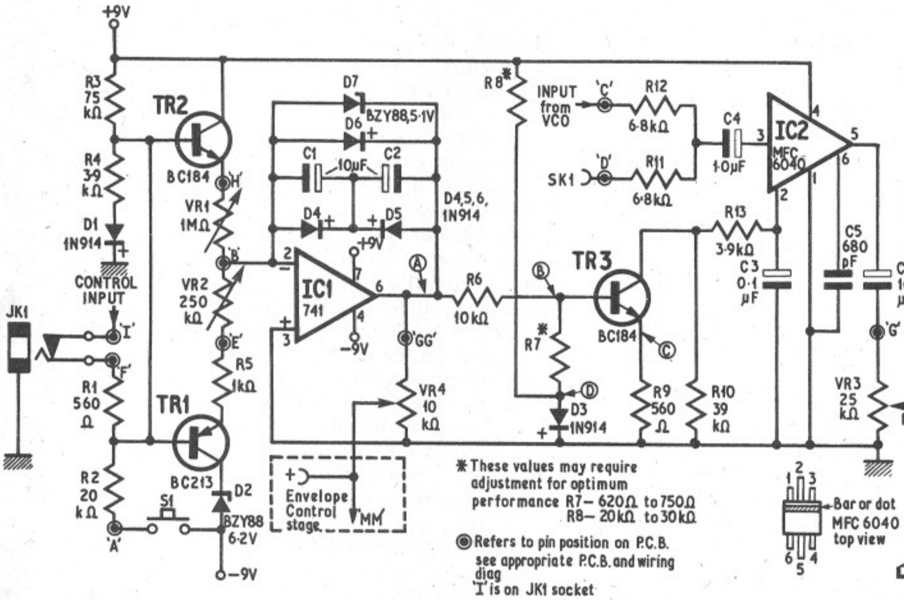


Fig. 2.6b. A selection of envelope formats

E.S./V.C.A.

PERFORMANCE	
Attack	Variable 30ms to 4s
Decay	Variable 100ms to 16s
Attenuation Range	48 to 54dB (referred to peak output)
Nominal Input	400mV p-p
Nominal Output	1·25V p-p
Operating Voltage Range	±9V to ±7·5V



D.C. CONDITIONS (volts)

	A	B	C	D
TR3 off	−0·5	0·6	0·01	0·65
TR3 on	4·5	0·8	0·24	0·65

Fig. 2.7. Complete circuit diagram of the Envelope Shaper/Voltage Controlled Amplifier. Note that potentiometer VR4 is fitted only to ES/VCA 1 to provide positive and negative going control envelopes (see block diagram Fig. 1.1)

Essentially the envelope shaper generates a control voltage which, if plotted graphically, will be found to conform with the basic waveform illustrated in Fig. 2.6a. If this waveform is applied to the control input of a VCA the amplitude of the audio signal will vary proportionately, i.e. with the envelope at zero the output of the VCA will be at its minimum volume (in the P.E. Minisonic about 54dB below the peak output signal level).

The first excursion of the envelope shaper output voltage is known as the "attack" and is variable, in the P.E. Minisonic, between about 30 milliseconds and four seconds.

The flat topped portion shown in the illustration is known as the "sustain" and represents the period of time that the VCA output is maintained at maximum volume while, finally, the return to zero volts is known as the "decay" and is variable between about 100 milliseconds and 16 seconds. The period of sustain is determined entirely by the length of time that the envelope shaper trigger signal is present and no separate control is provided. Some idea of the kind of envelope formats possible with this arrangement is given by Fig. 2.6.

CIRCUIT DESCRIPTION

The complete circuit of the ES/VCA is shown in Fig. 2.7. IC1 is a linear integrator whose output voltage is bounded, in a negative direction, by D6 and in a positive direction by D7. Thus the output voltage excursions of the envelope shaper range between −0·5V and +4·5V.

In the quiescent condition R3, R4 and D1 set the bias on TR1 and TR2 such that TR1 is off and TR2 is on. Current reaching the inverting input via TR2/VR1 charges C1/C2 and thus, with the aid of D6, holds the output of IC1 at −0·5V.

When a negative trigger signal is applied TR2 turns off and TR1 turns on. The charge on the integrating capacitors C1/C2 thus leaks away via VR2/TR1 and the integrator output ramps in a positive direction until it reaches the bounded value set by D7.

Triggering signals may be applied in one of three ways:

(i) Through the manual push button S1.
(ii) From an h.f. detector (to be described next month) operated from the stylus or external keyboard.
(ii) From an external source via JK1, thereby overriding the connection to the h.f. detector.

The integrator output is linked through a divider network R6-R7 to the base of TR3 which, with the output of IC1 at −0·5V, is held at the point of conduction by means of a current supplied from the positive rail by means of R8. The table in Fig. 2.7 gives the "on" and "off" d.c. conditions which have proved to be ideal in practice.

COMPONENTS . . .

