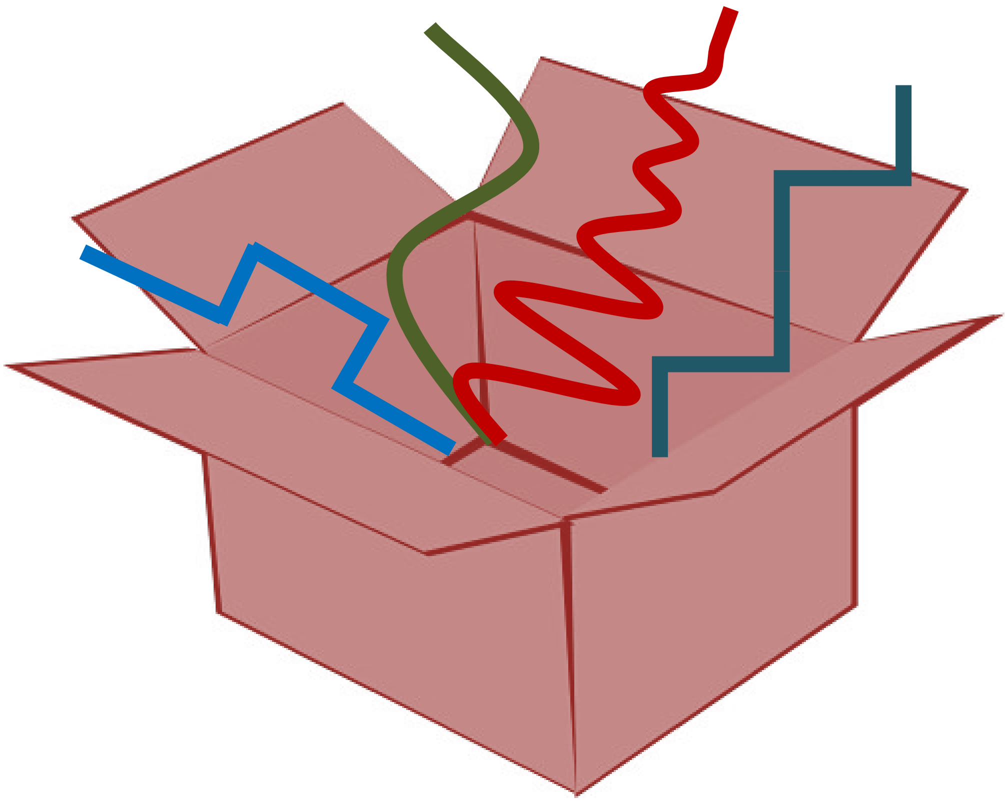
cyclebox



User’s Guide (version 2)

CYLONIX

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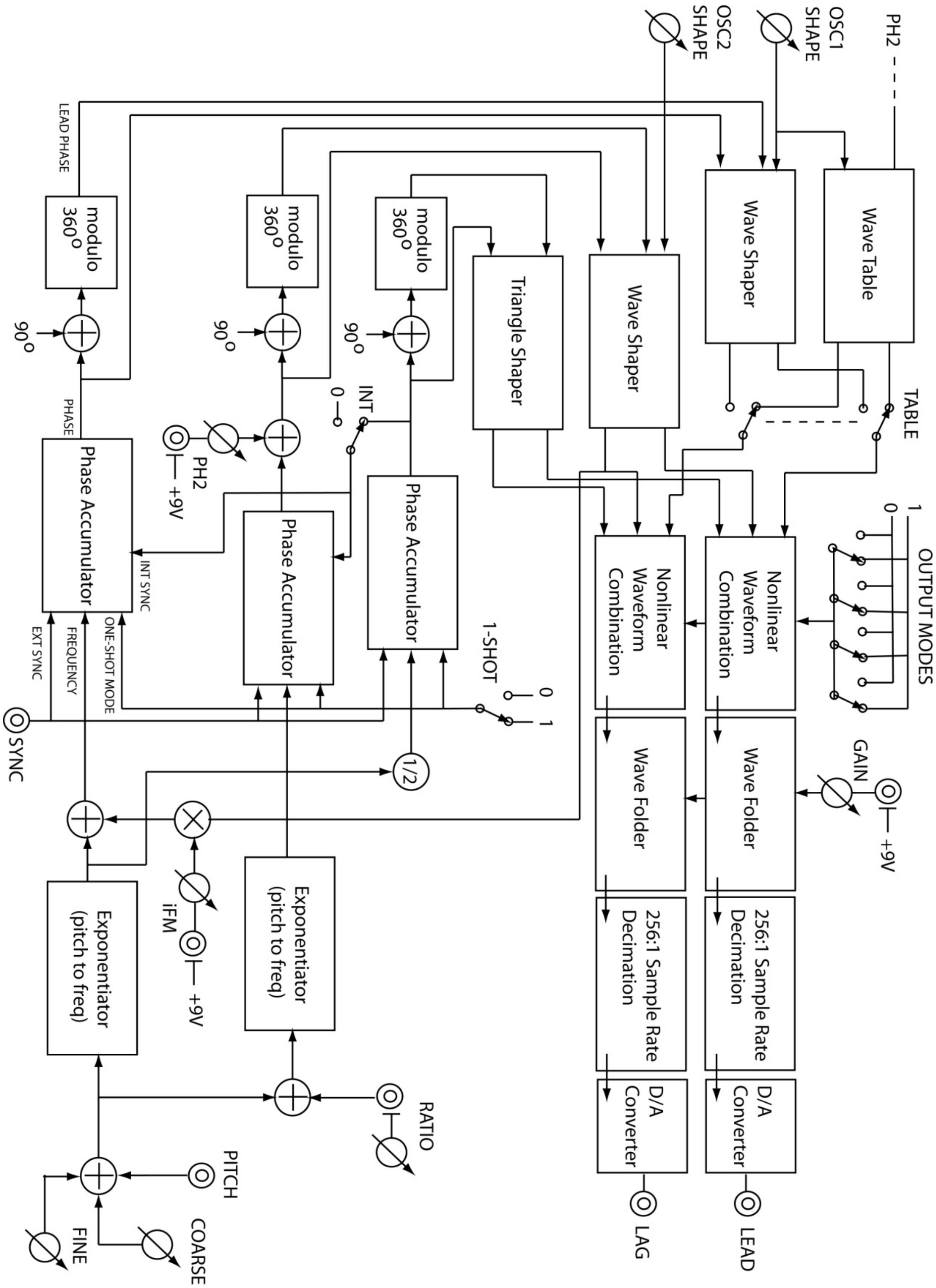
FEATURES

- Wide 22-octave frequency range (48KHz down to one cycle every 80 seconds)
- 3 oscillators: main - OSC1, secondary – OSC2, sub/sync-oscillator – OSC3 (triangle or square wave at half the frequency of OSC1)
- 8 different waveforms for OSC1 and OSC2 with smooth morphing:
    - Sine, triangle, sine-pulse1, square, saw, square-saw, sine-pulse2, random
- 8 additional externally selectable wavetable shape sets for OSC1 :
    - random pulses, truncated saw, bipolar pulse, mirrored bipolar pulse, resonant saw sweep, mirrored resonant saw sweep, vowels, mirrored vowels
- MEGA mode for OSC1 which stacks 8 detuned versions of the OSC1 waveform
- 16 different nonlinear waveform combinations
- High-Quality "through-zero" Internal Frequency Modulation of OSC1 by OSC2
- Two Quadrature outputs (i.e. separated by 90 degrees in phase)
- Externally controlled output asymmetric waveform folding
- Internal and External oscillator sync
- External control of internal FM level, OSC2 phase and OSC2 ratio
- LED display of pitch octave (C-22 to C9) and LFO output levels
- 256x oversampled digital sound generation with low aliasing noise
- 96KHz output sampling rate
- Expandable to give additional wave shapes, one-shot, non-through zero FM, octave shift, lfo mode, percussive and reverse sync modes

Cyclebox Architecture



The Cyclebox system consists of three oscillators (OSC1, OSC2, and OSC3) whose outputs are combined nonlinearly. There are 16 different combination modes available, selected through a set of 4 toggle switches. The output of the combination unit is passed through a gain stage and an asymmetric wave-folder and then to the module's output jacks. The gain is set by the GAIN input and control.

