EURO-SERGE - SYSTEM MODULES

CONTENT

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Fast-Forward and Rewind

THE OVERALL DESIGN OF THE EURO-SERGE SYSTEM

With this last STEP all three kinds of voltages and all four major types of modules found on the Euro-Serge have been used.

The three kinds of voltage:

1. AUDIO VOLTAGES: Black/White/Grey jacks. 20Hz to 20kHz. Output voltage typically -2.5V to +2.5V. Audio voltages produced by green jacks typically 0V to +5V. However, any voltage range, so long as it oscillates in the audio range can be used as an audio voltage. Black inputs are typically AC coupled meaning that any slow or non-changing aspects of the voltage are blocked.
2. CONTROL VOLTAGES: Blue/Green/Violet jacks. Typically 0Hz to 500Hz but can be higher particularly in the case of FM and AM. Usually either -5V to 0V or 0V to +5V but can range over -10V to +10V. Blue inputs are DC coupled meaning they respond to the full range including negative voltages.
3. LOGIC VOLTAGES: Red/Yellow/Orange jacks. Either 0V or +5V with a fast rising edge between 0V and +5V. Some yellow outputs can hold high indefinitely, others fall back to 0V in a set time. Red inputs are triggered by the rising edge and therefore other voltages, such as inverted saw waves, can be used to trigger. Some red inputs control certain functions of a module as long as the voltage remains HI. In these cases any +5V level will sustain the function.

The four major kinds of module:

1. SIGNAL GENERATORS. These modules produce audio voltages as their output. The oscillators are examples of this kind of module. The ES05 Noise Generator is another
2. CONTROL VOLTAGE GENERATORS. These modules produce control voltages as outputs. Envelope generators and sequencers are examples of this type of module.
3. AUDIO PROCESSORS. These modules input audio voltages, operate on these voltages and output a related audio voltage. Filters are examples of audio processors. In general they operate on the timbre of the sound. Another type of audio processor inputs two or more audio signals and combines them in various fashions. Mixers and the ES79 Ring Modulator are examples of this type of module.
4. VOLTAGE PROCESSORS. These modules input a control voltage and output a related control voltage. A processor is an example, in which

case a control voltage is the input. The output might be the same voltage inverted.

5. A fifth type of module that has not been dealt with yet is the Audio-to-Control-Voltage converter. One example might be a module that inputs an audio signal and outputs a control voltage representing the envelope of that sound. The ES02 Preamp Detector is such a module and has the function of an envelope follower.

Once the concept and basic principles of these five types of modules are understood, an infinite array of new "instruments" can be made or "patched" out of the modules available on the Euro-Serge. New modules, once their basic type is determined and their internal workings understood can be easily added to existing modules. In general, modules of the same type can be substituted for each other.

Each of the next five chapters will cover one of these five types of module, presenting modules and functions not yet covered. It is suggested that each module be explored as it is presented by setting up patches using it modules already understood.

SIGNAL SOURCES

OSCILLATORS: All the Euro-Serge oscillators have the ability to generate audio frequencies. They all also have an input labelled [SYNC]. This input allows two VCOs to be locked together so that they will not drift apart in frequency. Two VCOs that have drifted just a few Hertz apart can cause a "beating" to occur at their difference frequency. Sometimes this is the desired effect, producing a choral quality to the sound. When using the [SYNC], one VCO is locked to the fundamental OR to a strong overtone of the second VCO. Locking on to an overtone is useful in the setting up of chords.

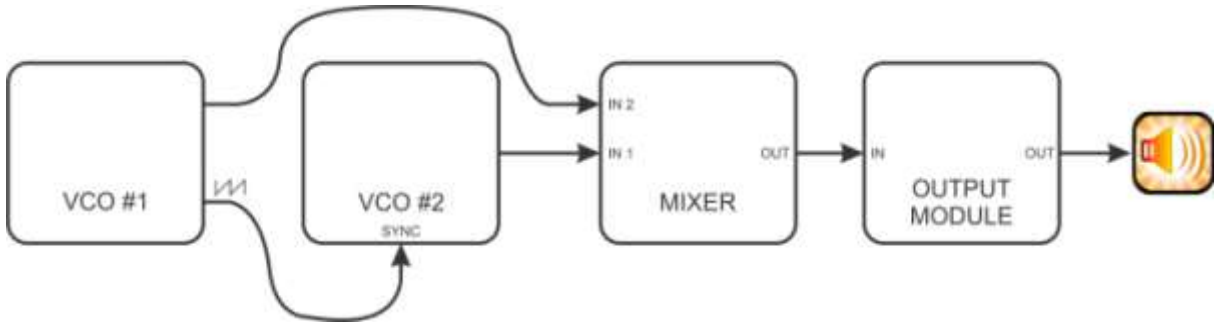

Figure 5.2.1

In the above patch VCO #2 is locked to VCO #1. It cannot drift. An interesting phenomenon occurs if VCO #1 is set very low and its [SAW] wave is used to sync VCO #2. If VCO #2 is now swept upwards over its range, either using its pot or a control voltage, you will hear it locking onto one overtone after another, creating a "just-intoned" stepped scale.

WHITE and PINK NOISE. White noise is a complex wave in which ALL frequencies appear mixed together. The sound is a sort of hissing sound.

Since it contains all frequencies it can be filtered in various fashions to produce bands of sound in many different frequencies. This is the ultimate material for subtractive synthesis. It is also useful for producing sounds such as snare drums.

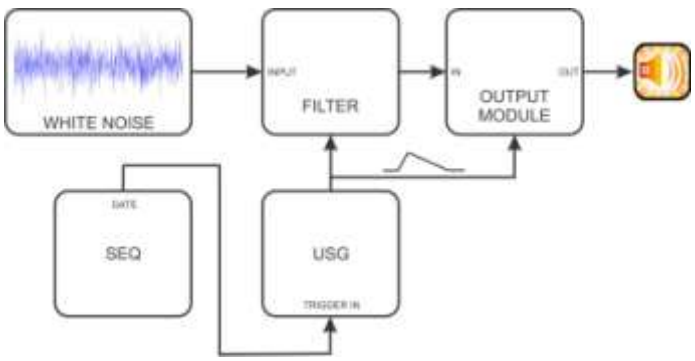

Figure 5.2.2

Pink noise is like White noise except that it sounds lower, more like a waterfall. The low frequencies have more amplitude.

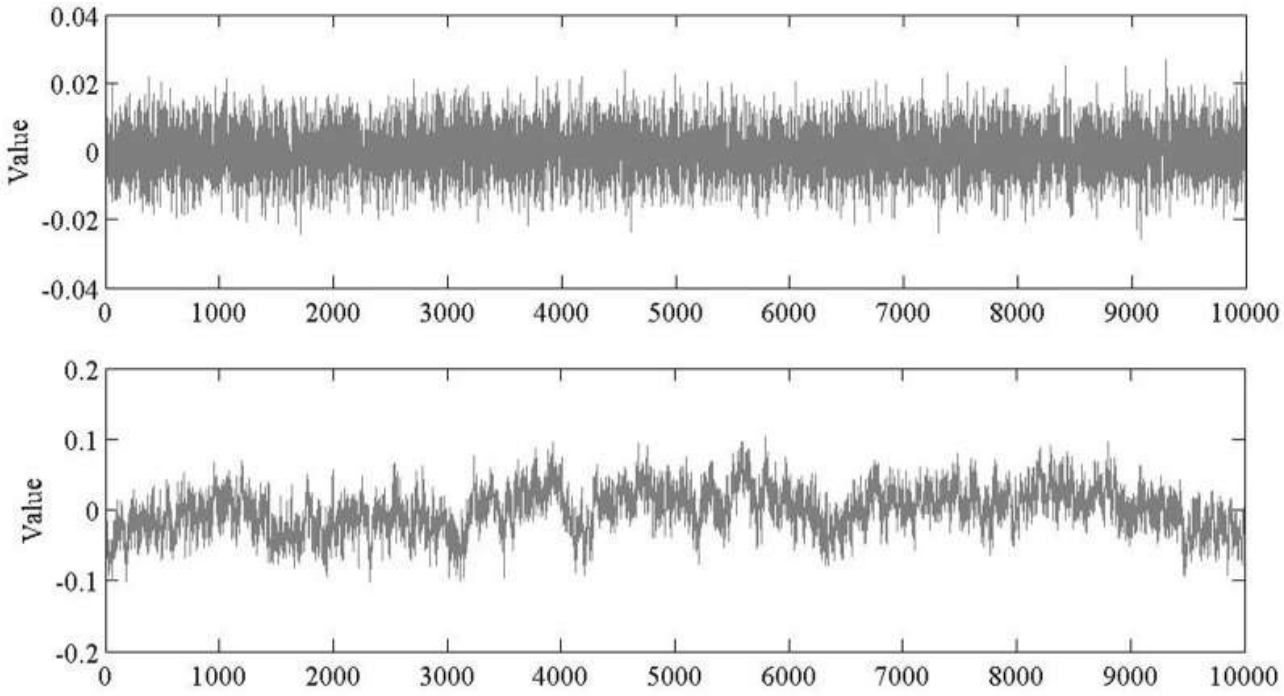

Figure 5.2.3 - White noise (top) and Pink noise (bottom)
!!! CHECK YOUR SPEAKER VOLUME FIRST !!!

RINGING FILTER. The filter can be "rung" much like a gong, with a trigger pulse to the [TRIG-IN].By adjusting the [FREQUENCY], different pitches can be achieved. Adjusting the Q will alter the sound from percussive clicks to bell-like sounds. The output is a damped sine wave:

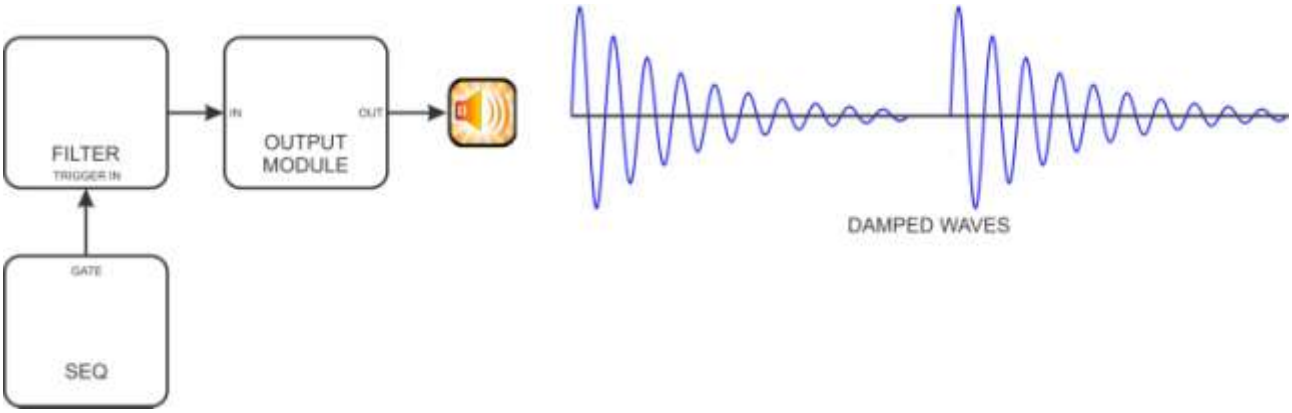

Figure 5.2.4 - Damped Cymbal and Undamped Cymbal

This technique can be used when other signals are applied to the [INPUT] of the filter to produce a wide range of interesting sounds.

SLOPE GENERATOR. As already discussed, the ES114 can be patched to trigger itself to produce a VCO. The frequency is set by adjusting the [RISE] and [FALL] time either with the pots or with a control voltage.

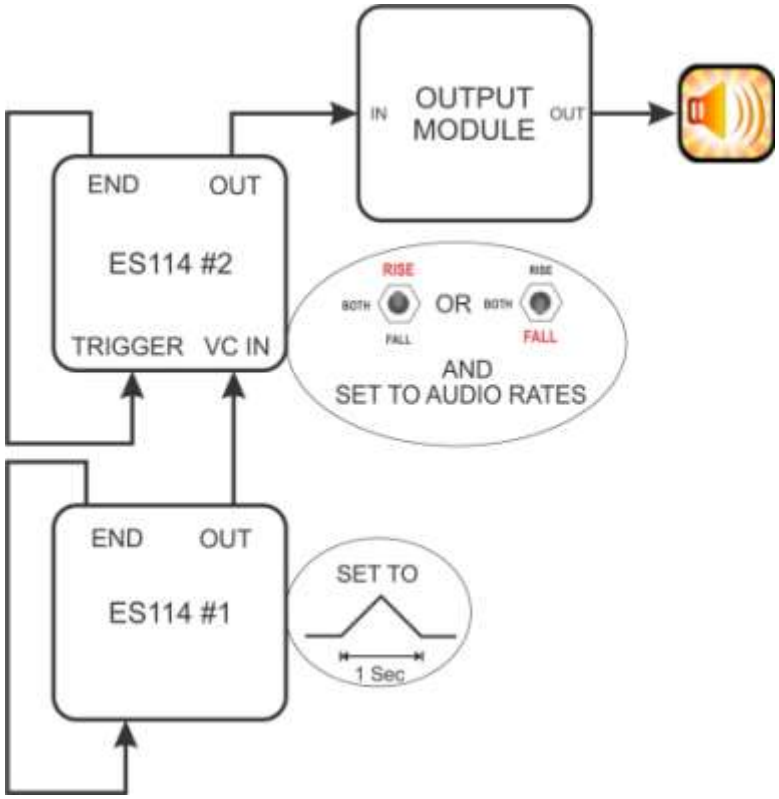

Figure 5.2.5

The ES114 can have a voltage controlled wave shape if the switch on [VC IN] is set to either [RISE] or [FALL].

AUDIO SEQUENCES. A sound source of a more unusual nature can be found in the ES28. To use the ES28 as a sound source the [CLOCK] trigger must be well in to the audio range. The output is taken from either the [A], [B], [C] or [D] outputs and sent directly to the output or to an audio processor such as a filter. Each pot on the chosen row defines the voltage of the wave at one point, so the wave shape is composed of eight levels. The frequency is one-eight of the frequency of the clock. Interesting wave shape variations can be produced by adjusting the position of the various pots.

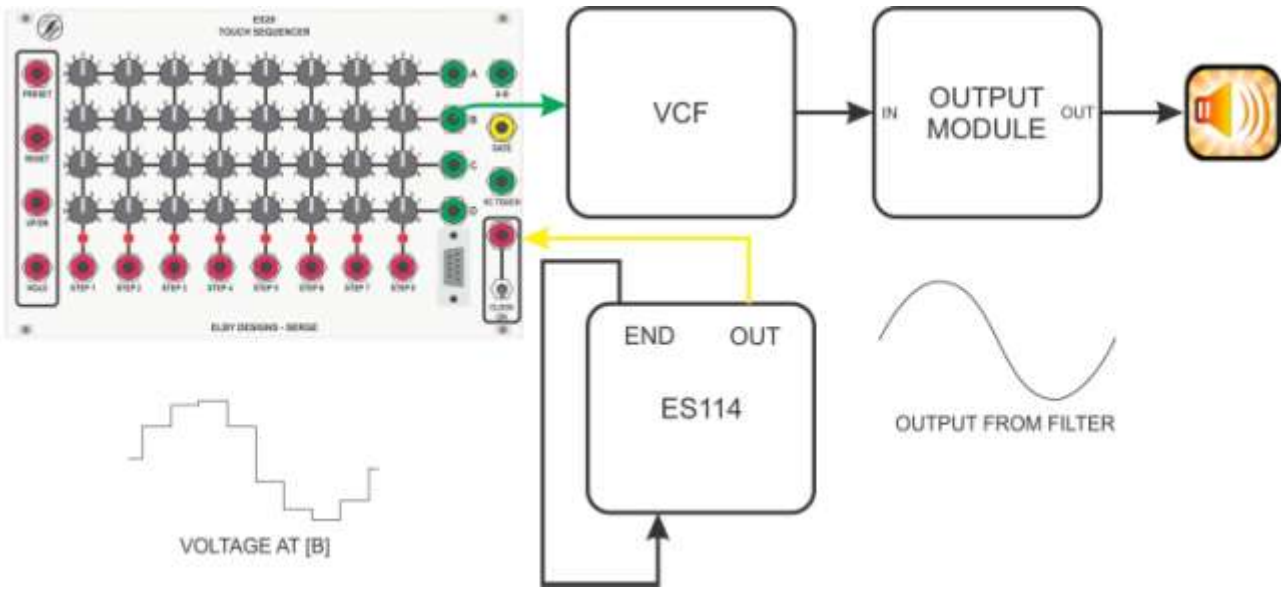
VCF
IN
OUTPUT MODULE
OUT
END
OUT
ES114
OUTPUT FROM FILTER
VOLTAGE AT [B]

Figure 5.2.6

CONTROL VOLTAGE SOURCES

ES01 RANDOM VOLTAGE GENERATOR. Very often you will want a changing voltage. Either it won't much matter what voltage it is, or you may want a surprise. Such situations come up when working with certain kinds of modern music such as Stochastic or Aleatoric, as well as other music styles such as symphony and rock and roll. In particular it sounds more "animated" to have timbre of an electronic sound slightly changing in a random or non-consistent manner.