ENVELOPE SHAPER/V.C.A. (2 required)

Resistors

R1 560Ω
R2 20kΩ
R3 75kΩ
R4 3·9kΩ
R5 1kΩ
R6 10kΩ
R7 620Ω to 750Ω } see text
R8 20kΩ to 36kΩ } see text
R9 560Ω
R10 39kΩ
R11, R12 6·8kΩ (2 off)
R13 3·9kΩ
All ±5% ¼W or ⅛W carbon

Potentiometers

VR1 1MΩ linear carbon
VR2 250kΩ linear carbon
VR3 25kΩ log carbon
VR4 10kΩ log sub. min. carbon (ES/VCA1 only)

Capacitors

C1, C2, C6 10μF 16V tantalum (3 off)
C3 0·1μF 35V tantalum
C4 1·0μF 35V tantalum
C5 680pF

Semiconductors

D1 1N914
D2 BZ88C6V2 6·2V 400mV Zener
D3–D6 IN914 (4 off)
D7 BZY88C5V1 5·1V Zener
TR1 BC213
TR1, TR3 BC184 (2 off)
IC1 Type 741 8-pin d.i.l.
IC2 Motorola MFC6040

Miscellaneous

JK1 3·5mm jack socket SK1 2mm socket
S1 Miniature pushbutton

SETTING-UP THE ENVELOPE SHAPER

Setting-up is restricted to the establishment of the bias conditions on TR3 as shown in the table of Fig. 2.7. With the output of IC1 at −0·5V, R8 should be adjusted so that a slight positive potential is apparent at the emitter of TR3. This indicates that the transistor is just beginning to conduct.

The actual d.c. level is fairly critical since too much conduction will restrict the gain/attenuation range of the VCA whilst too little will result in a propagation delay between the occurrence of the envelope shaper trigger pulse and the appearance of the audio signal at the output of the VCA.

After setting the bias the envelope shaper should be triggered manually and the button held down in order to check that the bias on the base of TR3 rises from +0·600V to +0·800V with the envelope at maximum level.

It is a good thing, at this time, to run a check on the VCA output with an input signal of 0·4V peak-to-peak. With correct biasing on TR3 the VCA output should be around 1·25V peak-to-peak.

It may be necessary to adjust the value of R7 in order to achieve the VCA output signal specified and, if this is the case, it is well to recheck the biasing with the envelope in the off state and re-adjust R8 as necessary to establish the ideal minimum bias point.

No setting up is required on the VCA as such except as explained above in relating input/output signal levels with the VCA on.

ELECTRONIC ATTENUATOR

The VCA, or to give it the proper title, electronic attenuator, is a purpose designed i.c. by Motorola.

The specification of the device is to provide an attenuation of 77dB and a gain of 13dB, relative to the input signal which should not exceed 500mV r.m.s., when the current sink from the control input (pin 2) is varied from minimum to maximum respectively.

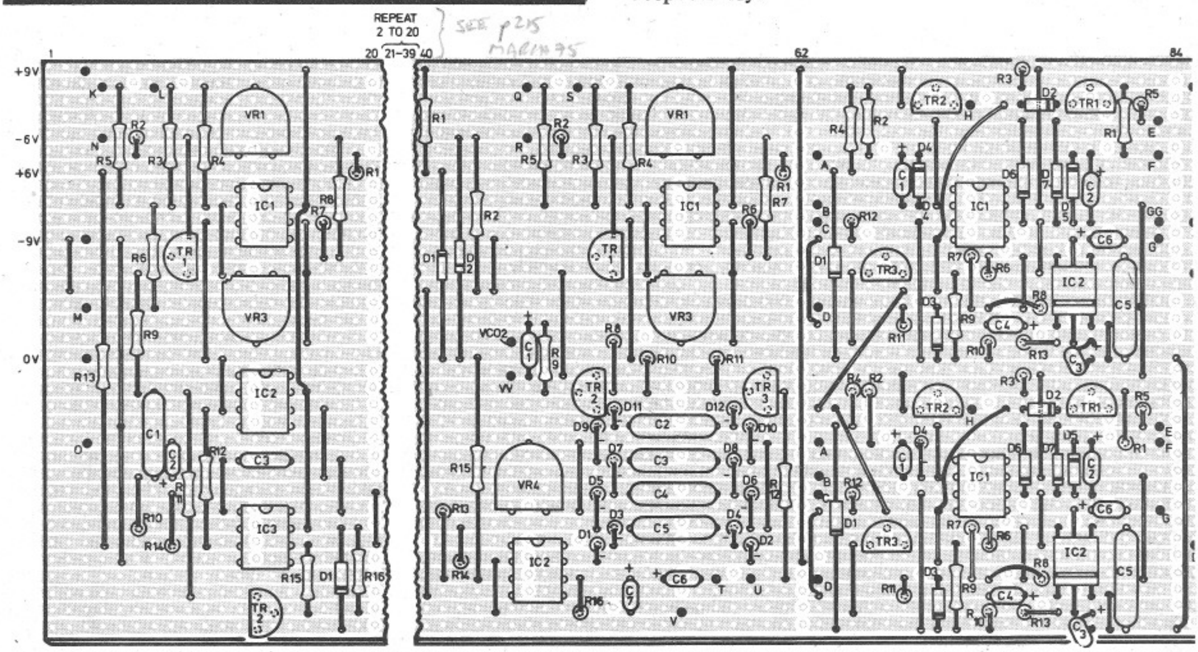
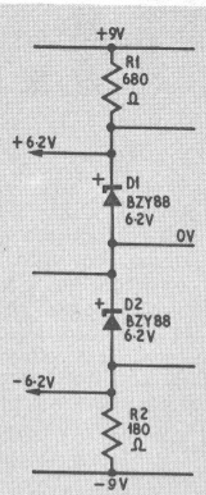