Each oscillator has two outputs, nominally 90 degrees apart in phase. OSC1 and OSC2 have multiple possible waveshapes, selected by the SHAPE controls. OSC3 outputs either a triangle or square waveform. OSC1 also has access to a set of waveshapes stored in a wavetable.

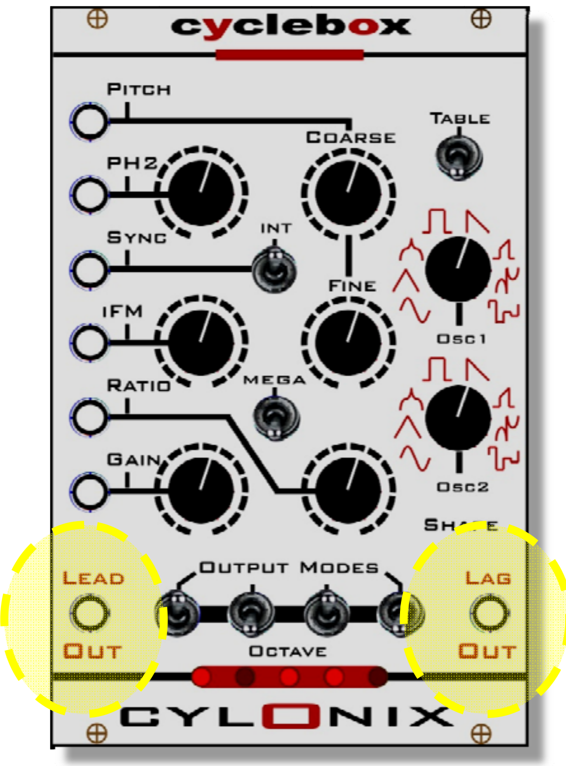
The overall pitch of the oscillators is set by the 1V/octave PITCH input as well as by the COARSE and FINE pitch controls. The pitch of OSC2 is offset from the main pitch by an amount determined by the RATIO input and control. The pitch of OSC3 is fixed at one octave lower than the main pitch. The frequency of OSC1 can be modulated by the output of OSC2. The level of this modulation is set by the iFM input and control. The phase of OSC2 can be shifted using the PH2 input and control.

The start of the oscillator cycles for OSC1 and OSC2 can be synchronized either to the start of an OSC3 cycle (if the INT switch is in the up position) or to the reception of a suitably strong positive going pulse at the SYNC input.

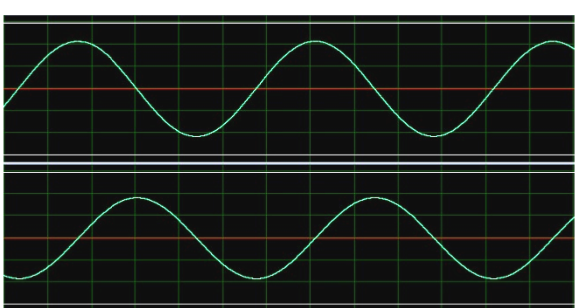
Cyclebox Front Panel

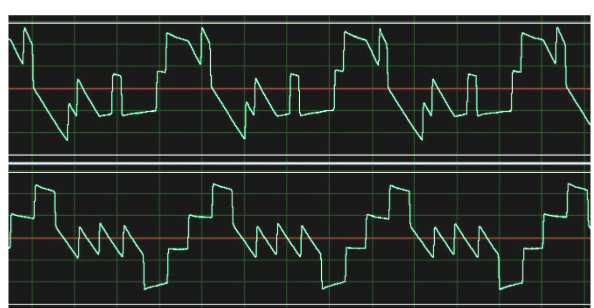
The function and operation of the front panel jacks, knobs, and switches are described in the following sections of this user's guide.

LAG and LEAD Outputs



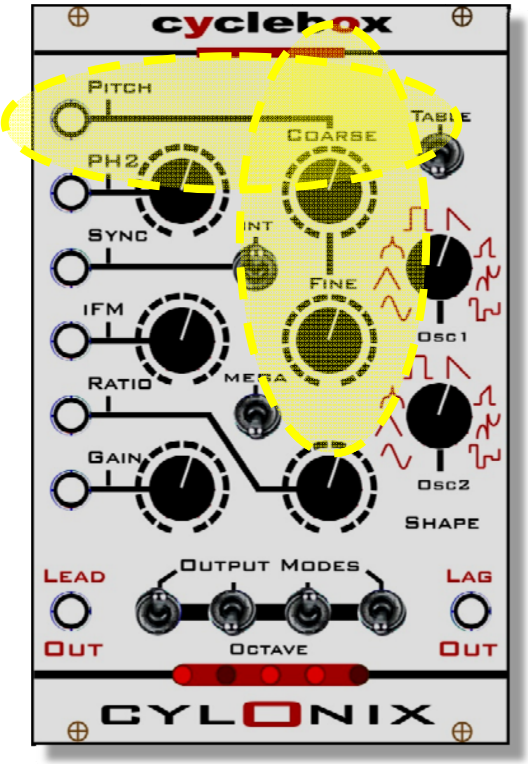
The Cyclebox module has two outputs. These outputs are obtained by passing the output of the nonlinear waveform combiner through the wave-folder. The LAG output is derived from the combination of the 3 oscillator waveforms, while the LEAD output is derived from the combination of phase-shifted versions of the 3 oscillator waveforms. The phase shift is fixed at 90 degrees, except in output mode 0001, where the phase shift is adjustable. If all of the oscillators being combined have the same frequency, the LAG and LEAD outputs will appear as time-shifted replicas of each other, as shown in the left hand figure below. If the oscillators being combined have different frequencies, the LAG and LEAD outputs will not have the same shape, as shown in the right hand figure below.





[Please note that all waveform images in this document were captured with an AC-coupled soundcard, which removes low frequency components. This causes a slight drooping (e.g. a slanting of the flat parts of the square-waves) which is actually not present in the outputs.]

Oscillator Pitch Control



The Pitch input, in combination with the knobs labeled Coarse and Fine, adjusts the pitch of the oscillators.

The Pitch input produces a one octave change in pitch for every 1 Volt change in the input. It has an input range of -10 Volts to +6 Volts, giving a total pitch range of 16 octaves.

The Coarse pitch control provides an offset to the Pitch input of between 0 and 6 octaves. The Fine pitch control provides an additional offset over a range of 1 semitone.

The pitch of oscillator 3 is always one half that of oscillator 1 (excluding frequency modulation of oscillator 1). The pitch of oscillator 2 is offset from that of oscillator 1 by an amount set by the Ratio input or the Ratio control.

The usable range of the pitch variation for the oscillators is about 22 octaves, as the oscillator shuts off at a frequency of 48 KHz.

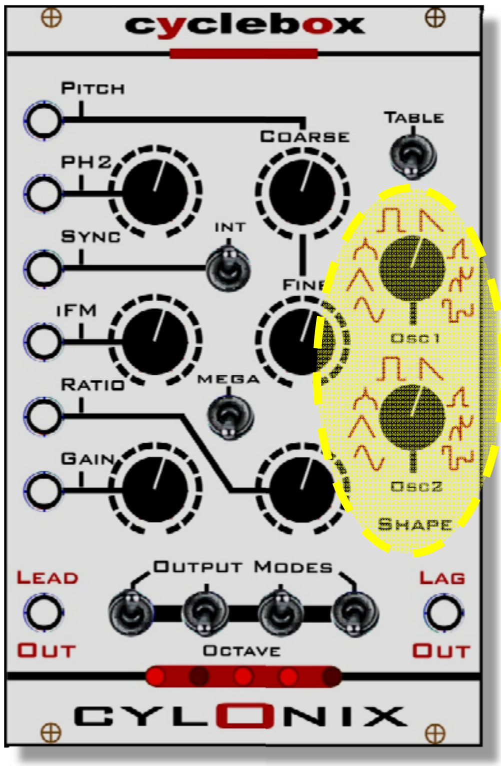
The following table shows the approximate oscillator frequency or period for various levels of the pitch input and settings of the COARSE control (assumes that the FINE knob is at 12 o'clock). The COARSE knob shifts the pitch over about a 6.5 octave range.