The Euro-Serge provides three kinds of random control voltage: stepped, smooth and pulse. These are diagrammed below:

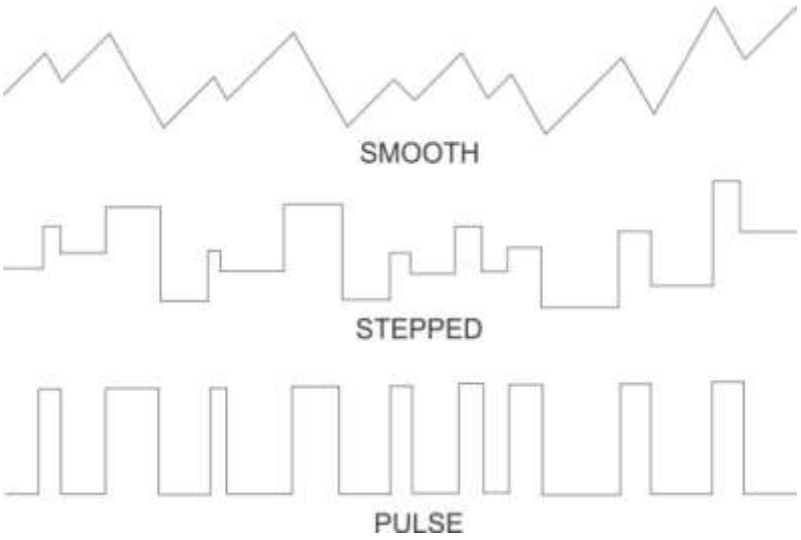

Figure 5.3.1

The [RATE] pot determines the overall rate of change, a function which can be voltage controlled.

Figure 5.3.2

The rate of randomness can be controlled on the ES01, and a processor or processing input can scale the random output to any desired level. The following patch is useful for exploring the possibilities of the smooth and stepped random output:

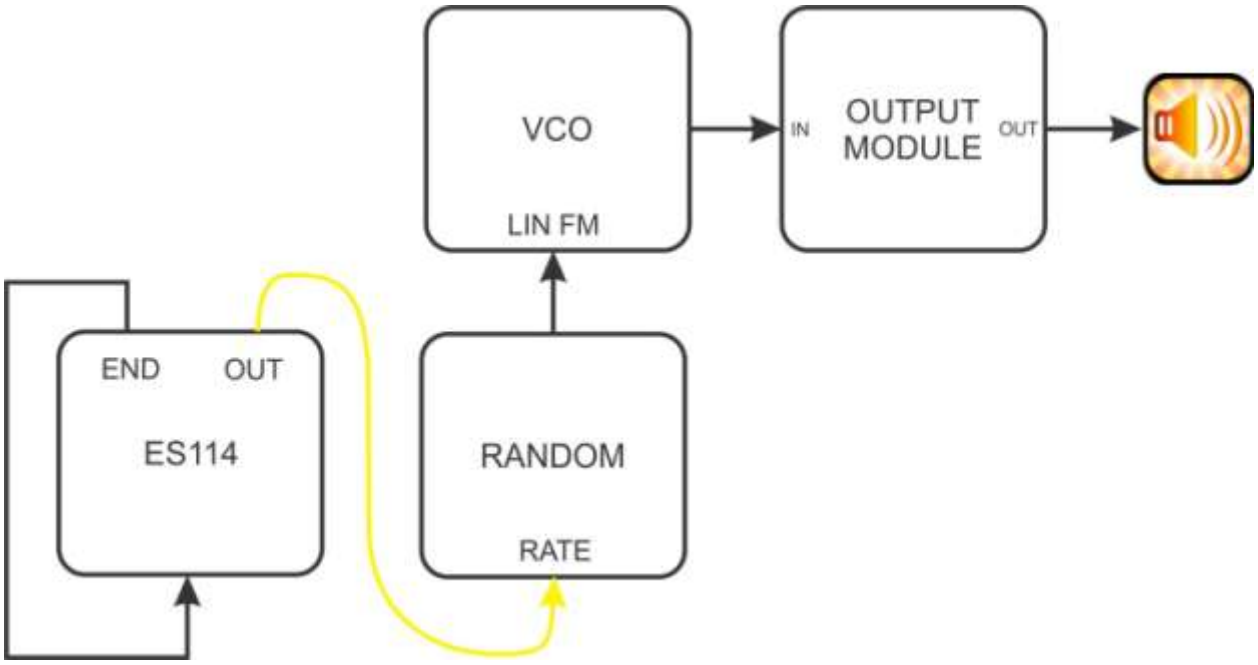

Figure 5.3.

If your Euro-Serge system has more than one random module it is possible to use a random control voltage to control the rate of the second random voltage. The pulse output can be explored using the following patch to provide a random rhythm:

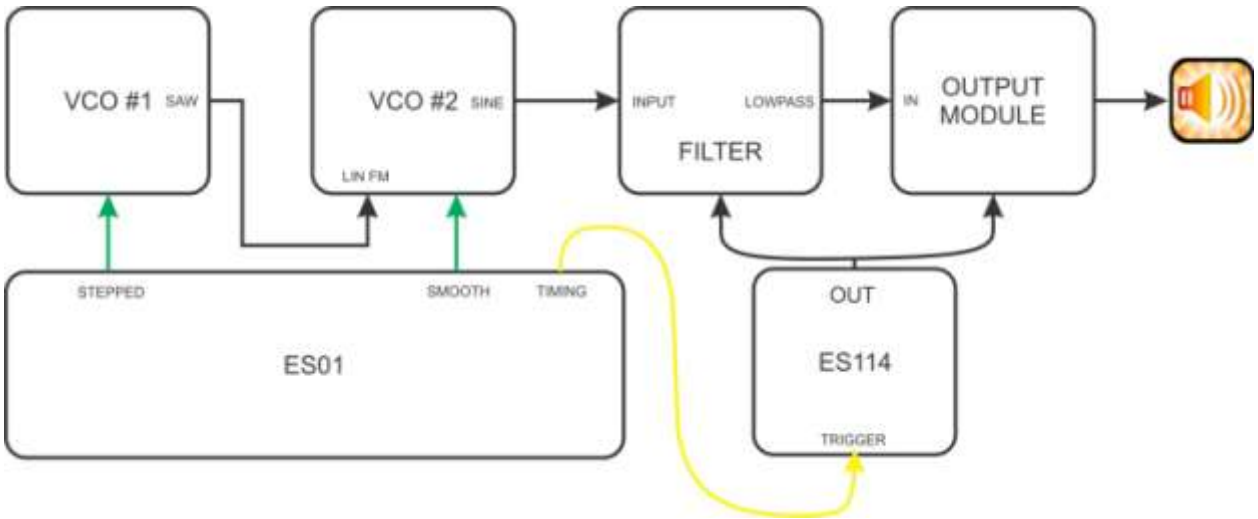

Figure 5.3.4

ES16 Extended ADSR: The ES16 is an envelope generator that can produce multi-segmented envelopes of a more complex variety than USG is able to provide. In certain kinds of synthesis this is necessary, since few natural envelopes are a simple rise and fall. The ES16 is able to provide a four-part envelope labelled ATTACK, DECAY, SUSTAIN and RELEASE, as in Figure 5.3.5.

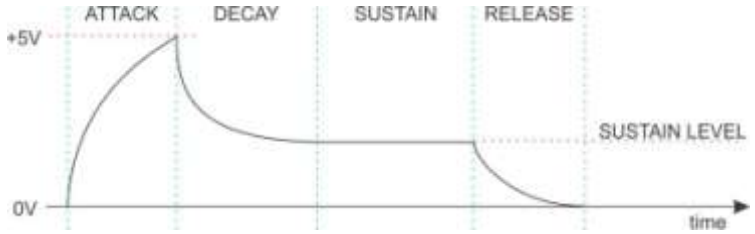

Figure 5.3.5

This envelope, in a general sort of way, represents the envelope of a trumpet or any instrument which can sustain a note at a steady level. The sustain section is settable to different SUSTAIN levels by means of a pot and a control voltage. In addition to these functions the ES16 also provides a delay that sets an amount of time between receiving a trigger and the onset of the envelop itself. This is useful when triggering related envelopes with the same TRIGGER or GATE.

The module is triggered by a pulse to its [GATE] input. Usually this trigger comes from a keyboard device such as the ES28's output which is a trigger that stays at a +5V level as long as a finger remains on the key:

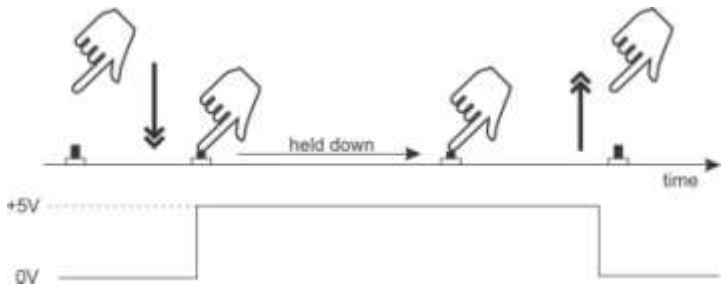

Figure 5.3.6

The sustained high level will be used in the timing of the ES16's output.

The ES16 has five pots, each with an associated control voltage input jack. These control voltages affect the same segments as the corresponding pots. The [DELAY (T1)] pot/control sets the length of the delay between receipt of the trigger pulse and the onset of the envelope. The further left the pot is set the longer the delay. The [ATTACK (T2)] pot controls the slope of the ATTACK in much the same way as the [RISE] pot on the ES114. It too is voltage controllable. The [DECAY (T3)] control/pot controls the slope of the initial DECAY, which falls to the voltage level set by the [SUSTAIN] control/pot. The ADSR will sustain the output voltage set by the control/pot for as long as the [GATE] input remains high. In the case of the ES28 [GATE] output, this is as long as one holds a finger down on the keypad. When the [GATE] goes low, the [RELEASE (T4)] control/pot determines the slope of the final DECAY.

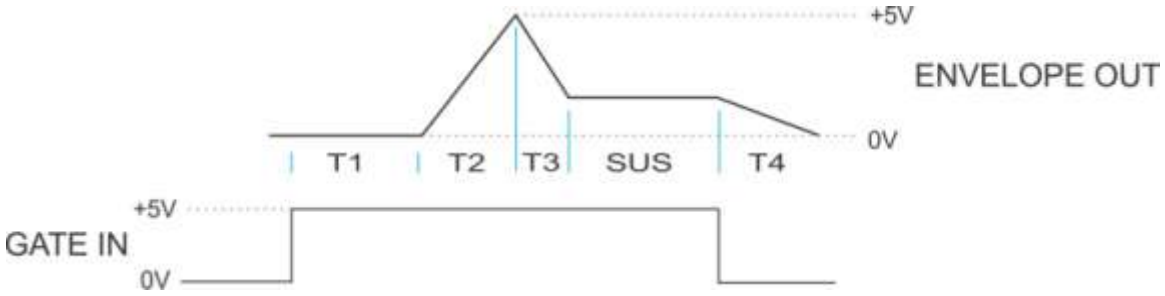

Figure 5.3.7

The ES16 functions in a slightly different fashion if the trigger pulse is applied to the [TRIGGER] input and not the [GATE] input. When there is no input to the [GATE], the output of the ES16 remains at the voltage set by the [SUSTAIN] control/pot. When the ES16 receives a trigger pulse the voltage drops to 0V from this level at a rate set by the [RELEASE (T4)] control/pot. The voltage then rises to the peak voltage at a rate set by the [ATTACK (T2)] control/pot and finally drops back to the level set by the [SUSTAIN] control/pot at a rate set by the [DECAY [T3)] control/pot.

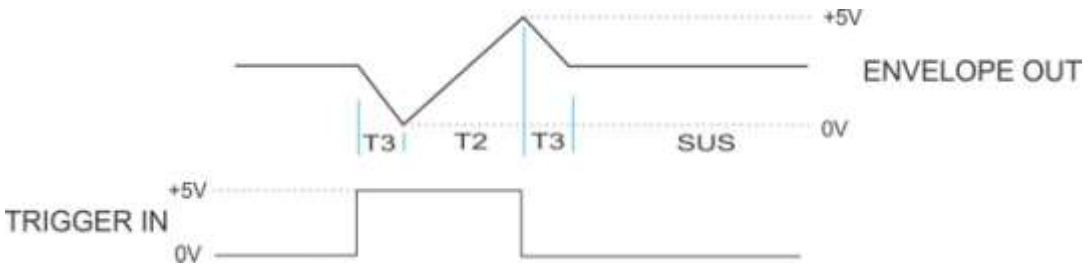

Figure 5.3.8

Using both inputs, more complex envelopes are possible. For example, during the sustain time set up by a GATE pulse, a trigger received at the [TRIGGER] will cause a new attack to start.

While in the sustain mode of an envelope, the ES16 will respond to changing control voltages at it's [SUSTAIN] input. This makes complicated sustains possible.

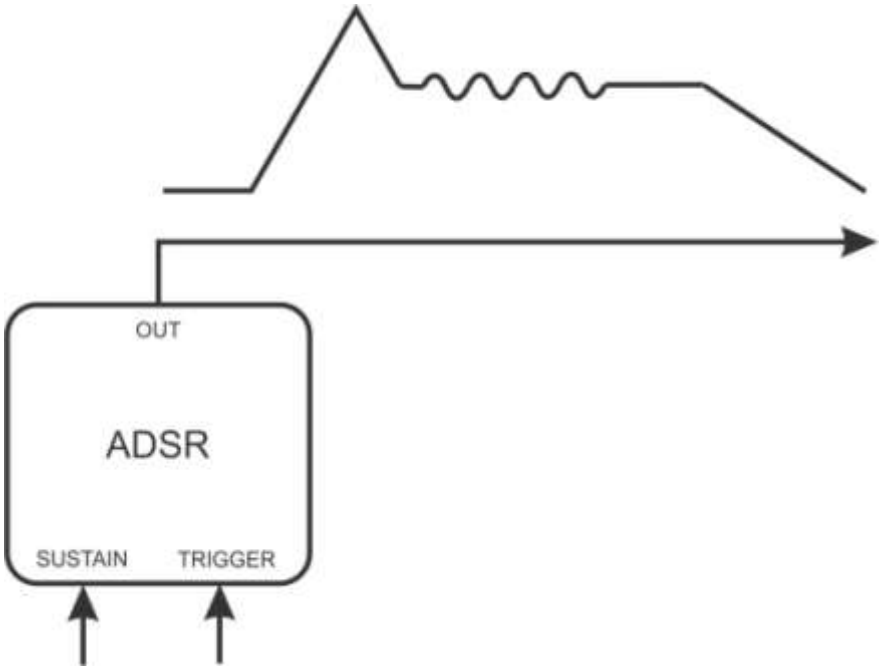

Figure 5.3.9

ES34 TOUCH PAD KEYBOARD on the ES28. The ES28 can be thought of as two separate but interconnected modules: the Sequencer and the Keyboard. The sequencer can be used by itself by removing the ES34 and its umbilical cord.