Fig. 2.8. Layout of the components on the Veroboard. Note that two identical VCO's are required side by side on the panel, only one is shown. Both Envelope Shapers are shown in full. Letters next to Veropins are for wiring to the front panel and correspond with those on the circuit diagrams



VOLTAGE REFERENCE

Resistors
R1 680Ω } ±5% ½W carbon
R2 180Ω }

Diodes
D1, D2 BZY88C6V2 6·2V Zener (2 off)

Fig. 2.9. Circuit of the voltage reference section giving ±6V

In the P.E. Minisonic the relatively low operating voltages result in a reduction of the overall attenuation/gain range to about 54dB which is sufficient for most practical purposes.

The current sink from pin 2 of IC2 is, in the off condition, restricted by the series combination of R10 and R13. As TR3 turns on it progressively short circuits R10 with the result that the current sink increases proportionately to a maximum which is limited by R13. It should be mentioned, of course, that the linear envelope of IC1 is converted into a negative exponential characteristic by TR3.

Although this is not ideal for an audio signal envelope, experience has shown that it is extremely difficult to differentiate subjectively between a negative exponential envelope and a positive exponential, or square law, envelope which is considered to give the best effect.

CONSTRUCTION

All the prototype circuits have been built in a number of alternative layouts and there appears to be no particular layout which gives rise to problems. The recommended Veroboard layout is shown in Fig. 2.8.

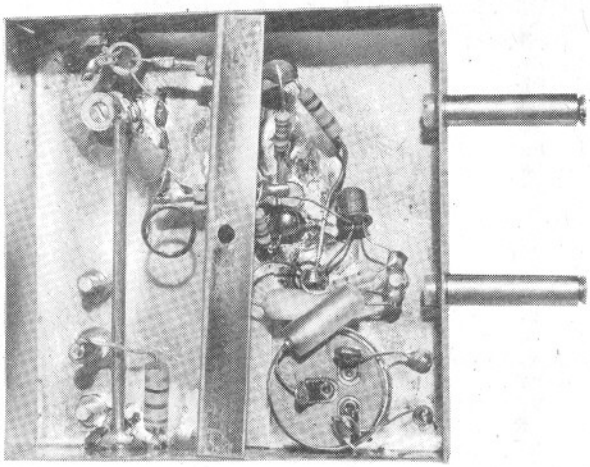
Also mounted on this section of Veroboard is the voltage reference section the circuit of which is shown in Fig. 2.9 (see photograph). This gives the stabilised ±6V rail for use in the VCO's and VCF.

It is recommended that all circuits in the P.E. Minisonic be bench tested and adjusted before any attempt to link the circuit boards with the front panel.

Next month: More of the P.E. Minisonic electronics plus details for wiring and setting-up.

P.E. CCTV CAMERA

continued from page 1059



Interior view of Crofton unit

camera u.h.f. signal might be beating with a normal transmitted signal giving patterning on the screen. Loss of sync is usually due to overloading of the signal and if the tuner has too much gain R10 can be increased until satisfactory results are obtained.

ALTERNATIVE MODULATOR

From what has gone before it can be seen that this form of modulator with a separate tuner might deter some constructors particularly if their involvement has never extended to u.h.f. It is for this reason that a commercial kit, the Crofton modulator, is recommended as an alternative, its obvious attractions being simplicity and small completed size.

The circuit for this is shown in Fig. 4.5 for which we are indebted to Crofton Electronics.

The kit comes complete with detailed building instructions. Numbered packs of piece parts with contents detailed means that instructions can be ticked off in the manual as construction proceeds until the unit is completed.

A step-by-step testing procedure is also included.

SCAN COIL CHANGES

Since the publication of the camera series a run on the specified EMI scan/focus coil assembly and a surprise discontinuation from the contracted manufacturer has meant finding a new coil assembly.

The author has found that the Japanese KV-13 assembly was not only a suitable substitute but provided an improvement in picture quality. Features include an automatic vidicon target connection and vidicon lens focusing by the turn of a small screw.

Both the coils and fitting data can be obtained from EMI, 243 Blythe Road, Hayes, Middlesex. The price is £14 plus VAT.

The only electrical modifications to be made is in the focus coil current supply. For this R50 and C31 in Fig. 2.10 are not required. The supply line input is +15V and should be taken from the Regulator circuit of Fig. 2.8.

Note that in the Components List for Part 1, R39 is 2·7kΩ, R8 —4·7kΩ and R42 —390Ω. These values are correctly shown in the circuits. ★