	Pitch input voltage				
COARSE control	-10V	-5V	0V	+5V	+10V
CCW	80 sec	0.4 Hz	12.8 Hz	400 Hz	1.28 KHz
mid	8 sec	4 Hz	128 Hz	4 KHz	12.8 KHz
CW	0.8 sec	40 Hz	1.28 KHz	40 KHz	off

The usual mode of operation will be with a PITCH input of between 0 and 5 volts (which is the range for most MIDI-CV converters). Thus, in this case the range of frequencies will be from about 12 Hz to 40 KHz.

To use the Cyclebox as an LFO you should input a negative voltage into the pitch input. An input of -10V will produce oscillator periods from about a second to over 80 seconds over the full range of the COARSE control, which should be sufficient for most LFO applications. Or you could set the COARSE knob to its midrange, in which case the period ranges from 1/128th of a second to 8 seconds as the pitch input varies from 0 down to -10 volts.

OSC1 and OSC2 Waveform Select



The knobs labeled OSC1 and OSC2 select the ***shape*** of the waveforms output by each of the two main oscillators.

Each oscillator has 8 different waveforms available for selection by these controls.

The waveforms are, going clockwise from the bottom left:

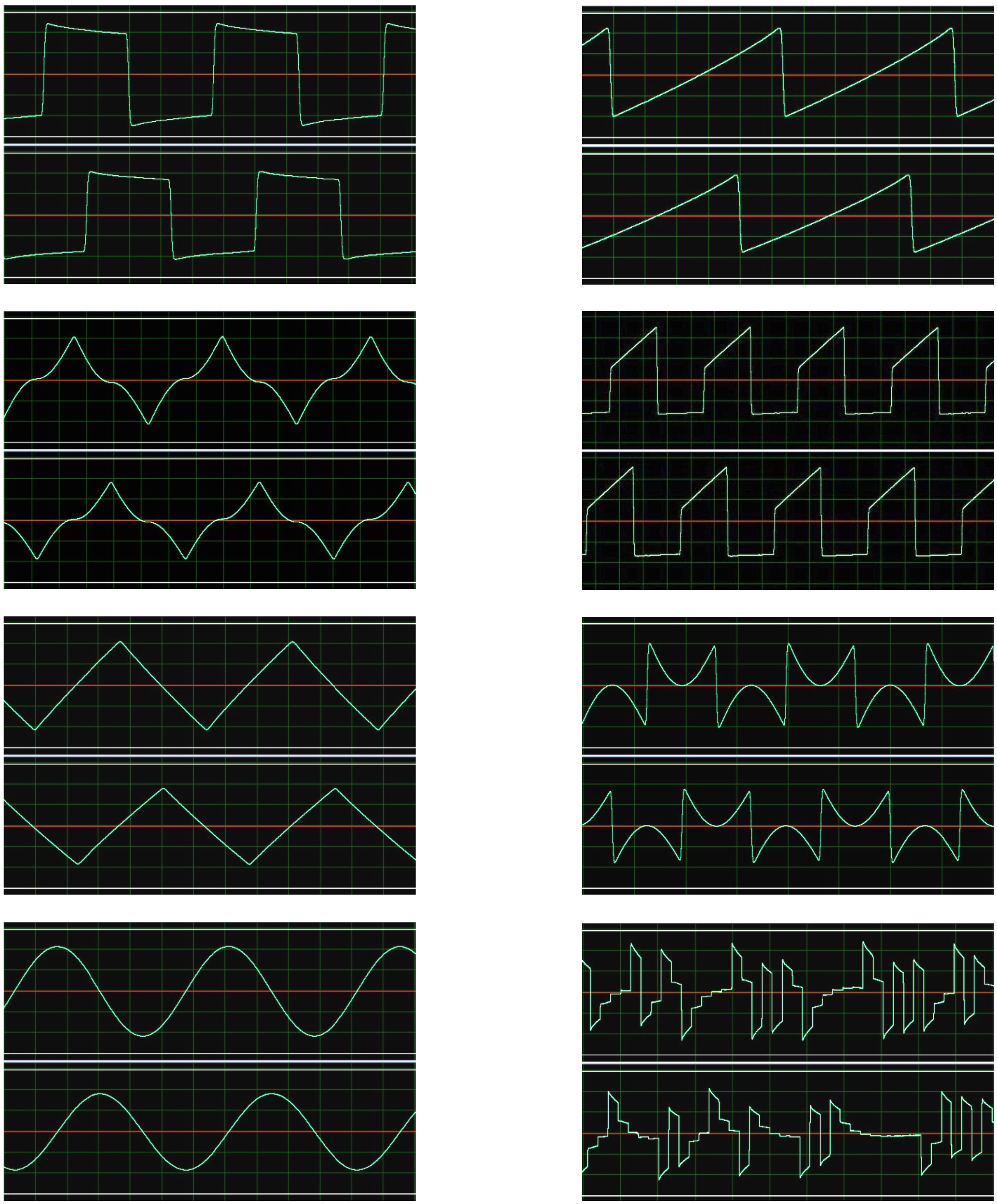
SINUSOID, TRIANGLE, SINE-PULSE1, SQUARE, SAWTOOTH, SQUARE-SAW, SINE-PULSE2, and RANDOM

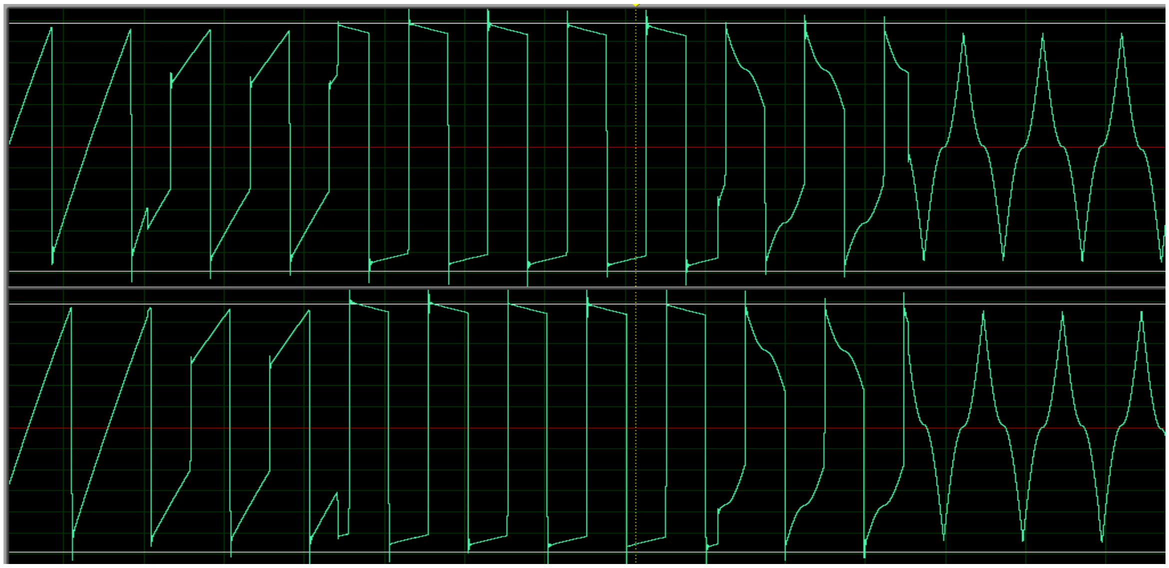
The ***RANDOM*** waveforms are created using a pseudo-random number generator to produce a different random level on each cycle. This level is held constant during the cycle.

These waveforms are depicted on the following page.