The ES28 provides the user with four voltage outputs [A], [B], [C] & [D], and [VC TOUCH] which output a voltage depending on which keypad was last pressed. Each keypad can be assigned a voltage such that keypad [1] has the lowest voltage, keypad [2] the second lowest and so on up to keypad [8] which has the highest voltage. Setting the voltage increase between any two adjacent keys to an equal voltage, allows the ES34 to be used as an equal-tempered scale keyboard. A processor or processing input can be used to calibrate an oscillator to produce any desired equal-tempered scale including the western 12 divisions to the octave.

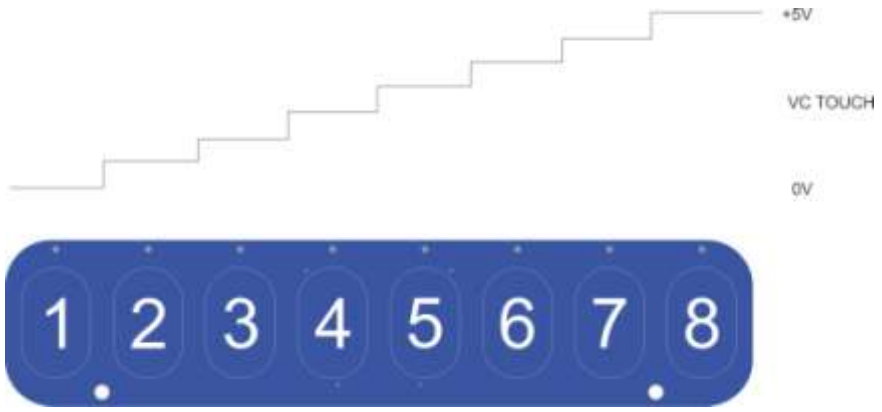

Figure 5.3.10

The [VC TOUCH] output is a voltage proportional to the amount of pressure applied to the keyboard with the finger. When used to control a VCA, it can act much like an expressive envelope generator simulating the 'piano-forte' (soft-loud).

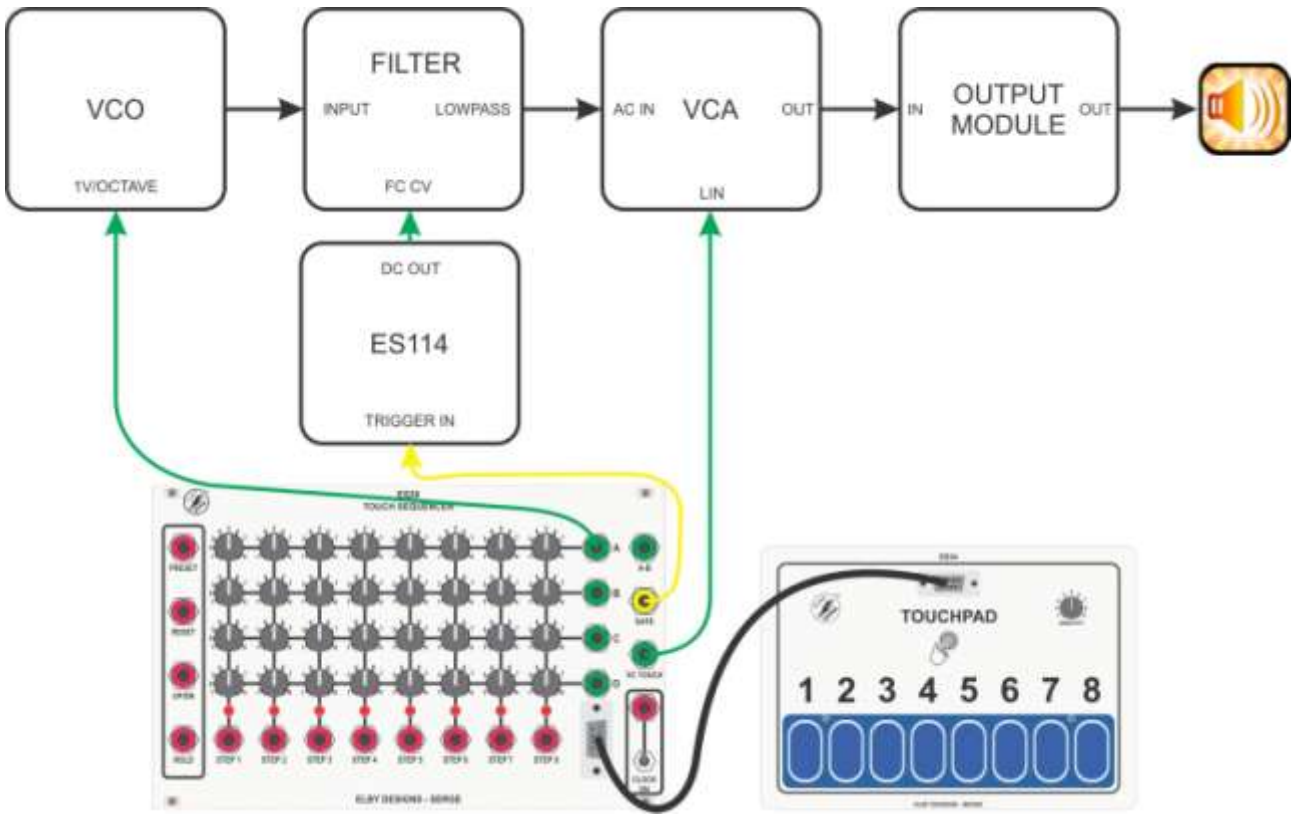

Figure 5.3.11

ES27 TRANSIENT GENERATOR. The ES27 is a smaller version of the ES114. The [RISE] and [FALL] are only voltage-controllable simultaneously and can not be controlled separately. The ES27 has three outputs: a final

pulse [END OUT] which can be used for recycling itself or triggering another function, and two envelope outputs [DC] and [BI-POLAR].

In the patch in Figure 5.3.12, the outputs from two ES27 are mixed with the ES14 Processor module to generate complex envelopes. Note that in this patch diagram, the [END OUT] to [IN] connection is shown with a dotted line, this is because the EURO-SERGE banana sockets have a unique feature commonly known as 'normalising' in which a 'default' signal is internally patched to the jacks 'signal' pin while there is no jack inserted. Inserting a jack disables this 'normalised' connection allowing the external patched signal to take control. This function is that same as fitting an 'INTERNAL-EXTERNAL' switch alongside the jack.

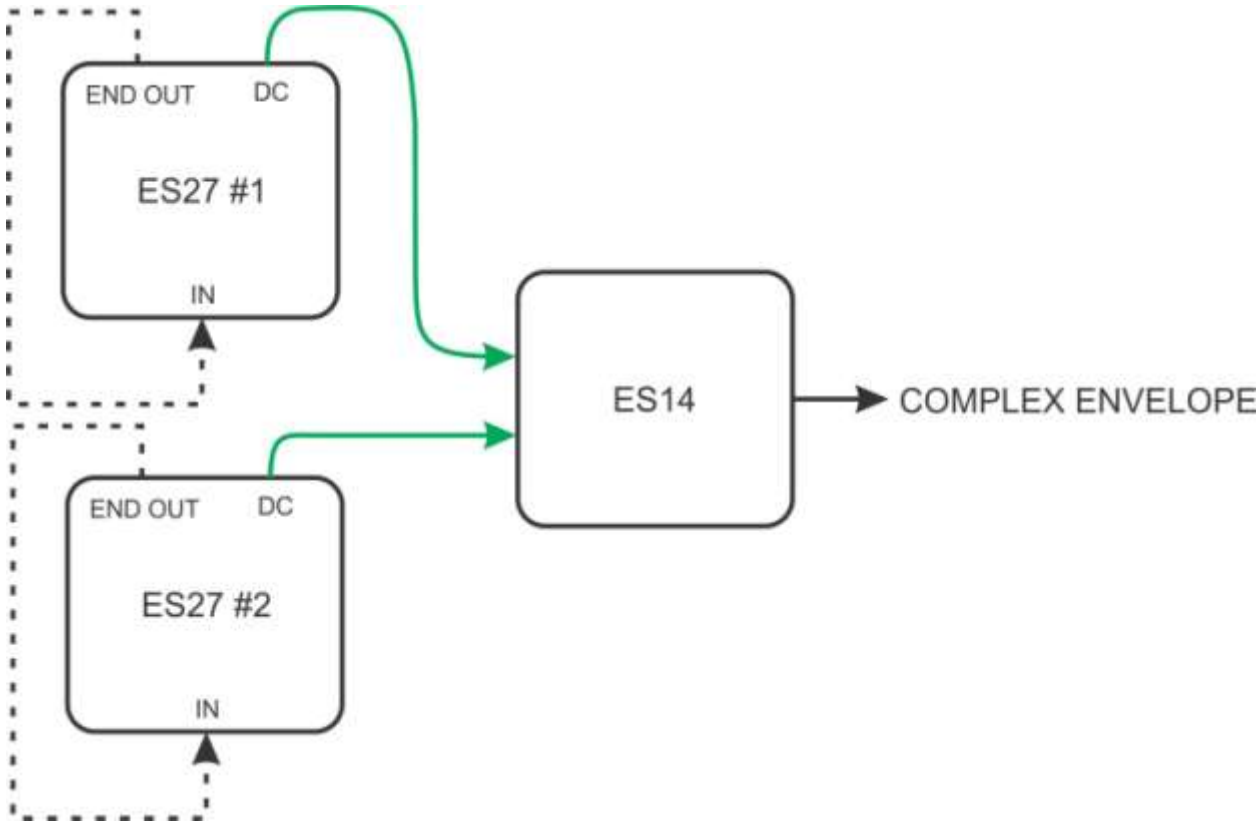

Figure 5.3.12

AUDIO PROCESSORS

There are four major paths to analogue electronic music synthesis:

1. ADDITIVE SYNTHESIS: Since any sound can be shown to be made of sine waves, it is possible to construct any sound by adding the appropriate sine waves together. While conceptually this seems to be the most flexible method of synthesis, in reality it is a difficult and time-consuming procedure except in some limited cases. Often it is more practical to mix already complex sounds together
2. SUBTRACTIVE SYNTHESIS: The opposite of additive synthesis is subtractive synthesis. In its ideal form, one can take white noise, which contains ALL frequencies and subtract the ones not wanted, much like the sculptor chipping away at a block of stone. More commonly, the synthesist takes appropriate waveforms, such as sawtooth waves, or a mix of waves, and "chips" away at these sounds.
3. MODULATION: There are a number of electronic processes that take one simple waveform and modulate it, or alter is, with a second waveform. This would include AM, FM and RING modulation. The resultant waveforms are then often subjected to either additive or subtractive synthesis.
4. WAVESHAPING: Wave shaping is a technique where a given wave is input in to a device and a related but different wave is output. For instance, a simple wave shaper is a "rectifier" which outputs the absolute value of its input wave.

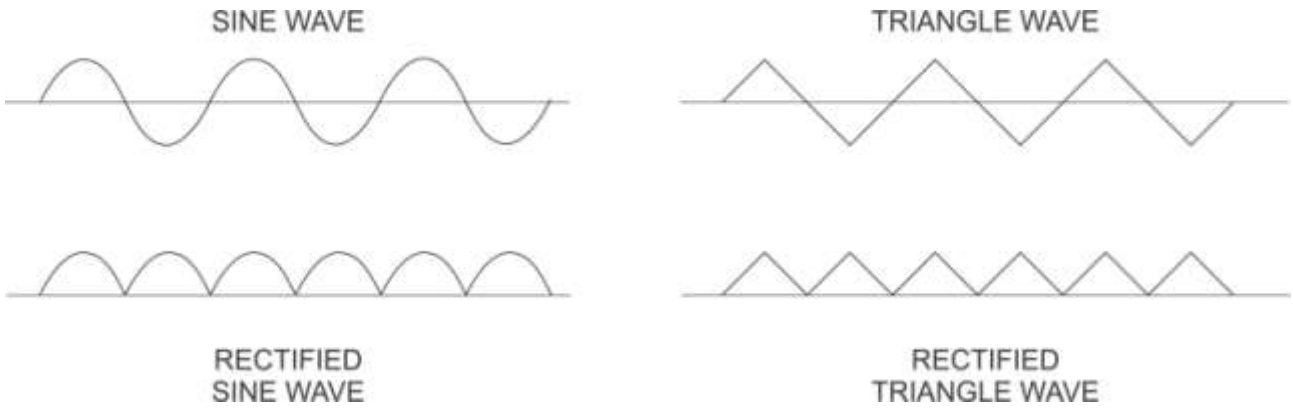

Figure 5.4.1

Modules that wave shape signals, add signals together, subtract parts of signals, or that modulate signals are called Signal Processors. The Euro-Serge system is a Signal Processor-rich synthesizer and includes many processors that are not found on any other synthesizer. So far in this manual

the processors dealt with have been mixers, voltage controlled amplifiers and filters.

ES22 RESONANT EQUALIZER. An Equalizer or Comb filter is a bank of band pass filters that cover the entire spectrum and whose outputs are mixed together such that amplitudes of each filter can be controlled. With this device the sound as a whole can be adjusted and balanced to suit. The Resonant Equalizer has ten bands with each band's output being controlled by a pot that is labelled with the centre frequency of the band. When the pot is turned right, the band it controls is amplified up to about the '8' position (this is 12dB higher than the input signal). Past '8' the band is given more and more resonance. If the pot is turned to the left the associated band is attenuated further and further.

The ES22 has three outputs. The ES22 output sums all ten bands together while the remaining two outputs each sum together alternating outputs.

The bands are arranged in sevenths so that a false tonic does not develop. A LEVEL pot adjusts the overall gain of the output and prevents overload when resonance is set high. These fixed resonant bands are common in almost all timbres produced by musical instruments, and it is the skill of the violin or piano manufacturer in tailoring these resonances that partially determines the quality of the instrument.

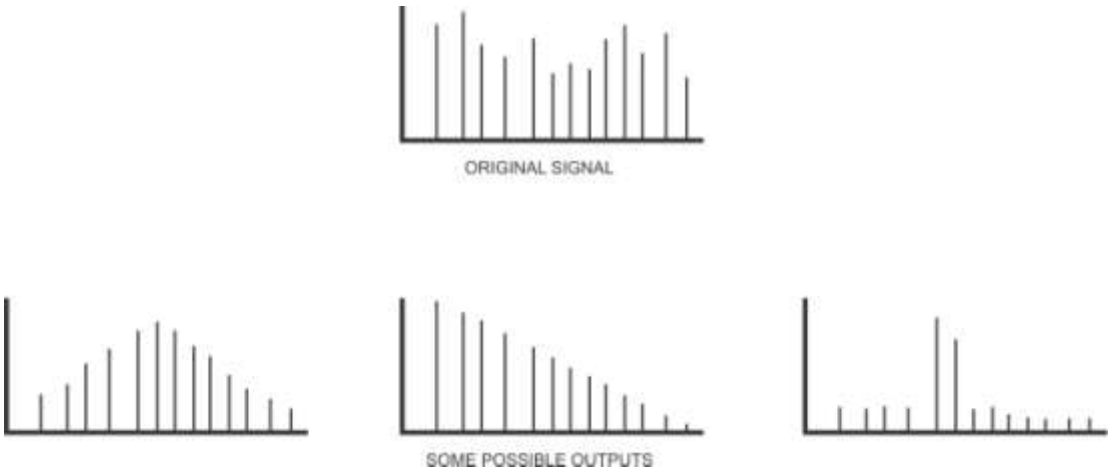

Figure 5.4.2

ES10 TRIPLE WAVESHAPER. The ES10 module contains three identical devices which can be used to convert sawtooth waves in to sine waves and can provide a wide range of other forms of sound and timbre modification. The timbre can be affected by a manual pot and two different VC inputs which operate on the sound in two different ways. It is a useful module for producing interesting and changing sound timbres, something difficult to achieve in other synthesizers.

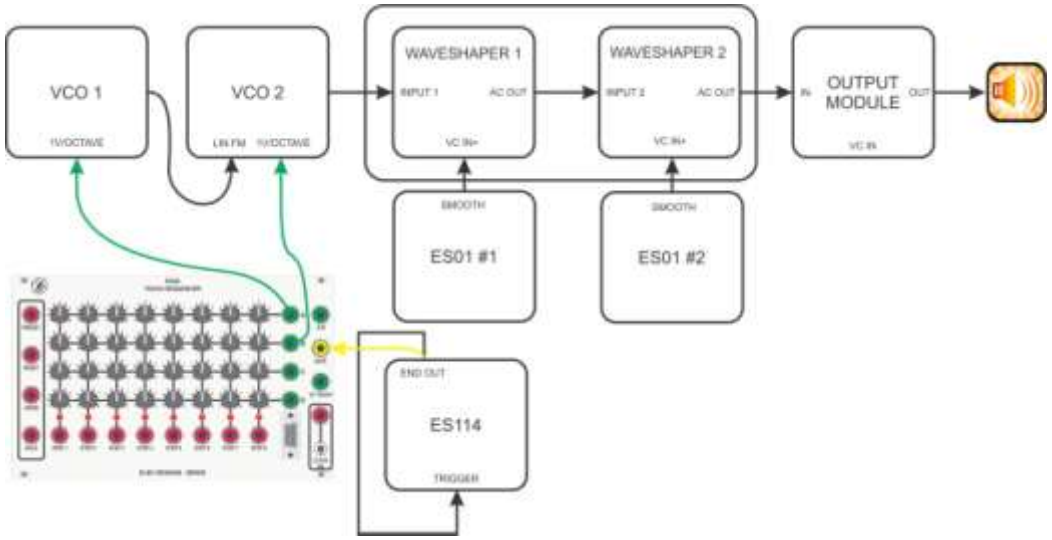

Figure 5.4.3

WAVE MULTIPLIERS (ES04, ES17, ES18). The Wave Multiplier modules are a family of modules that operate on their inputs in a unique fashion, transforming simple sounds into musically complex and interesting ones. They should not be confused with such devices as Ring Modulators which multiply their input signals in a linear fashion - the Wave Multipliers are highly non-linear in their action. In many ways these modules represent a new node in the typical synthesizer patch.

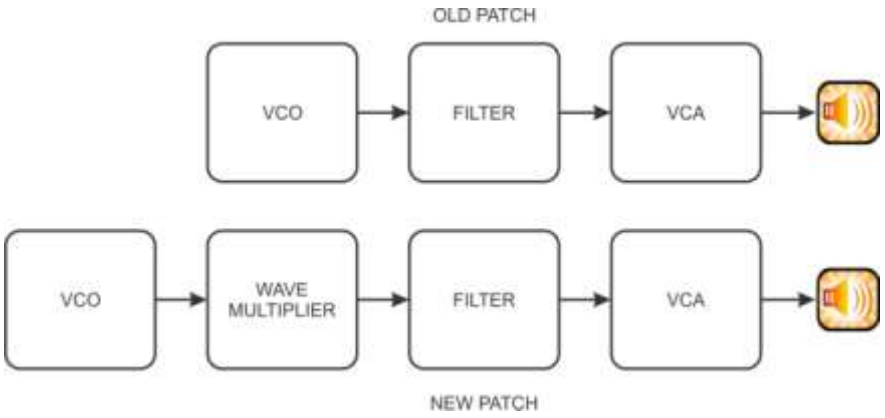

Figure 5.4.3

ES04 VCM 1. ES04 is the simplest of the trio. It has a switch for two different settings characteristics. In the [OVERDRIVE] position, ES04 acts to moderately "square up" or soft clip the signal. The soft clipping is amplitude dependent, producing changes in timbre as the loudness increases.

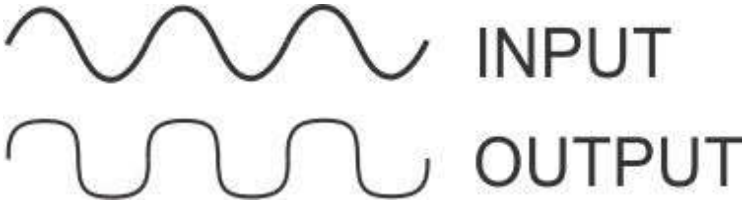

Figure 5.4.4

In the [LINEAR] setting it acts like a linear VCA. A device useful for producing different types of AM sounds.

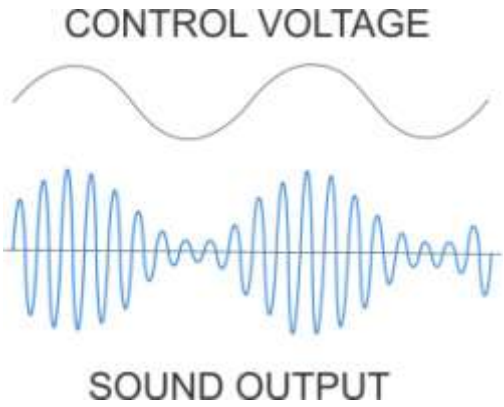

Figure 5.4.5

In both settings the module can be controlled either manually or with a control voltage.

ES17 VCM 2. ES17 has two inputs, each producing a slightly different result at the output. One input is DC coupled and has a Blue jack. The other input is AC coupled and has a Black jack. A sine wave will sound the same when connected to either input, but a triangle wave will produce different effects. These inputs can be used together to provide unusual effects. The general effect of the module is to produce new odd overtones from a sine wave input when the manual pot is turned or when a voltage is applied to the [VC] input. However, control voltages of complicated natures or inputs more complex than sine or triangle waves can create shimmering bodies of sound somewhat reminiscent of over-blown wind instruments. The [VC] input can accept AC signals, allowing for more complex modulation.

ES18 VCM 3. Like the ES17, ES18 also has two independent (but identical) inputs. Both inputs are AC coupled. The general effect of the module is that of a full-wave rectifier for audio signals, which means that negative voltages are "flipped" up in to the positive realm.

Such a rectified sine wave contains only even harmonics and is one of the few waveforms to contain only these harmonics. The ES18 in actuality contains three waveform-transforming circuits in a carefully controlled series.

Figure 5.4.6

Like the ES04 and ES17, the module produces both manual and voltage control over the output. Unlike its companion modules, however, there are distinct outputs, [AC] and [DC]. The [DC] output provides a "squared up" version of the [AC] output.

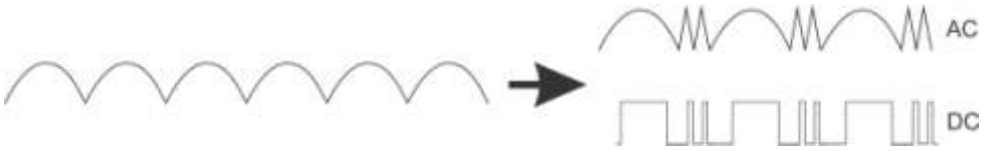

Figure 5.4.7

One important feature of the ES18 is that, unlike simple rectifiers, the amplitude of the output does not decrease through successive rectifications.

Overall, these three Wave Multipliers provide a method of producing timbres as rich and as varied as acoustic sounds and yet having the precision and repeatability of analogue synthesis.

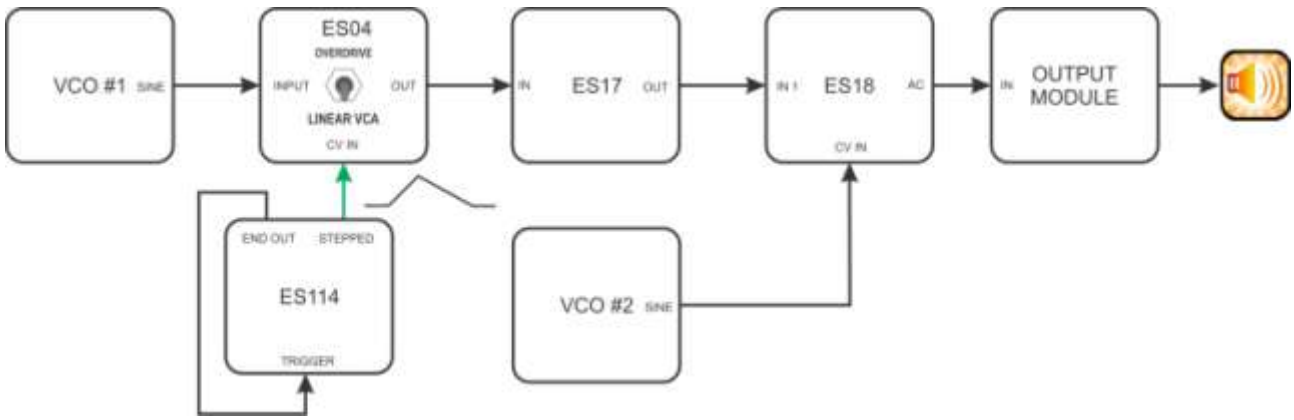

Figure 5.4.8

ES114 UNIVERSAL SLOPE GENERATOR. The ES114 can function as a non-linear low-pass filter essentially by softening the slopes of the [IN] signal. Generally speaking, the less steep the slope of a waveform the fewer high frequencies it contains. To accomplish this the RISE and FALL items must be set quite fast. Increasing either the [RISE] or [FALL] times will increase the filtering action.

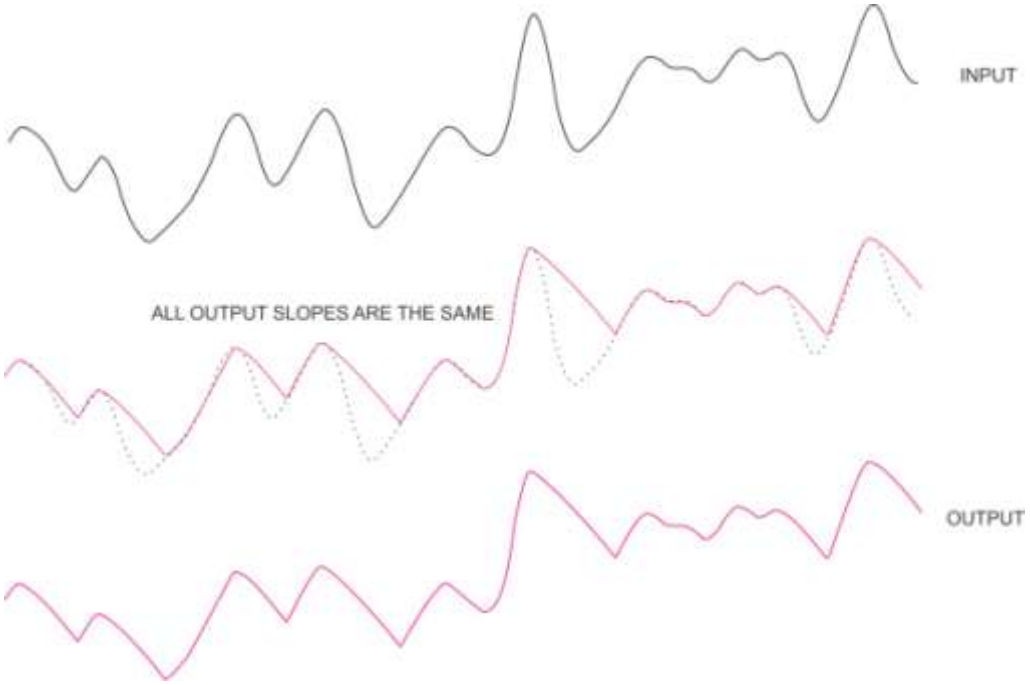

Figure 5.4.9

Because the RISE and FALL time on the ES114 is voltage controllable, when used in this fashion, the module becomes a voltage controlled filter.

Figure 5.4.10

Closely related to this patch is the use of the ES114 as an ENVELOPE FOLLOWER. An envelope follower is a device or module that inputs a complex sound and outputs a control voltage proportional to the envelope of the input.

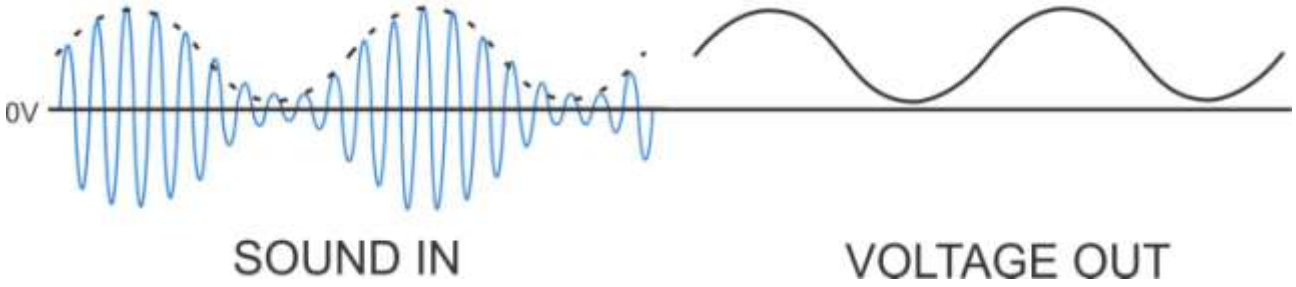

Figure 5.4.11

To create an ENVELOPE FOLLOWER it is not desirable to exactly follow the voltage, for that will simply reproduce the wave itself, perhaps with a slight delay or softening of the slopes. Rather, an envelope follower should follow the rising voltages as closely as possible, but have a very slow FALL time. When this is done, the upper edge of the waveform alone is traced, this being the envelope.

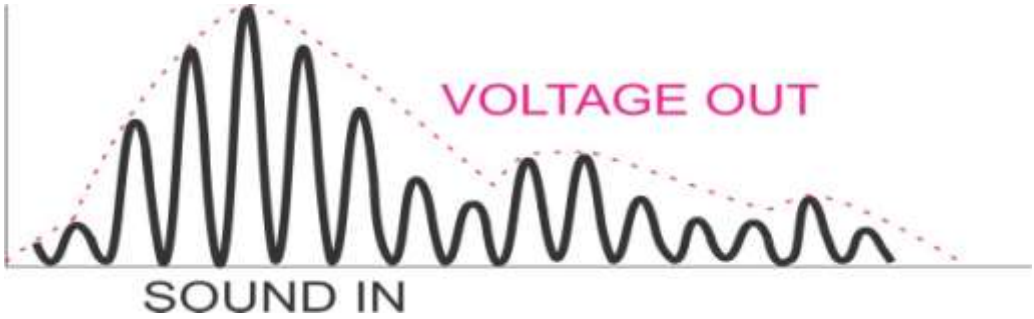

Figure 5.4.12

On the ES114 this is easily accomplished by using a very fast RISE time and a slow FALL time.

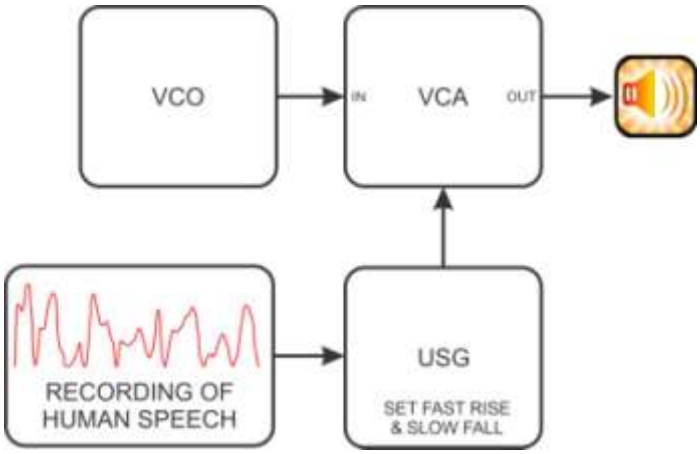

Figure 5.4.13

If the ES114 is set with a fast FALL time and a slow RISE time, the ES114 will follow the negative peaks of the sound. Usually these peaks are almost identical to the positive ones, but not necessarily always. The negative envelope can be used directly to "shut down" a VCA. This can be useful for suppressing backgrounds during solos and for inverting dynamics.