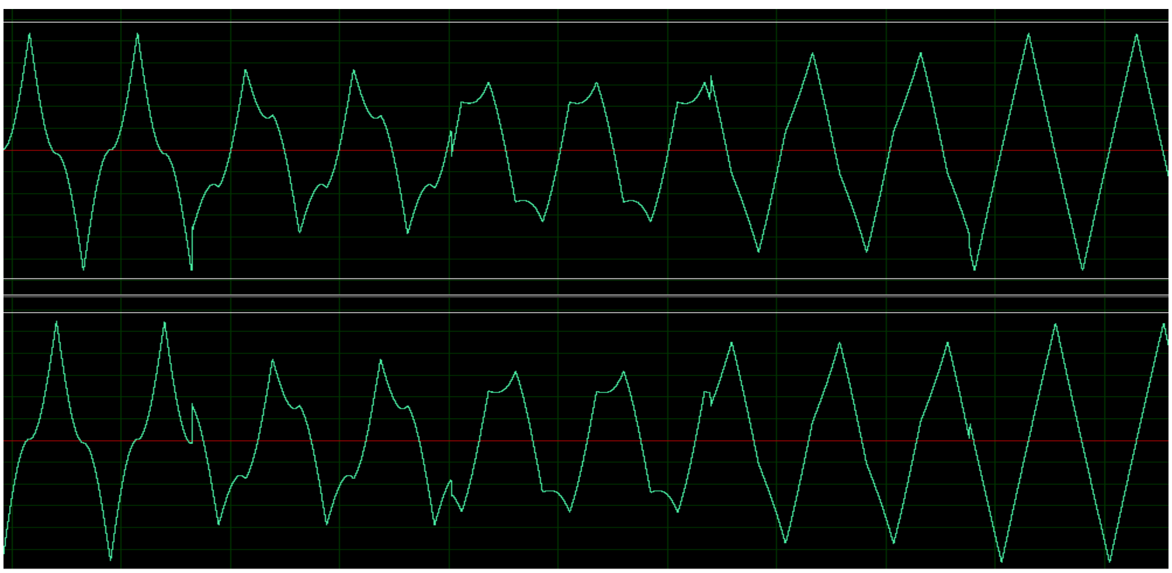
The shape knob provides a smooth morphing between successive shapes, permitting additional intermediate shapes.

OSCILLATOR WAVEFORMS





Morph from saw through square to sinepulse



Morph between sinepulse and triangle

OSC1 Wavetable Mode

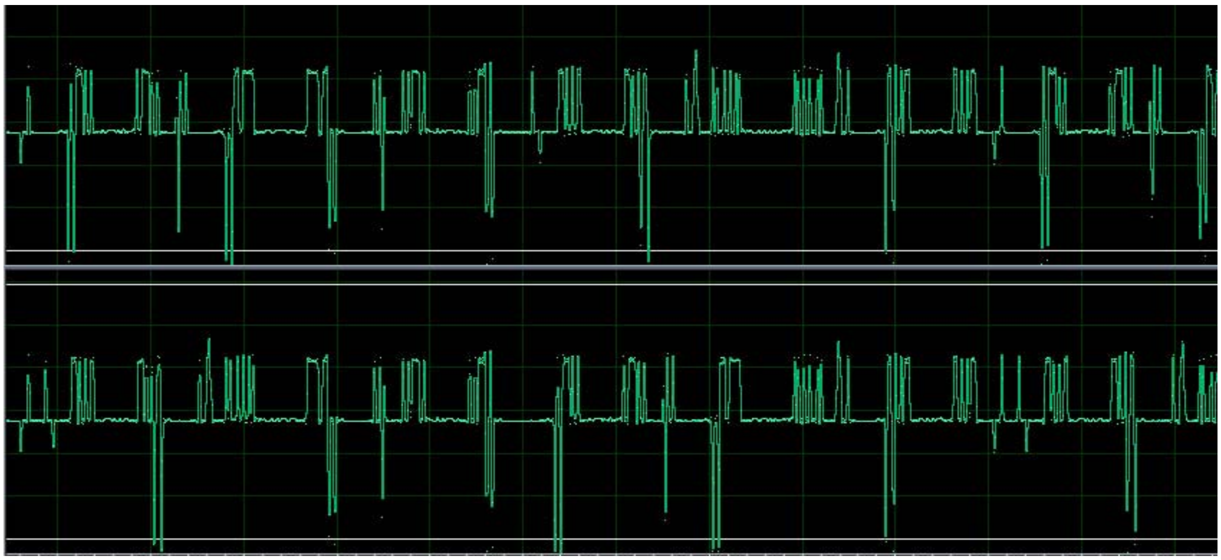
When the TABLE switch is in the up position, the OSC1 waveforms are taken from wavetables stored in memory. There are 8 banks of wavetables, selected using the OSC1 SHAPE control. Within each bank there are 128 individual one-cycle waveforms with 256 samples each. The samples stored in the wavetable are indexed by the OSC1 phase value and there is no interpolation between samples. This causes the waveforms to appear stepped.

The one-cycle waveforms are selected using the PH2 input and control. The PH2 input thus allows the scanning of a wavetable bank using an external signal (such as an LFO or envelope). The PH2 signal is not interpolated, meaning that the scanning of the wavetable bank is sometimes noisy, as there are can be slight jumps between adjacent waveforms.

The individual wavetable banks are intended to provide sweepable variations on a single type of waveform, rather than as collections of different waveforms. The bank waveforms are described on the next few pages, starting from fully counter-clockwise on the OSC1 SHAPE control to fully clockwise.

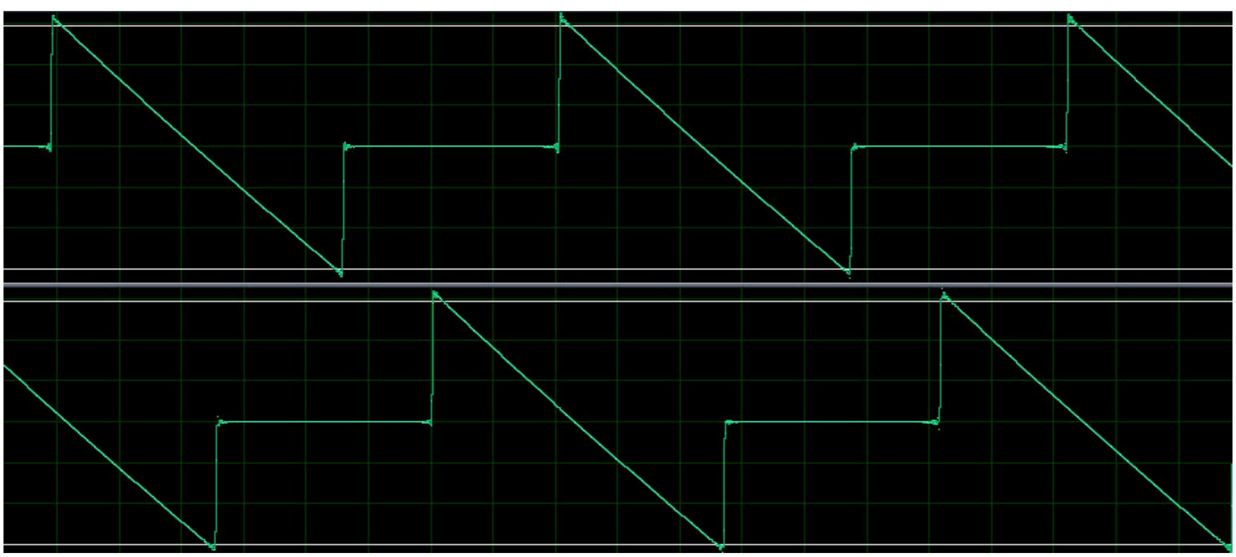
Wavetable Bank 1 – Random Pulses

Bank 1 consists of samples taken from the middle of the FPGA configuration ROM and that are essentially random pulses.



Wavetable Bank 2 – Truncated Sawtooth

Bank 2 consists of truncated sawtooth waveforms. As the PH2 signal increases, the width of the sawtooth decreases. This gives a sound similar to pulse width modulation.