Another use of the ES114 is that of a SUB-HARMONIC or UNDERTONE GENERATOR. This is accomplished by applying a very fast pulse train to the [TRIGGER IN] and by having an ES114 set to audio frequencies. The ES114 will not respond to a second trigger until its envelope is complete. If the duration of the envelope is set (manually or with a control voltage) longer that the time frame between the pulses in the train, it will "skip" one (or more) pulses. If it misses a single beat, the frequency is lowered by an octave; if it misses two, the frequency is lowered by an octave and a fifth. Note that this wave has an inverted trapezoidal shape.

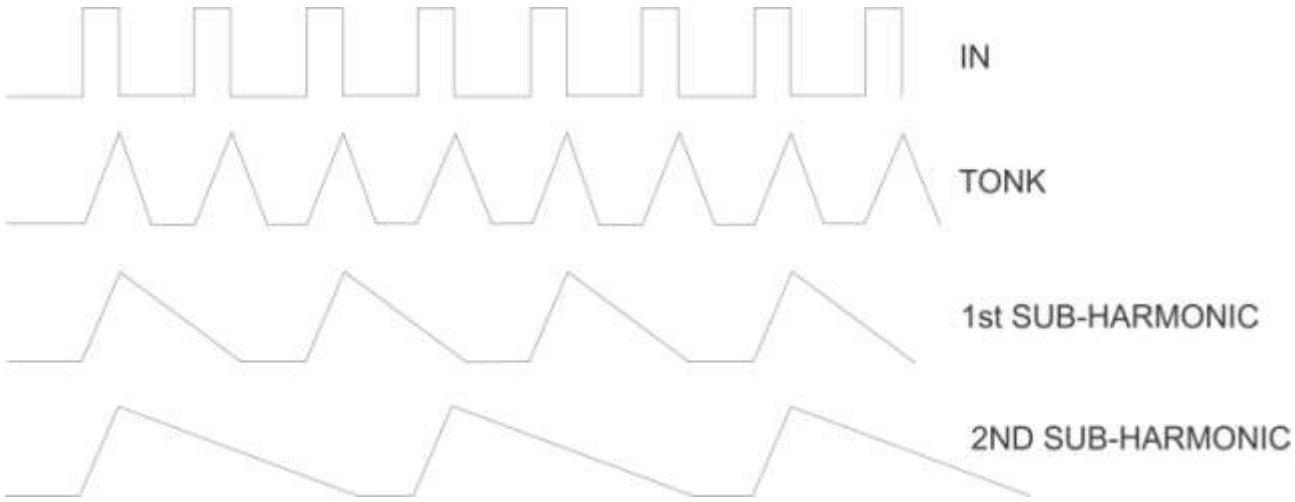

Figure 5.4.14

It is sometimes desirable to shape the envelope so that is has a NON-LINEAR SLOPE, this is often the case when producing long sustained sounds or sounds that gradually change in loudness over a long duration. The ES114, when patched to the VCA, will see to have little effect on the loudness of sound at the start and the end of the long envelopes. This is because of the wide range of the VCA's and the exponential relationship between the voltage and the amplitude.

By "feeding back" the output of the ES114 to the [VC-IN] and setting the processing pot to the left, the final output is made non-linear. This phenomenon occurs because higher voltage to the VC input causes the slope to decrease, so the ES114 remains longer at the higher voltage levels.

If the processing pot of the ES114 is turned to the right, the feedback has the opposite effect: the envelope becomes a sharper and sharper spike, useful for creating short percussive envelopes.

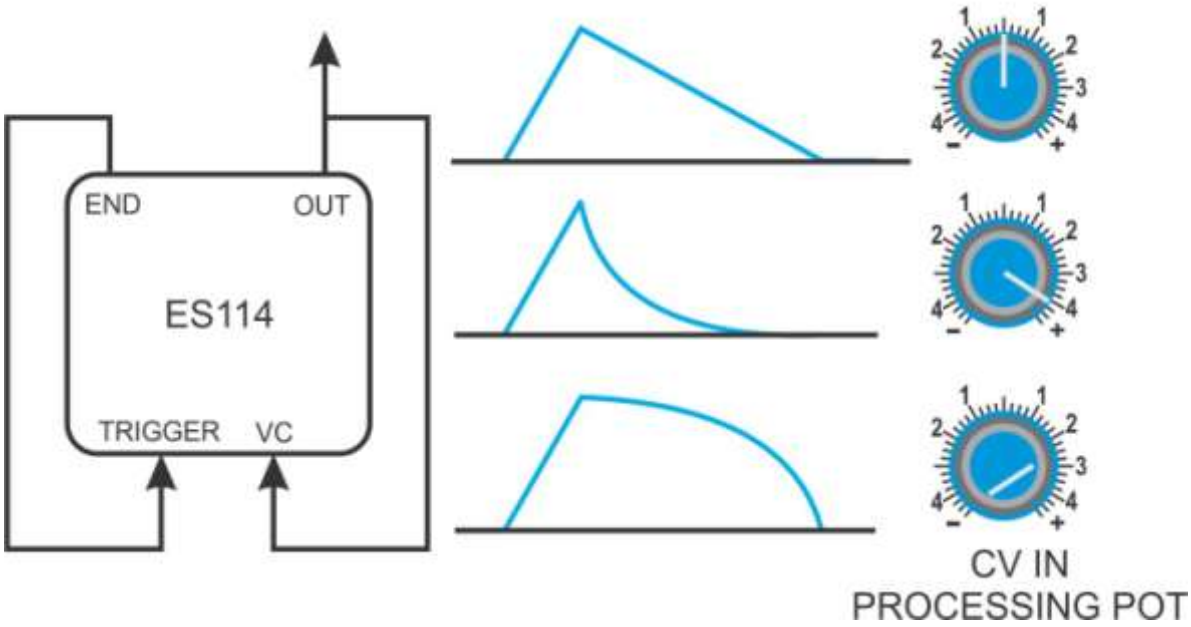

Figure 5.4.15

ES11 TRIPLE COMPARATOR. The ES11 contains three separate (but identical) comparators. The action of these comparators is this: when the voltage of the "-" input is greater than the voltage at the "+" input, [OUT] goes high to +5V. Otherwise [OUT] is at 0V. The pot sets a threshold voltage which is added to the "+" input. If there is no "+" input, this pot alone sets the voltage which the "-" input must rise above for the [OUT] output to go high.

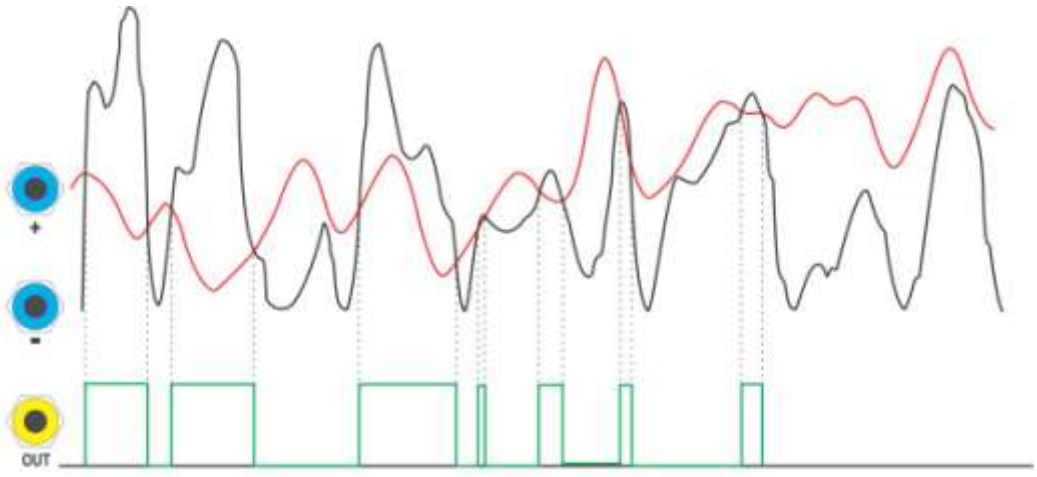

Figure 5.4.16

This device can be used to cerate rectangular waves of various duty-cycles. By inputting a sawtooth wave in to the "-" input and inputting a control voltage in to the "+" input, a voltage controlled pulse width generator can be created. These pulses sound like a certain kind of filtering or phasing. A square wave contains only odd harmonics but different rectangular waves contain different harmonics depending on the "duty cycle" (amount of ON time to OFF time). It is interesting to note that rectangular waves with duty cycles of: 1:2 have these harmonics missing: 2, 4, 6, 8, 10 etc (a square wave has only odd harmonics); 3:1 have missing 3, 6, 9, 12 etc; 5:1 have missing 5, 10, 15, 20 etc.

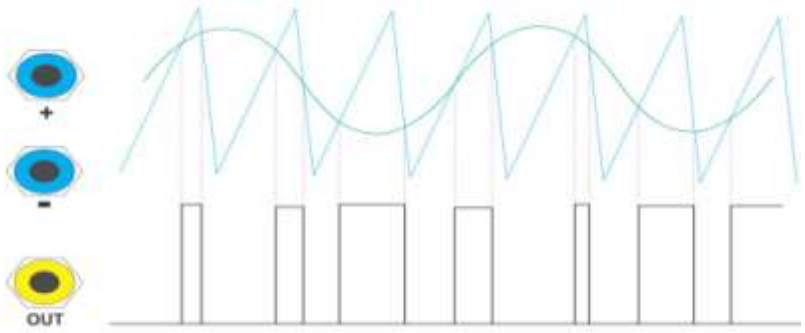

Figure 5.4.17

The pulse outputs of the ES11 can be used to trigger any device on the Euro-Serge that requires a trigger pulse.

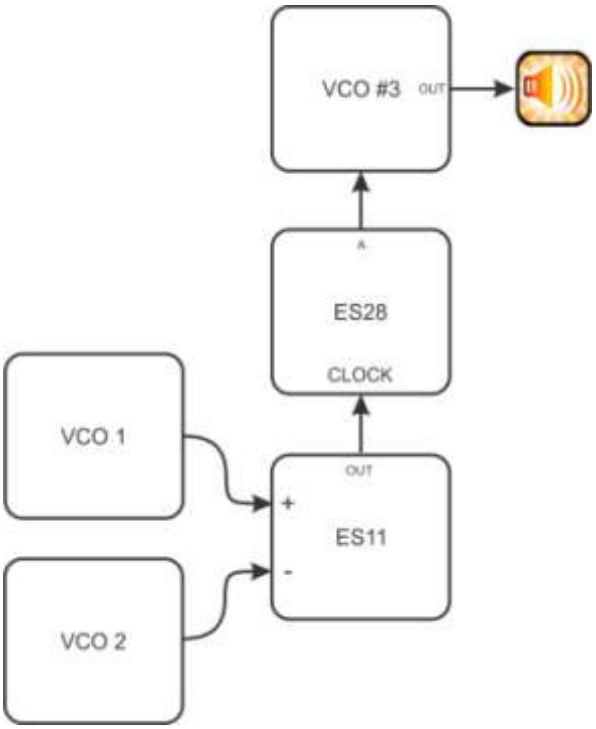

Figure 5.4.18

ES78 VCA. The ES78 has an audio input, a voltage control input, an output and a [GAIN] pot. These are logarithmic VCAs and are useful for putting envelopes on sounds, and for Amplitude Modulation.

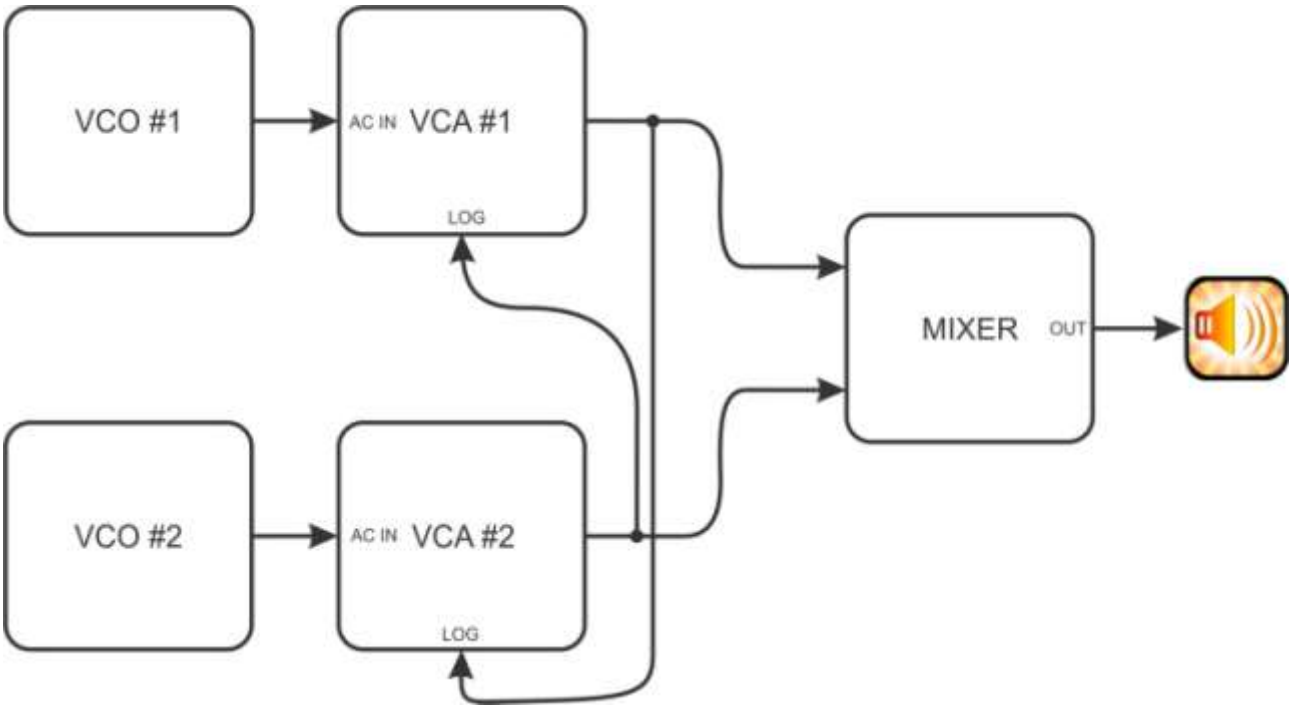

Figure 5.4.19 – 2-VCA RING MODULATOR

OUTPUT MIXING

For three million years, in fact up until the early 1900's, EVERY sound heard by a man or a woman was integrally associated with its source. The sound of a lion implied a lion, the sound of a snapping twig implied a snapping twig, and the sound of somebody calling out your name implied somebody calling out your name. This changed suddenly and irrevocably with invention of the record player. The sound of a lion could now be a speaker cone vibrating. The sound of somebody calling out your name could be a telephone.

Despite this recent change, we humans still hear sounds as distinct entities. Even though all the sounds in a room combine to form a single complex pressure wave which vibrates our ear drum, we still hear the tap dripping, the clomp of shoes in the apartment above, the cars whooshing outside, the conversation in the other room, and if the radio is on not only do we hear the music, we can hear the singer, the bass player, the piano, the drums and even something else called "hiss". All these separate "sound sources" are MIXED in the air to impinge on our ears as a single complex waveform. Our brain easily sorts them out. This ability to sort different sounds is valid even with electronic sounds. A synthesizer can create two different sounds, mix them together, and the ear upon hearing them, can separate them out again. For three million years not only could we tell that a lion was roaring, but we could tell that the lion was roaring over there, that the twig broke behind that bush,, that somebody called your name behind you. It was possible to localise the sound in space. While it is important to know that a big cat is around, it is just as important to know where (you run the other way!).

A "sound entity" is located in space by hearing the sound twice, once with each ear. Because sound takes time to move through the air it reaches one ear before the other - just enough to create a phase difference. The brain can process these phase differences to locate the direction of the sound source. The relative loudness and quality of the sound help to determine the distance of the sound source. A phenomenon called the "Doppler Shift" helps to determine whether the sound is coming or going. Because the brain discovers the direction of a sound by phase differences and distance by relative loudness, location can be simulated with two speakers. With two speakers appropriately placed the brain can locate a recorded lion pacing back and forth. To accomplish this a single sound is PANNED back and forth between the two speakers.

- A MIXER is a module that adds together a number of different sounds and sends the mixture to one or more outputs. A MIXER can be categorized by the number of inputs and outputs it has
- A PANNER takes some sound and sends it to two or more different outputs, fading from one to the other. This creates the illusion of movement.
- A CROSSFADER takes two sounds and smoothly mixes between them so that as sone sound decreases in amplitude, the other increases.

ES08 AUDIO MIXER. This module allows a mix of 5 signals, four with their own level setting with an associated pot. The fifth input is a "unity gain" input that can be used to cascade mixers to increase the number of inputs to the mixer.

An extension module (ES08EXT) allows the number of outputs to be increased to create a matrix-mixer.

VOLTAGE CONTROLLED STEREO MIXER. This is a two-in, two out mixer. Each input can be individually gain controlled by a [GAIN] pot and a VC gain input. Further more, each input can be directed to either or both of the two outputs by means of a [PAN] pot. This panning function can also be voltage controlled by the VC Pan input.
This is an equal power pan.
The Stereo Output Module has a Master Gain Control which can attenuate all input signals simultaneously with either manual or voltage control.

The ES31 has two grounded mini-jack outputs that can be directly patched to an amplifier. This shielded connection output allows the synthesist to run fairly long cords without picking up hum or crosstalk. The ES31 also has two mini-jack inputs which allow the synthesist to bring in external sound sources such as tape recorders and pre-amplified microphones.

The ES30 is a two-channel STEREO PANNER and can be added to the ES31 to increase the number of input channels to the Output Mixer output.

CONTROL VOLTAGE PROCESSORS

Because there is no difference, other than frequency, between audio voltages (AC) and control voltages (DC) it should not seem too strange that it is possible to have modules which process control voltages in much the same way that there are modules which process audio voltages. Not should it seem odd that these modules for processing control voltages are themselves voltage controllable. These modules extend the range of shapes and forms that control voltages can have, and thereby extend the possibilities of control. It is the control voltage processors which "mould" the control voltages that determine the complex dynamic shifts so important to interesting electronic music. The simplest of these devices have already been explored - the control voltage Processors that are found on the control voltage inputs of many modules on the Euro-Serge system. These processors enable the user to amplify, attenuate and/or invert the control voltage.

ES114 UNIVERSAL SLOPE GENERATOR. The ES114 can act as a Positive or negative or Positive/Negative SLEW or Portamento device. A Slew is a device which slides from one voltage to another voltage; a Positive slew affects positive-going voltages (not just positive voltages, but changes in a positive direction), and a Negative Slew acts on negative-going changes.

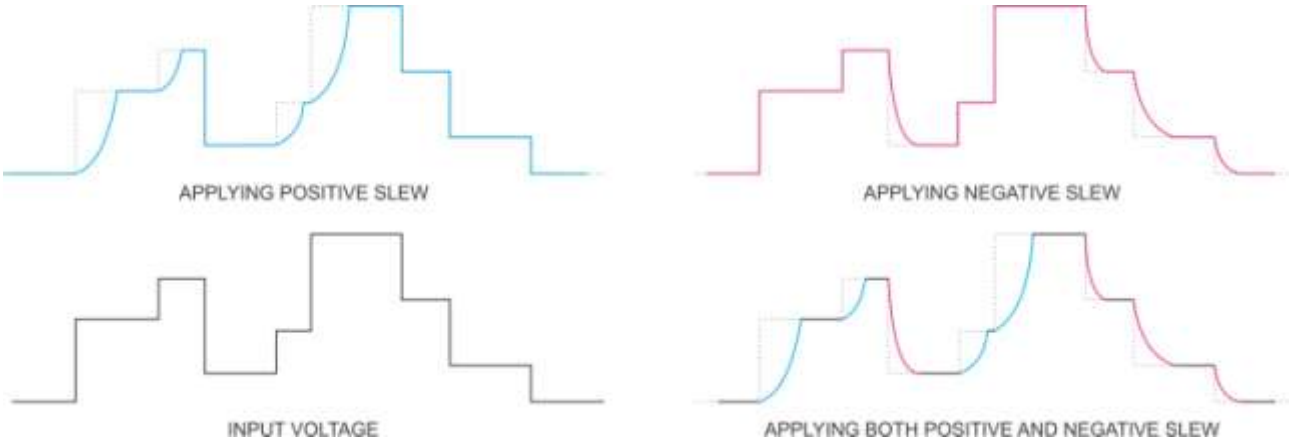

Figure 5.6.1

When both positive and negative slews are present the device is often called a Portamento, Glissando or LAG device.

Because the ES114 will Rise or Fall to the voltage IN, it can be used as a Positive and/or negative Slew limiter. The slower the Rise and Fall time settings, the more that parameter acts like a slew. A Positive Slew, for

instance, would have a slow Rise and a very fast Fall time. Because the ES114 is voltage -controllable, it is a voltage-controllable slew.

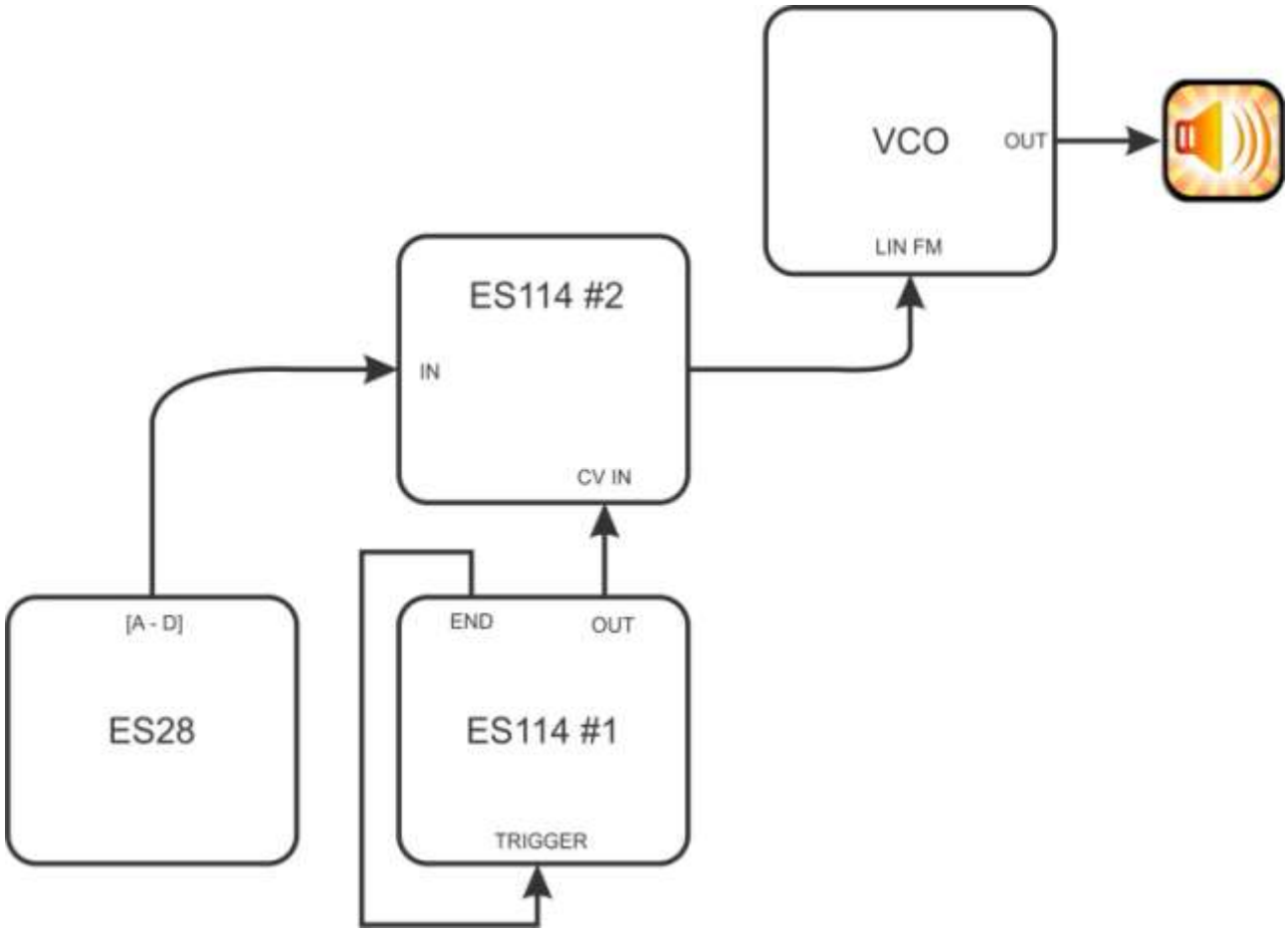

Figure 5.6.2

ES12 BI-DIRECTIONAL ROUTER. This unique triple module can be used in two ways:

1. ONE-IN TWO-OUT SWITCH. An input at [B] can be sent to either output [A1] or [A2] depending on the state of input [A1-A2]. If [A1-A2] is HI (+5V) then [B] appears at [A1], otherwise it appears at [A2].
2. TWO IN ONE OUT SWITCH. If there is an input at [A1] and a second input at [A2] then [A1] will appear at output [B] if [A1-A2] is HI, otherwise [A2] will appear at the output

NOTE: If there is an input at [B] there CANNOT be an input at [A1] or [A2]. This would, in effect, short outputs together.

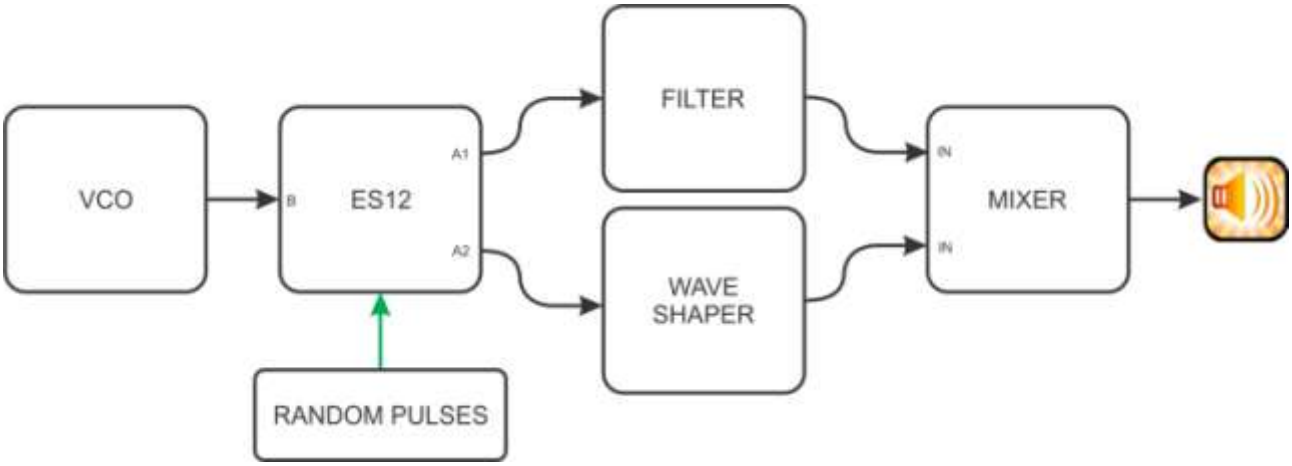

Figure 5.6.3

While in the above patches audio voltages are being routed about, control voltages can be routed in much the same way. However, any time there is an instantaneous change in voltage there will be a click.

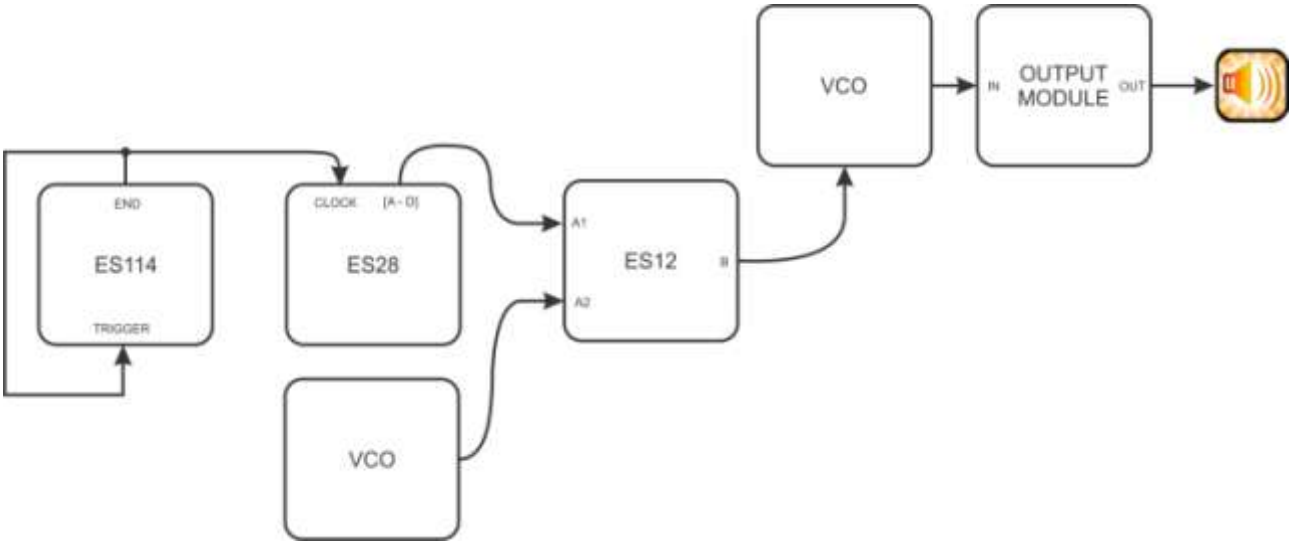

Figure 5.6.4

ES14 CONTROL VOLTAGE PROCESSOR. The Processor is, to control voltages, what a Mixer is to audio voltages. It can be used to sum together up to three control voltages. Each of its three inputs can be independently attenuated, amplified and/or inverted.

Furthermore a manual offset pot sets a fixed voltage that can be added into the mix. This offset voltage is available at the output of the Processor even if there are no other inputs.

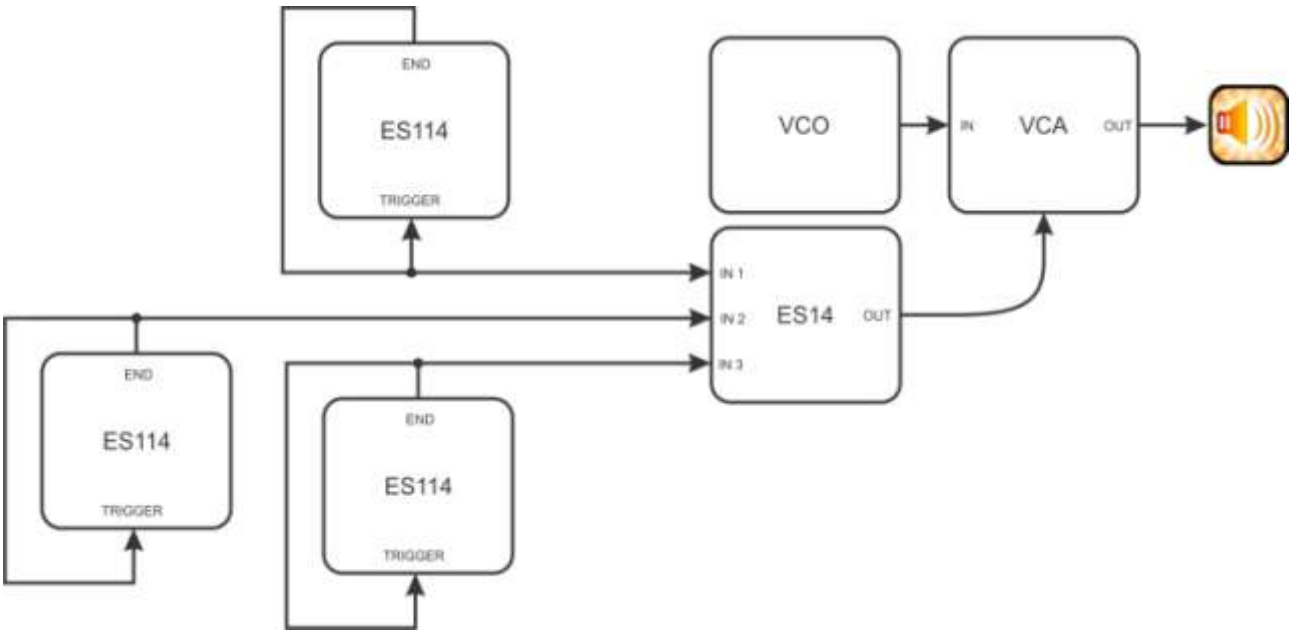

Figure 5.6.5

ES15 SMOOTH AND STEPPED GENERATOR.