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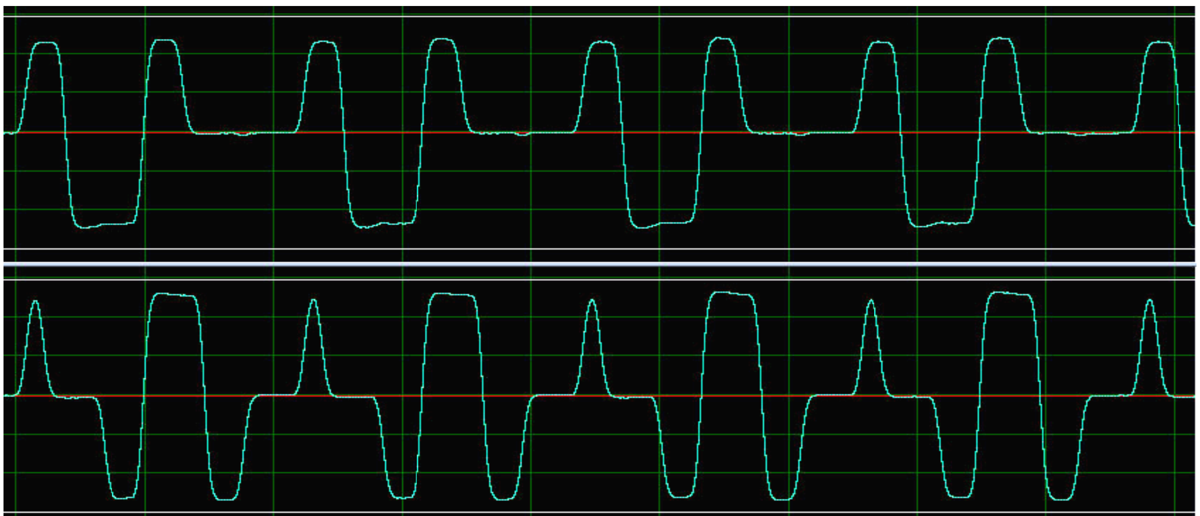
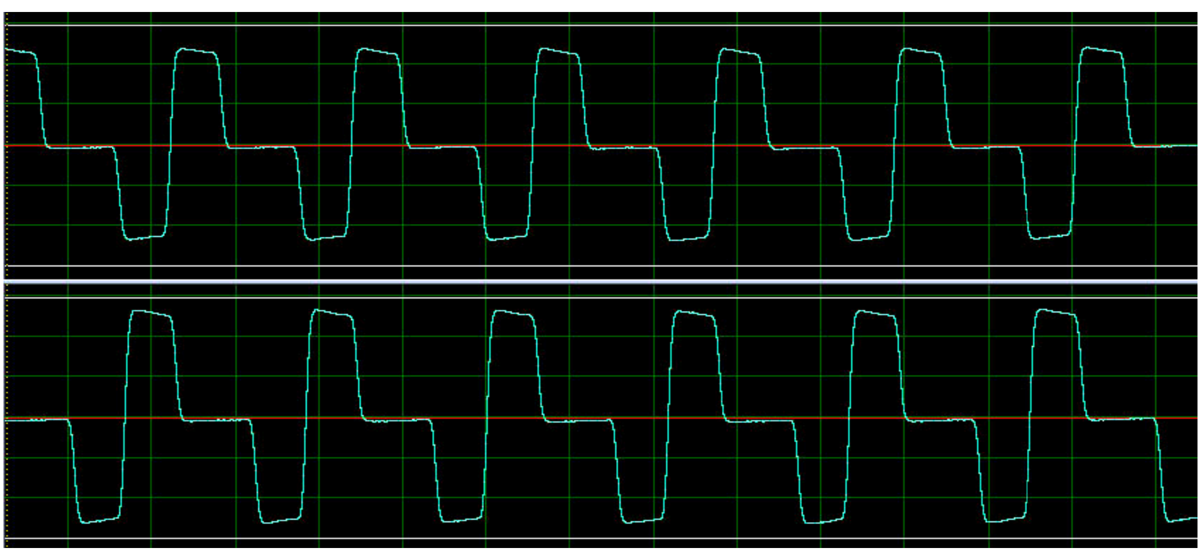
Wavetable Bank 3 – Pulses (mirrored)

Banks 3 and 4 consist of bipolar pulses. At the beginning of the cycle the pulse first goes negative, then it goes positive, and finally goes to zero. As the PH2 signal increases, the pulse width gets narrower. Bank 3 waveforms are the same as those in Bank 4 except that they are mirrored about the center of the cycle.

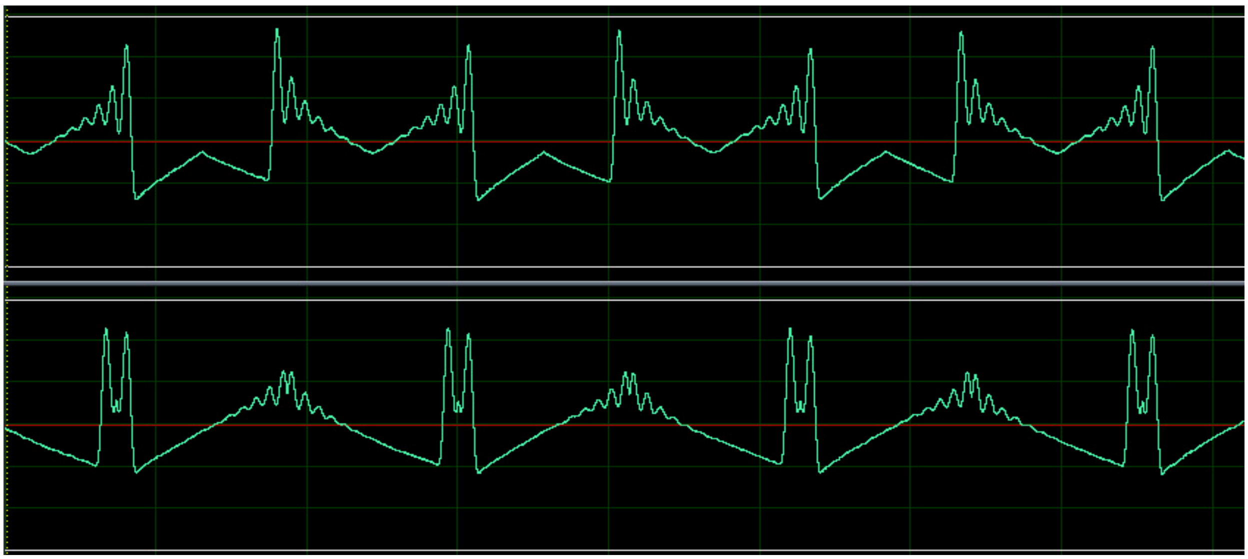


Wavetable Bank 4 – Bipolar Pulses

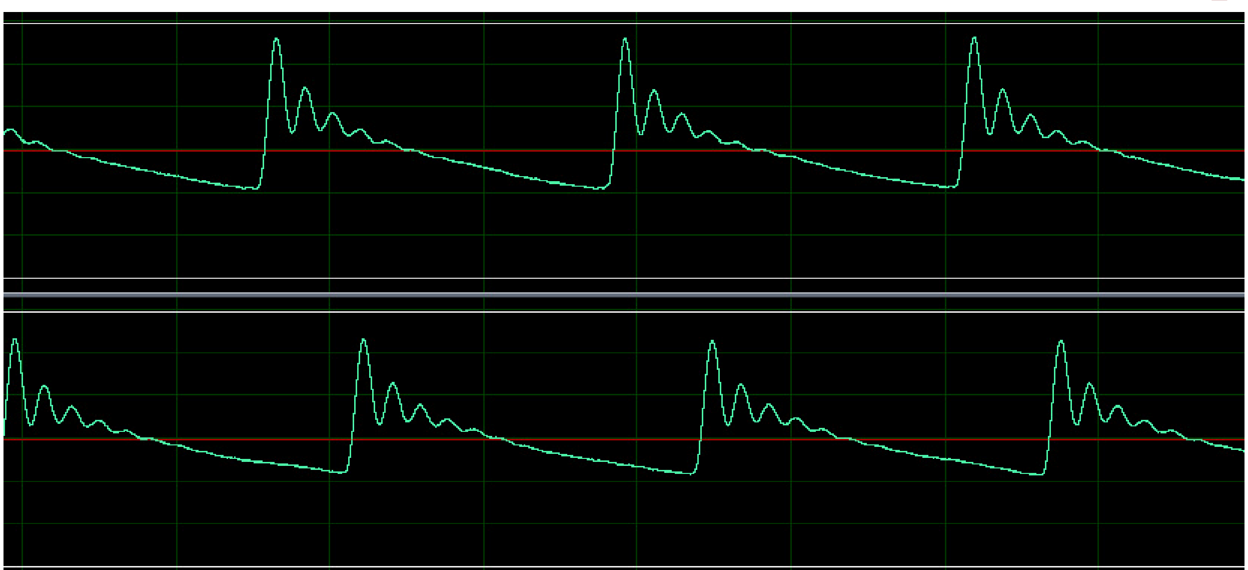


Wavetable Bank 5 – Sawtooth Filter Sweep (mirrored)

Banks 5 and 6 consist of sawtooth waves passed through a resonant lowpass filter. As the PH2 signal increases, the resonance frequency increases. Bank 5 waveforms are the same as those in Bank 6 except that they are mirrored about the center of the cycle.

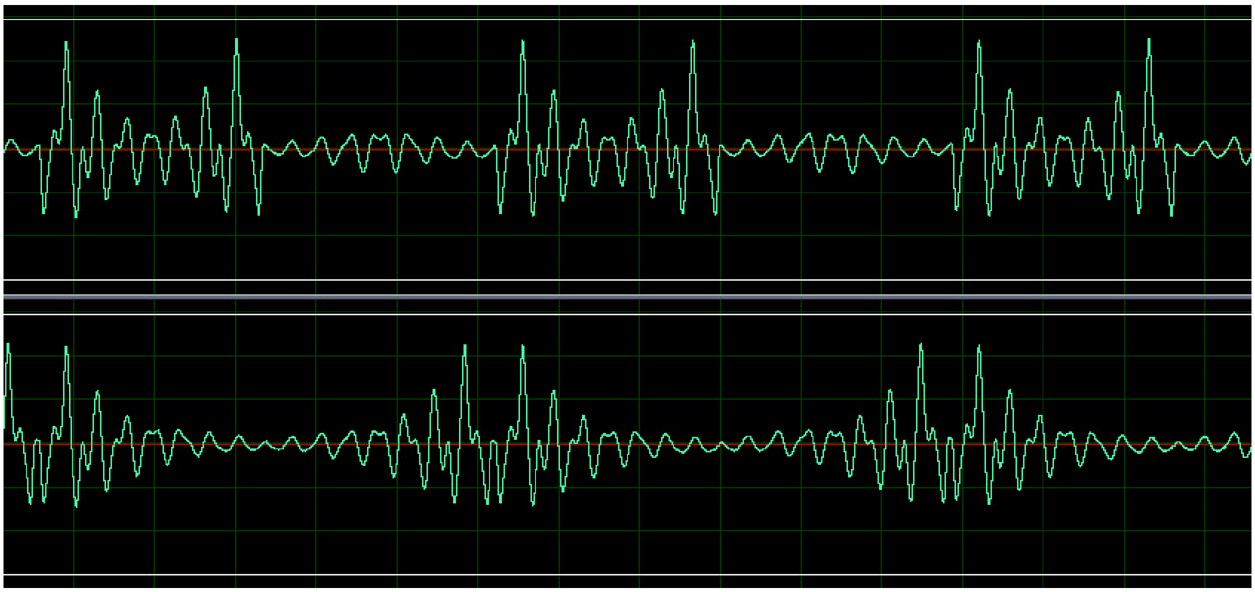


Wavetable Bank 6 – Sawtooth Filter Sweep

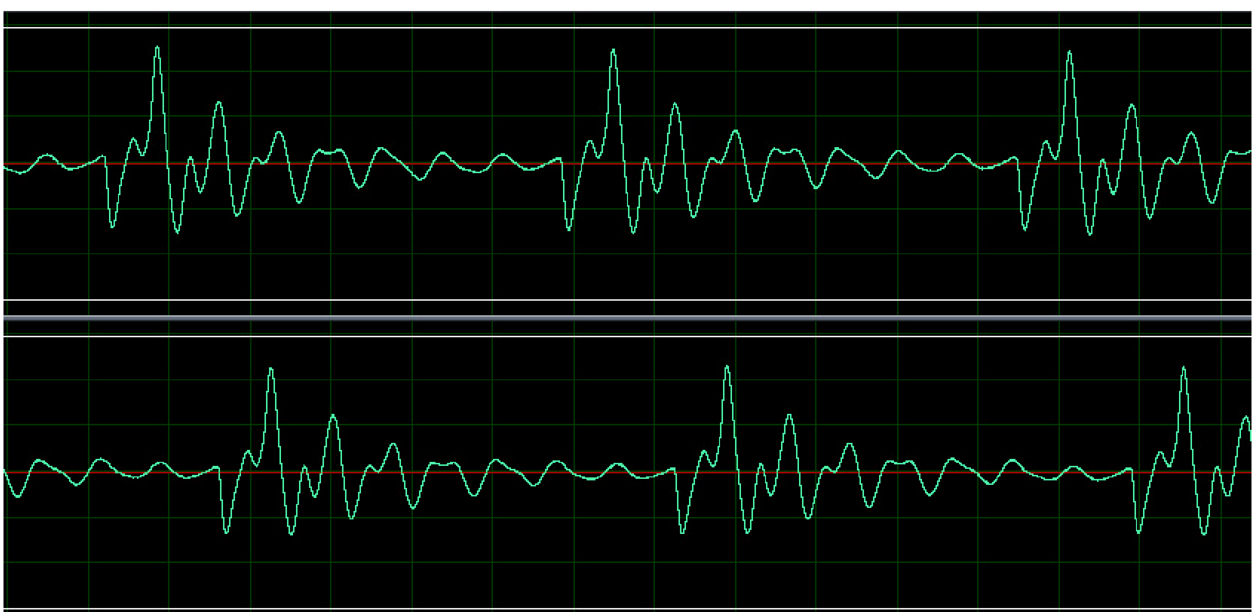


Wavetable Bank 7 – Vowels (mirrored)

Banks 7 and 8 consist of different vowel waveforms. Bank 7 waveforms are the same as those in Bank 8 except that they are mirrored about the center of the cycle.



Wavetable Bank 8 – Vowels



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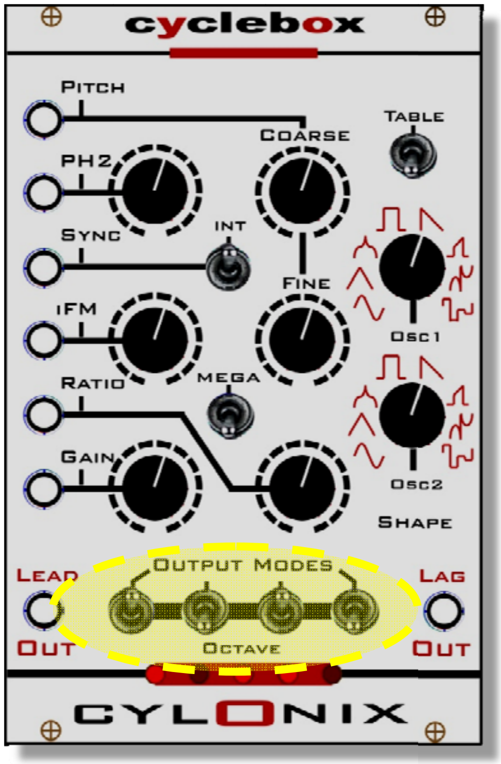
Output Modes – Waveform Combination

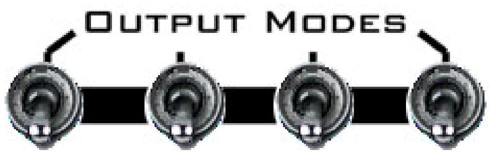


One of the keys in generating the distinctive ***Cylonix cyclebox*** sound is the nonlinear combination of the oscillator waveforms.

There are 16 different output waveform combination modes available, selectable using the toggle switches labeled "***output modes***". The Cyclebox can be thought of as 16 different synthesizers in one package!

Some of the combination modes involve combining the OSC1, 2, and 3 waveforms at the bit-level. The Cyclebox module is digital in nature and the waveforms are represented internally by 24-bit digital words.

Some of the combination operations are rather arcane, but it is not necessary to understand how they work to appreciate the sounds that they make!



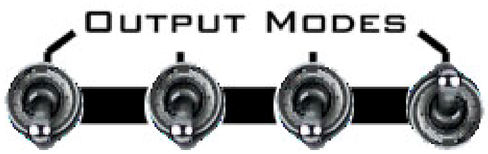
MODE 0000

OSC 1

In this mode the waveform produced by OSC1 is passed directly to the output of the waveform combiner.