THE SMOOTH FUNCTION GENERATOR

SLEW LIMITER. The Smooth Function generator serves as a voltage controlled Slew limiter on its input. The slope of the slew (both positive and negative) is determined by the manual [RATE] pot and a VC input associated attenuation pot.

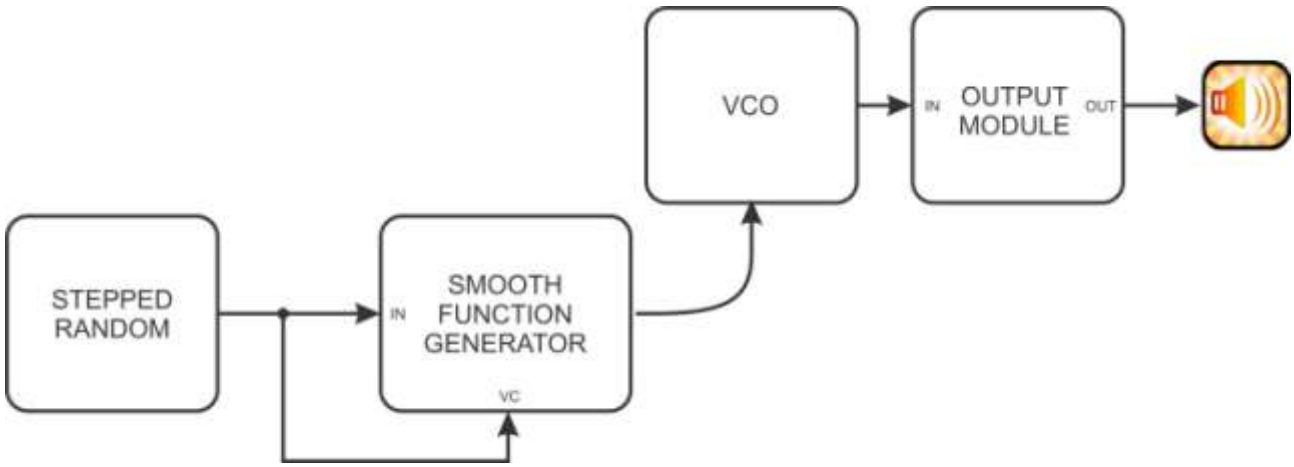

Figure 5.6.6

TRACK AND HOLD. A [HOLD] input is provided on the Smooth Function Generator. When this input receives a HI voltage it has the effect of

HOLDING the present output voltage level until the [HOLD] input goes low. If the [RATE] is set very fast so that the Smooth Function Generator follows its input closely (that is, tracks the input), the receipt of a pulse train at its [HOLD] input will produce a staircase-like series of voltages.

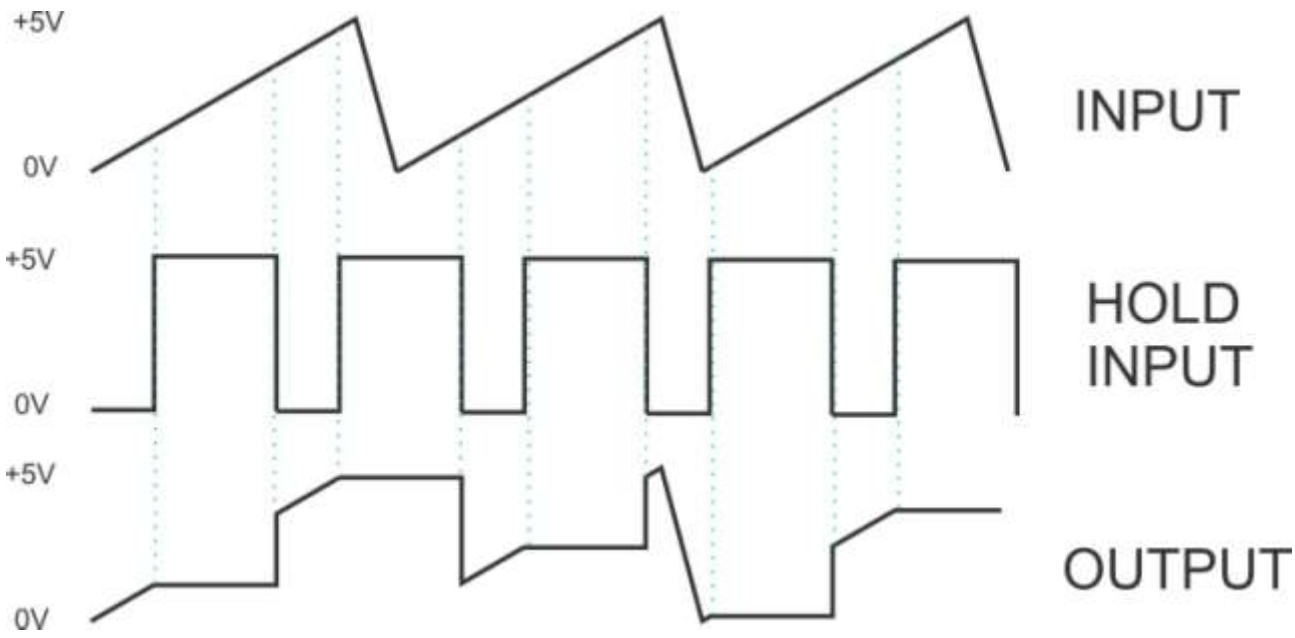

Figure 5.6.7

LOW FREQUENCY OSCILLATOR (LFO). If the [INPUT] of the Smooth Function Generator is patched to the [CYCLE] jack, the output is a triangle wave whose frequency is determined by the [RATE] and control voltages. The [CYCLE] output will be a series of pulses with the same frequency as the triangle wave output.

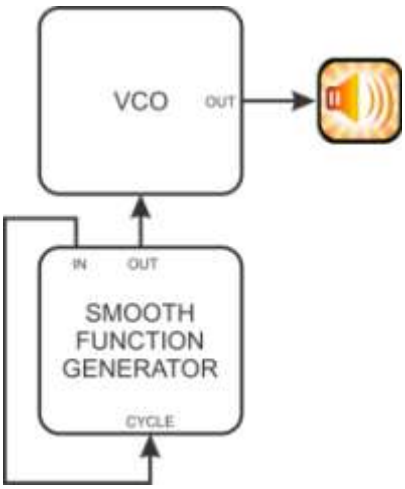

Figure 5.6.8

When the Smooth Function Generator is patched to cycle, the [HOLD] function remains operative to be able to produce up and down staircase-like voltages.

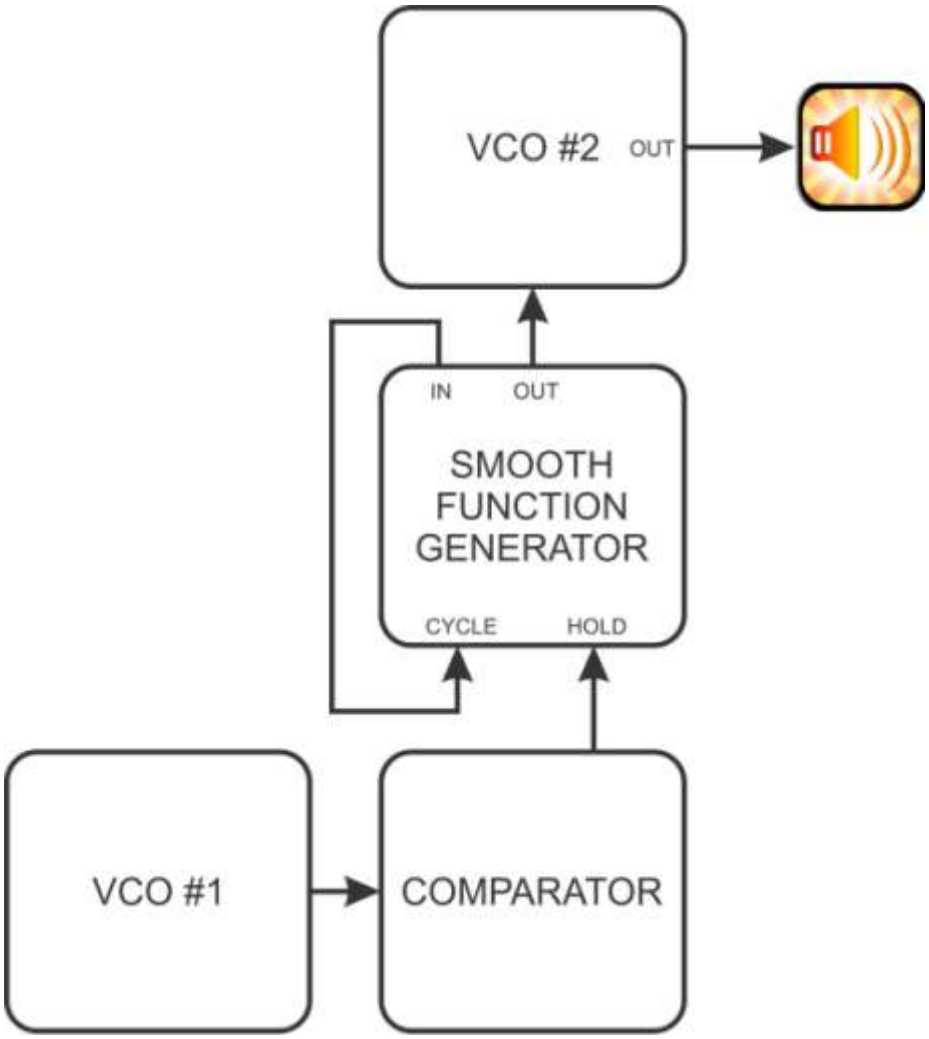

Figure 5.6.9

THE STEPPED FUNCTION GENERATOR

SAMPLE AND HOLD. A Sample and Hold is a device which produces a discrete stepped waveform from a changing input voltage. When a pulse is received at the [SAMPLE] input, the voltage appearing at that instant at [IN] appears at [STEPPED OUT] and is HELD until another pulse is received at [SAMPLE], when this process is repeated.

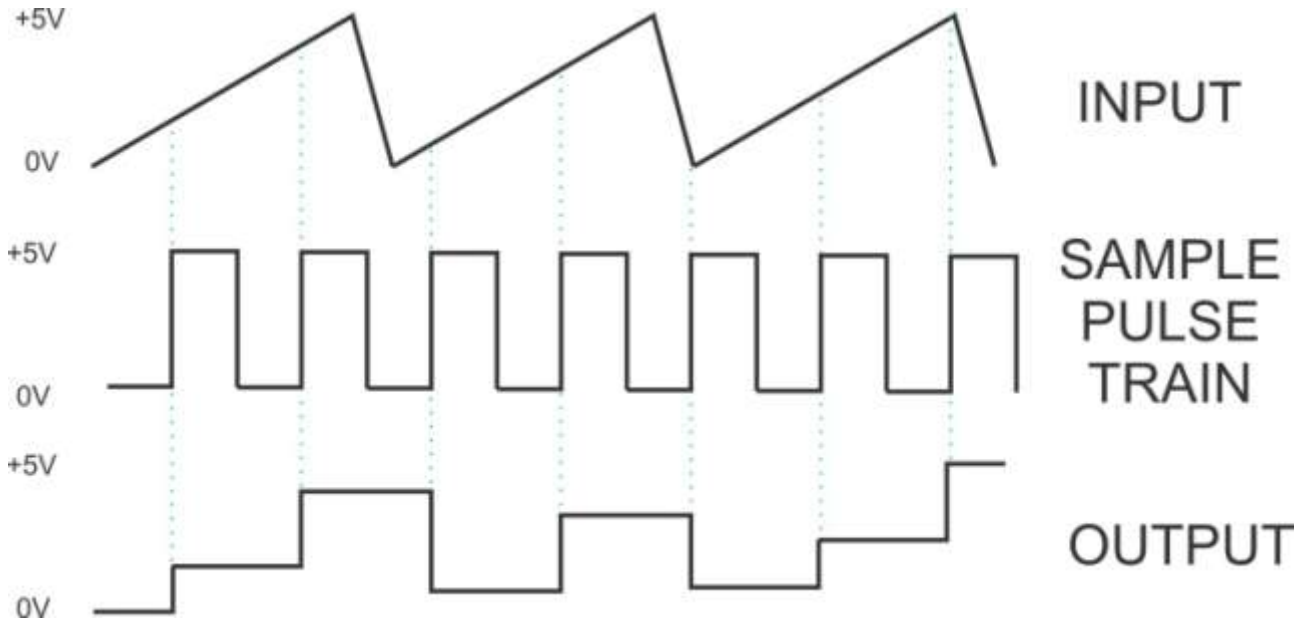

Figure 5.6.10

CORRELATION. The [RATE] pot and the VC input with its associated attenuation pot control the "correlation" of one voltage output level to the previous voltage output level. In the stepped voltage as correlation increases, each step must be closer and closer to the previous step.

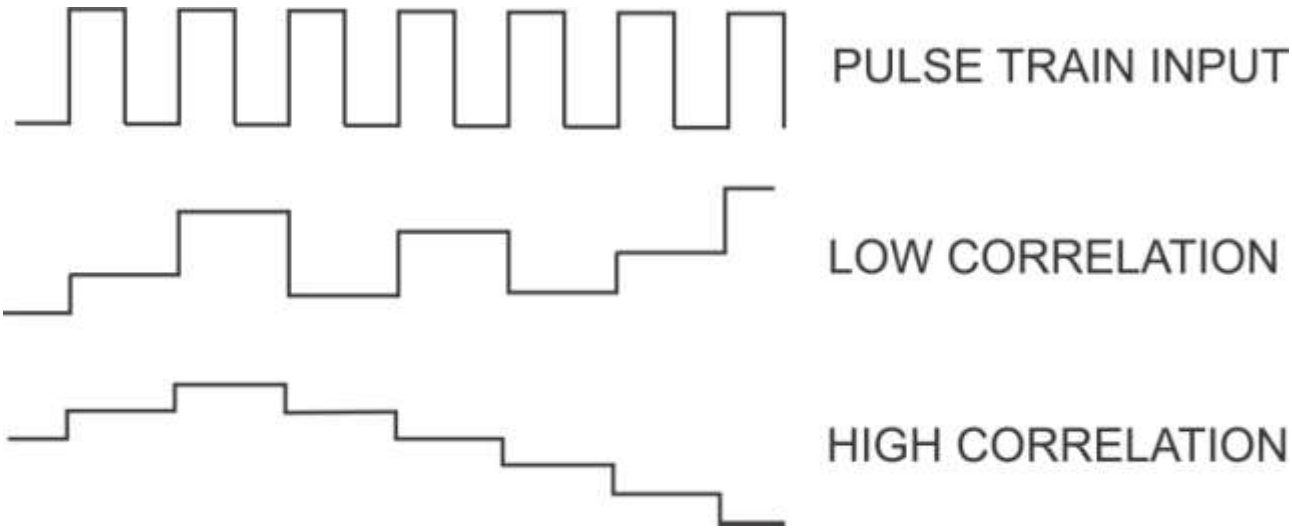

Figure 5.6.11

When the [RATE] pot is at a middle position, and the input is a random voltage such as the [S/H SOURCE] on the ES01 Noise Generator, the output approximates the function called 1/F. 1/F is a random-like function that describes the shape of, for example, natural coastlines, cloud movements and many kinds of music.