Use this mode to get the basic waveshapes (sine, triangle, sinepulse1, square, sawtooth, square-saw, sinepulse2, random, and wavetable waveforms).

This mode is good for obtaining FM sounds (try setting both the waveforms of OSC1 and OSC2 to sine and playing with the RATIO and IFM controls).



MODE 0001

OSC 2

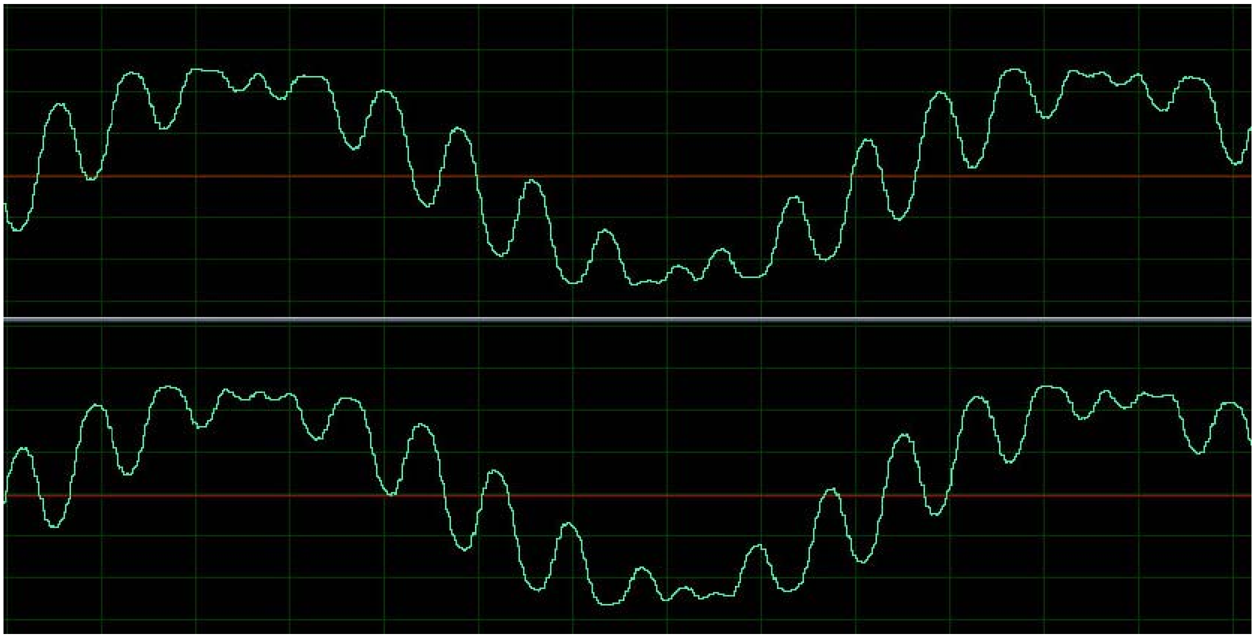
In this mode the waveform produced by OSC2 is passed directly to the output of the waveform combiner.

This mode can also be used to get basic waveshapes as in mode 0000. The MEGA-waves are not available.

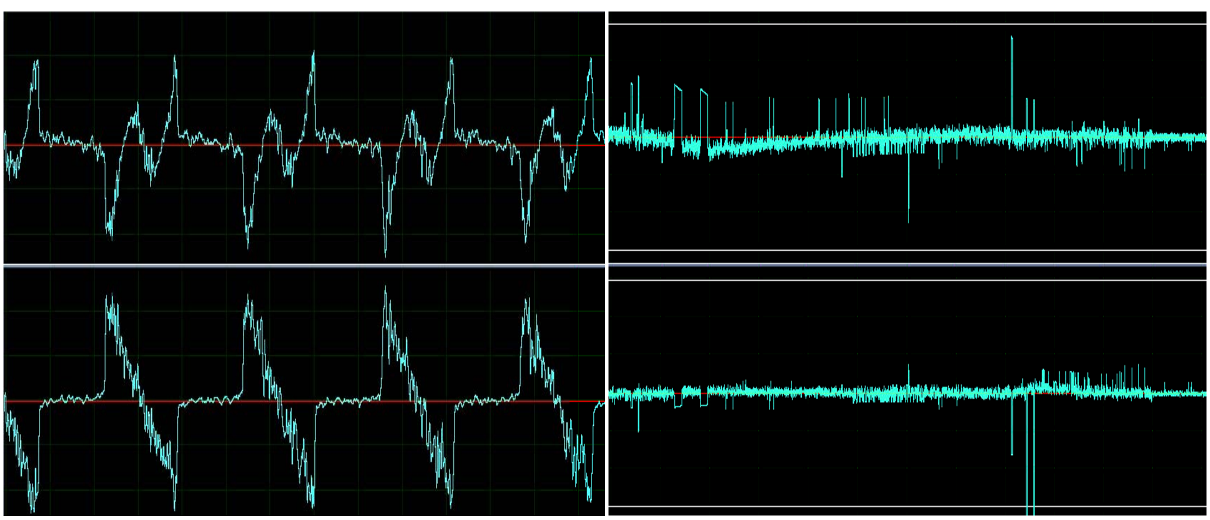
This mode can be used to obtain FM sounds with external modulation by using the RATIO input. This modulation is of (much) lower quality than produced by the internal modulation path of OSC1 in mode 0000. The sampling rate is much lower and the bit width is lower. The modulation is also exponential rather than linear.

In this mode the phase shift between the LAG and LEAD outputs is not fixed at 90 degrees, but is adjustable using the PH2 input and control. A PH2 input of 0 Volts gives 0 degrees phase difference, about +4 Volts gives 180 degrees and about +8 Volts gives +360 degrees. Negative voltages produce negative phase differences.

Feeding an LFO or oscillator signal into the PH2 input can give a phase modulation of the output waveform as shown in the figure below.



In addition, in this mode the iFM input is used control the amount of the LAG output which is fed back to the phase input. This can bend the output waveforms and even produce chaotic outputs, as shown in the figures below.



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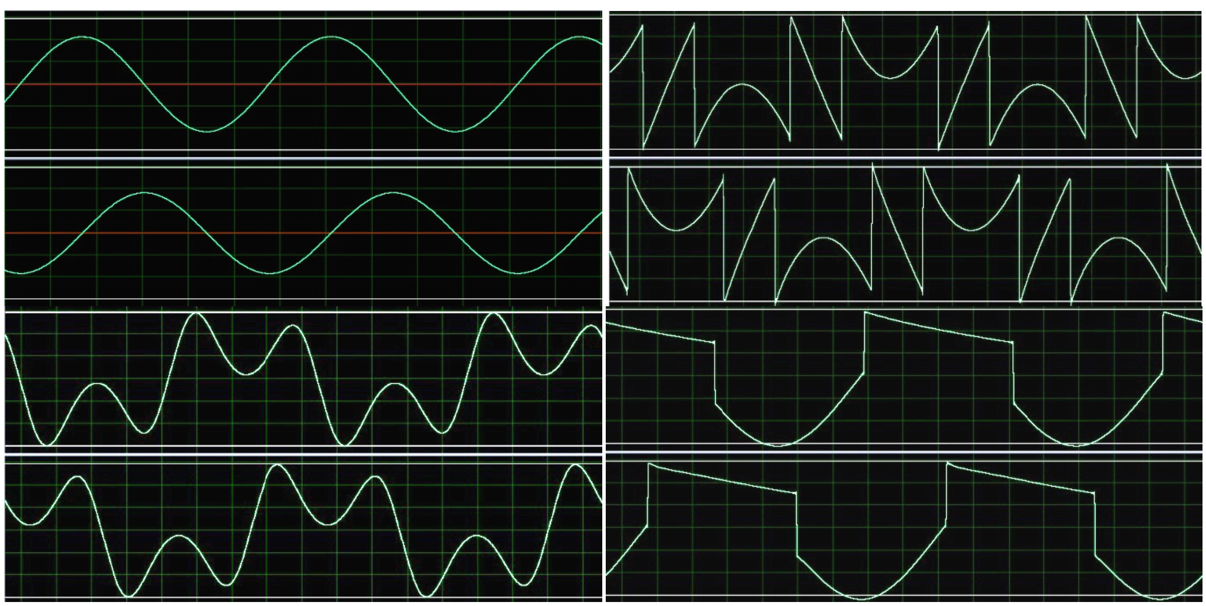
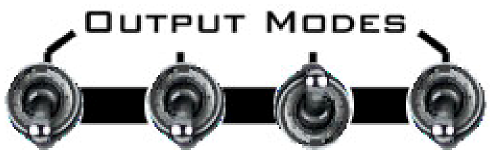
In this MODE the SHAPE control for OSC1 is used to select the shape of an additional waveshaper that is applied to the output of the wavefolding. There are four possible shapes for this additional waveshaper. When the OSC1 Shape control is fully counter-clockwise (i.e. in the SINE or TRIANGLE position) then the shape of the additional waveshaper is a SAWTOOTH. This does not alter the output at all, so selecting a SINE for OSC2 gives a SINE on the output. When the OSC1 Shape control is between ¼ and ½ a turn clockwise, the additional waveshaper is a TRIANGLE shape. This folds the output. When the OSC1 Shape is between ½ and ¾ a turn clockwise the additional waveshaper is an offset SINE. This provides a somewhat smooth folding. Finally, when the OSC1 shape control is from ¾ to fully clockwise, a square-saw shape is applied. This squares off the positive part of the wave and passes the negative part unchanged.