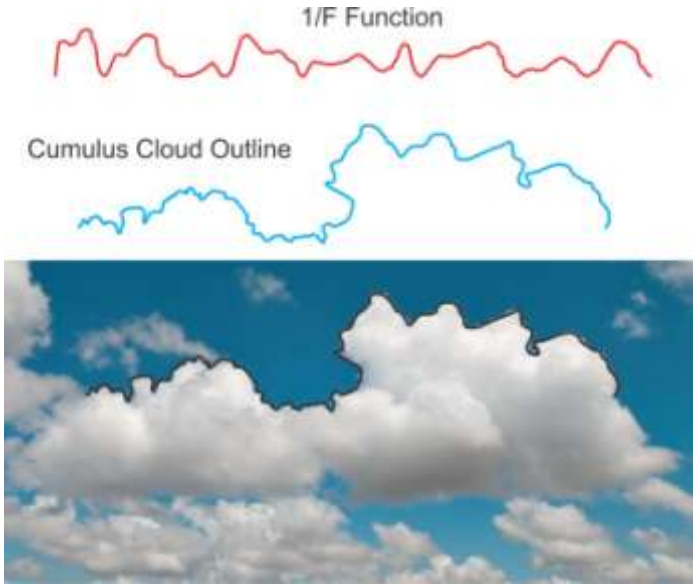

Figure 5.6.12

STAIRCASE GENERATOR. When [INPUT] is patched to [CYCLE] and pulse are applied to [SAMPLE], a complex staircase wave is generated at [STEPPED OUT], determined by the pulse frequency, the position of the [RATE] pot and [VC].

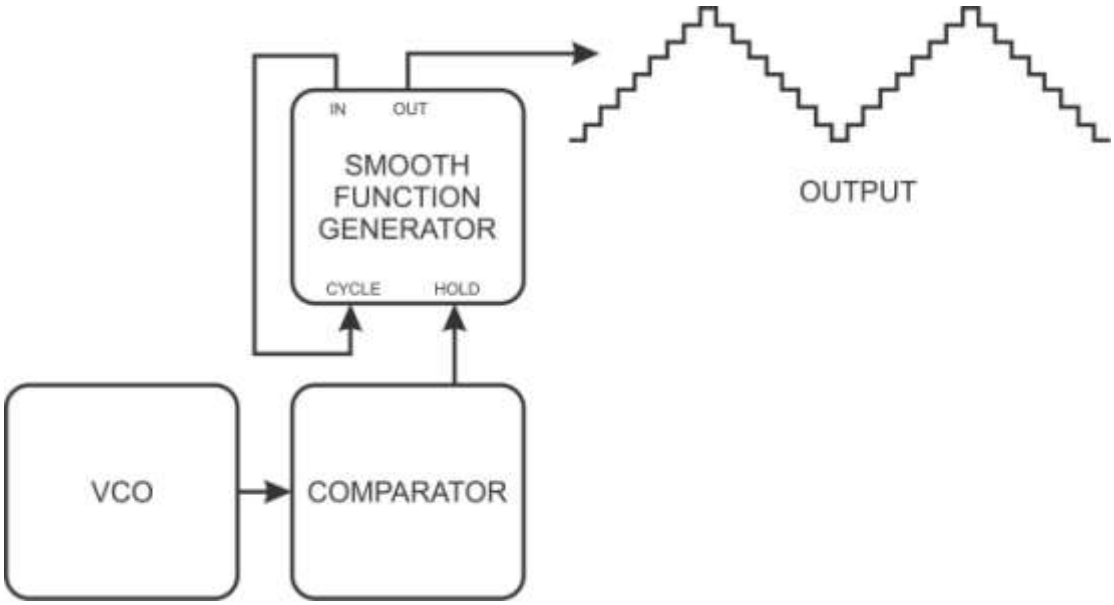

Figure 5.6.13

RANDOM VOLTAGE GENERATOR. It is sometimes desirable to create random voltages to control the various devices on the Euro-Serge, or, if the system already has a random voltage generator, it is sometimes desirable to have a second. Using the [COUPLER] output on the ES15 and the [S-H SOURCE] on the ES01 Noise Generator it is possible to patch the ES15 to become a random voltage generator.

COUPLER. The COUPLER is a comparator which is hard-wired (that is not patchable, but pre-wired behind the module panel). The COUPLER compares the level at the [SMOOTH] and [STEPPED] outputs. Whenever the Step Function Generator is HIGHER in voltage than the SMOOTH section, the output of the COUPLER goes HI. Otherwise the output is LO. The COUPLER has two outputs, one of which switches between 0V and +12V, the other switching between -12V and +12V. Both of these signals are 'hotter' than normal Euro-Serge signals and so are assigned and ORANGE (0/+) and a GREY (-/+) jack.

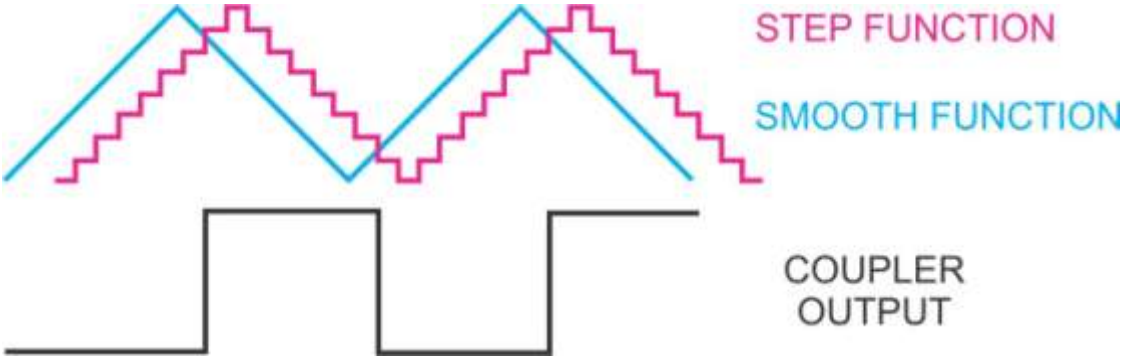

Figure 5.6.14

ES01 RANDOM VOLTAGE GENERATOR. The [S-H SOURCE] output of the ES01 is a randomly modulated sawtooth wave. The form of wave is ideal for generating random voltages with sample-and-holds. Since this wave is always going from 0V to +5V, there is an equal probability for any voltage to be selected. And since the frequency is random, it is impossible to predict what voltage will be sampled.

The [SMOOTH] output is a continuous random voltage; the [STEPPED] output is a stepped random voltage while the [TIMING] output is a random pulse output with random on-times as well as onset times. The rate of change is set by the [RATE] pot and it's associated [VC].

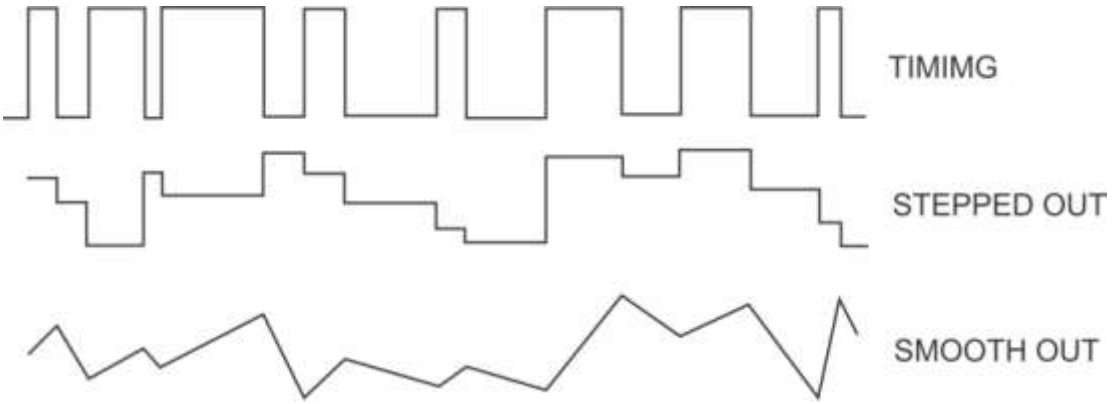

Figure 5.6.15

ES28 TOUCH SEQUENCER. It is useful to think of the ES28 as composed of two separate parts: The Sequencer and the Touch Pad Controller.

8-Stage Sequencer. Only one stage can be on at any given instant. Each stage controls a specific column of pots, so that if Stage #7 is on, it activates all four pots in Stage #7.

In its normal mode the Sequencer will advance one stage every time it receives a CLOCK pulse. That is, if the Sequencer was on Stage #5 and it receives a CLOCK pulse it will advance to Stage #6. If it is on Stage #8 and receives a clock pulse, it wraps around and activates Stage 31. This function was described in an earlier section. There are, however, a number of other ways of controlling the Sequencer to provide musical patterns.

UP/DOWN. If a HI voltage is applied to the [UP/DOWN/ input, the Sequencer will step DOWNWARDS instead of upward when it receives a CLOCK pulse. If it is on Stage #1, it will wrap-up to Stage #8.

HOLD. If at any time (either in it's up or down mode) the Sequencer receives a HI voltage as its [HOLD] input, the Sequencer will stop until the [HOLD] drops LO. This is useful for producing elaborate rhythms.

VARIABLE LENGTH SEQUENCE. It is often desirable to have sequences shorter than the eight stages, or it have variable length sequences. For these purposes a [RESET] input is provided. The [RESET] is triggered by a pulse from other pulse outputs on the ES28 or by pulses from other modules.

In the above patch, to get the ES28 to RESET to Stage #1 you must first touch Keypad #1. The number of stages clocked advanced before resetting is determined by the ES27 Transient Generator which is triggering the [RESET]. Set this Transient Generator so that about four stages are clocked through before RESETting occurs. If you touch a different keypad, say Stage #6, you will find that the sequence resets to that stage. Each RESET input rests to the keypad last touched. Using the above patch, and by touching different keypads, it is possible to produce an interesting interactive sequencer.

ED137 STEP-NEXT-ROW. The ED137 is a VERTICAL SEQUENCER that can be used with the ES28 to provide extended sequence patterns. The four ES28 outputs [A], [B], [C] & [D] are patched to the four ED137 inputs [IN 1], [IN 2], [IN 3] & [IN 4] respectively. Every time a trigger is received at the [NEXT ROW] input of the ED137, it steps DOWN one ROW. That is, if row [IN 2] was currently active then it will progress to row [IN 3]. After row [IN 4] it wraps around to row [IN 1]. The [OUT] output of the ED137 is determined by the pot that is in the activated stage of the ES28 (as determined by the main Sequencer and Keypads) AND in the row specified by the ED137. If the activated stage is not changed, then [OUT] will have a four stage sequence set by the four pots in the current stage.

If in the above patch, Stage #7 is now activated by touching its associated keypad, the four pots in Stage #7 will determine the [OUT] outputs.

CGS734 ANALOGUE SHIFT REGISTER. An Analogue Shift Register is a sequential sample and hold device. It is also referred to as a Bucket Brigade Delay. The CGS734 has three stages. Each stage of the CGS734 can hold and save a voltage which is available at all times at outputs [OUT 1], [OUT 2], [OUT 3]. When the device receives a TRIGGER at [CLOCK] the voltage stored in stage #1 is moved to stage #2, the voltage at stage #2 goes to stage #3 and the voltage at stage #3 is lost. Stage #1 picks up the voltage at [CV IN]. It is this action which gives the device the name of bucket brigade.

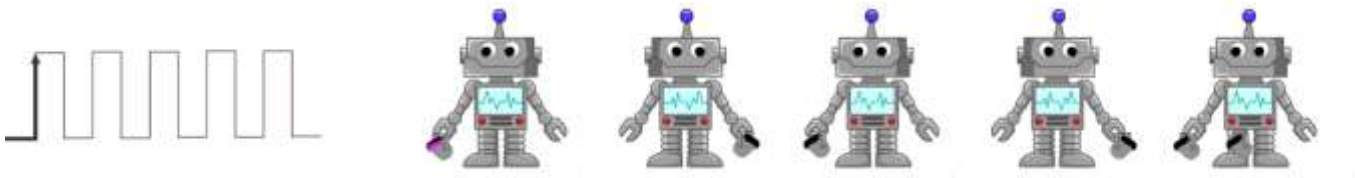

Figure 5.6.1. The bucket brigade in action. Click on the image for animation

One of the many uses to which this device can be put is that of producing chords and arabesques from a monophonic keyboard input. The patch in Figure 5.6.2 illustrates this use.

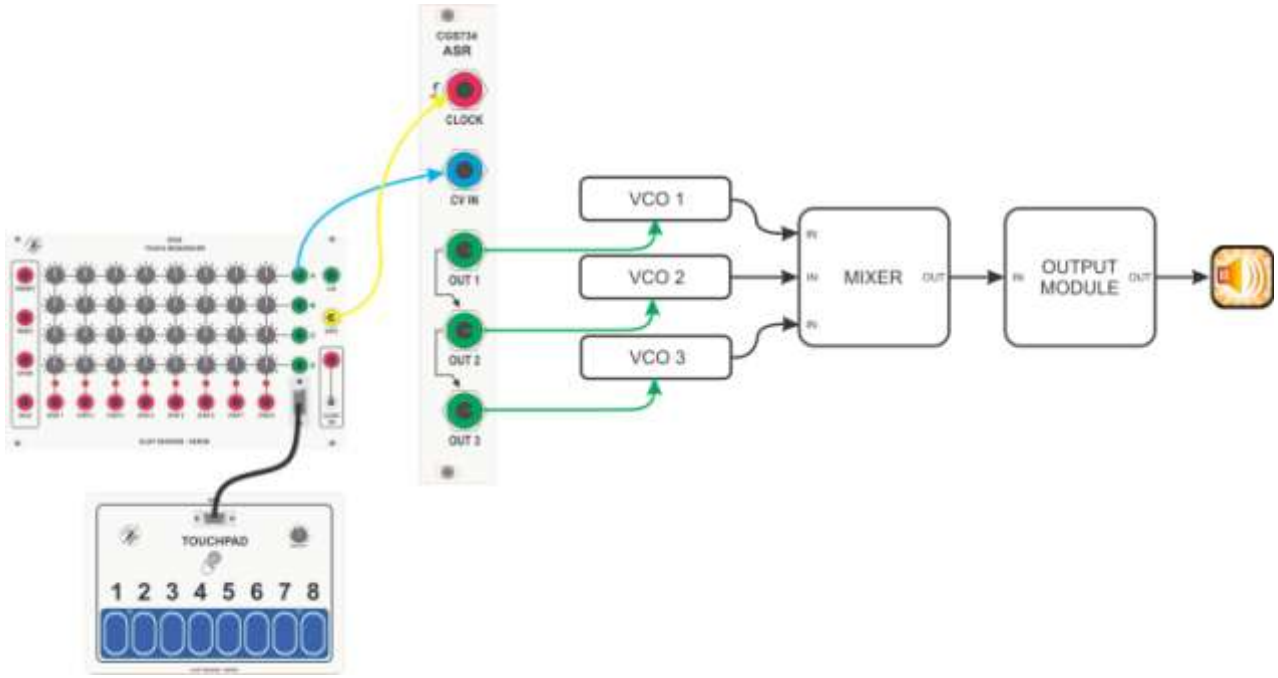

Figure 5.6.2

Chapter 6
What Does It Sound Like

ELBY Designs - Laurie Biddulph
9 Follan Close, Kariong, NSW 2250, Australia
elby-designs@bigpond.com http://www.elby-designs.com