The result of this additional waveshaping is that in MODE 0001 there are a total of 32 basic waveforms rather than just 8 as in MODE 0000.



MODE 0010

OSC1, OSC 2

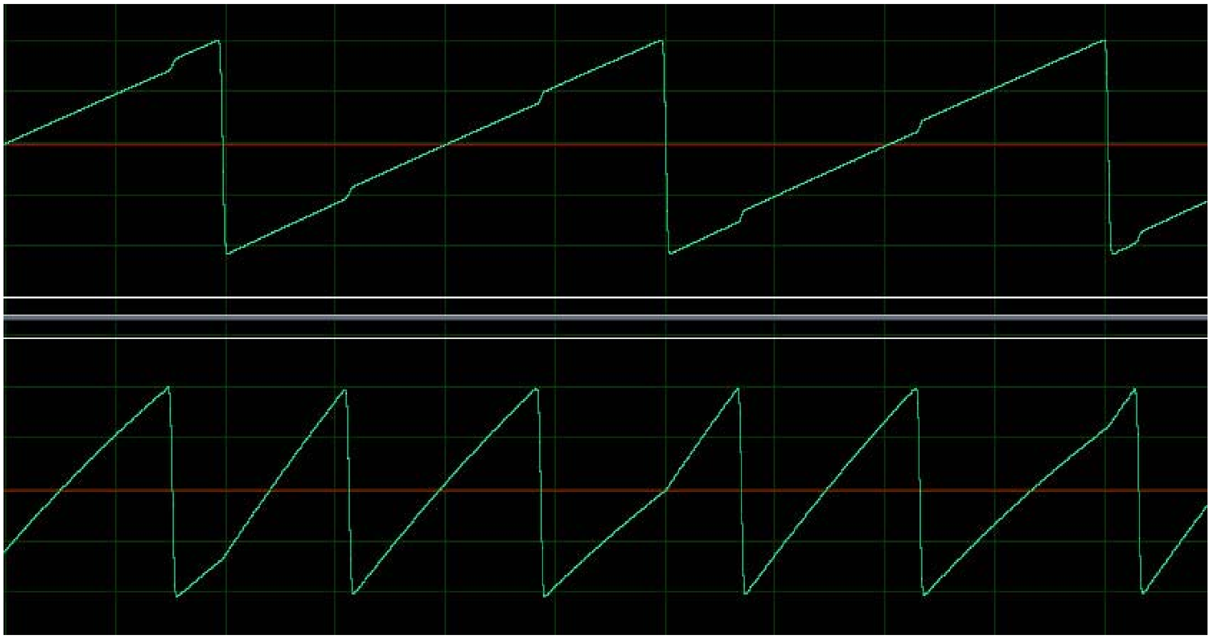
In this mode the waveform produced by OSC1 is passed directly to the LEAD channel of the wave folder and the output of OSC2 is passed to the LAG channel.

In this way the Cyclebox becomes two independent oscillators.

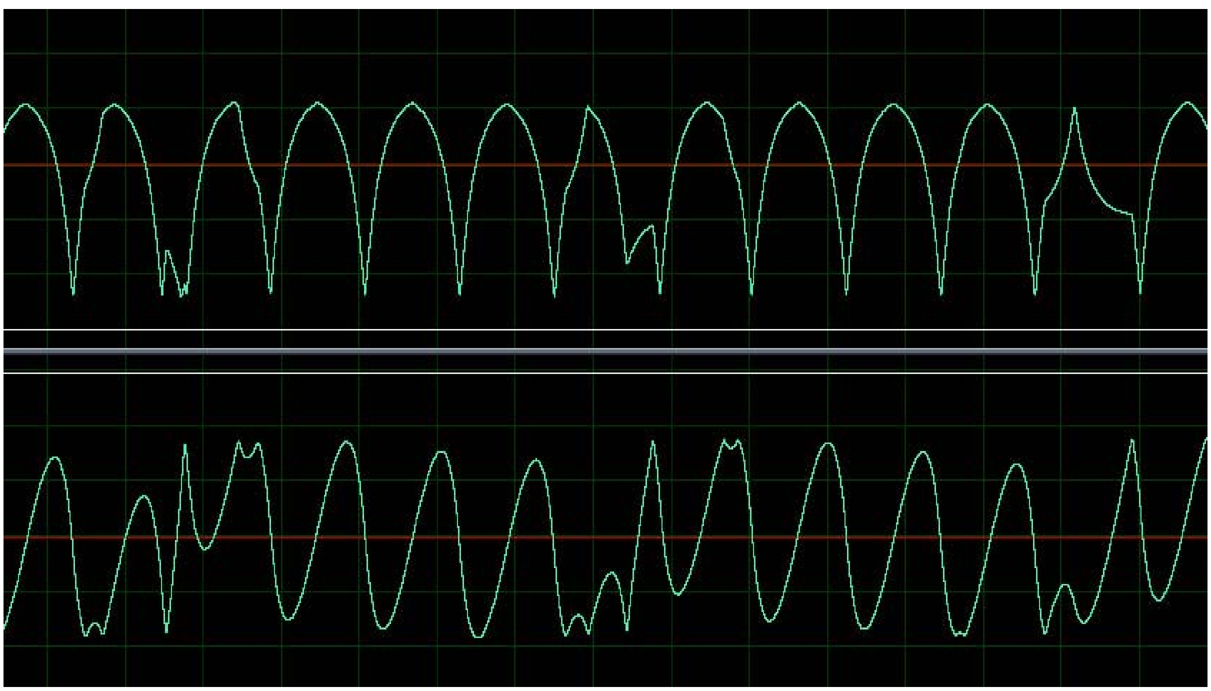
The pitch of OSC1 is controlled by the PITCH input as usual, but the pitch of OSC2 is controlled by the RATIO input or the RATIO control if nothing is plugged into the RATIO jack. Both inputs have a 1V/octave response. The COARSE and FINE controls affect both oscillators by the same amount. Thus, if the same signal is input to the PITCH and RATIO inputs the pitches of OSC1 and OSC2 will be the same (in practice they will be slightly different due to offsets in the two separate A/D converter channels used for the two inputs).

The wavefolder works as usual, as do the SYNC and the internal FM of OSC1 by OSC2.

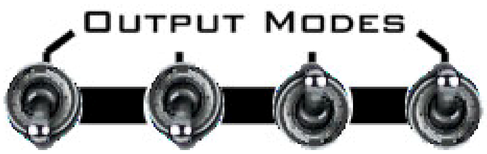
In this mode the PH2 control and input also adjust the amount of OSC1 output that modulates the phase of OSC2. By combining the usual FM of OSC1 by OSC2 with the phase modulation of OSC2 by OSC1 interesting and sometimes chaotic sounds can be created.



Mode 0010 combination of an OSC1 saw and a fixed frequency OSC2 saw with a little bit of FM and PM feedback



Mode 0010 combination of an OSC1 triangle and a fixed frequency OSC2 triangle with heavy FM and PM feedback

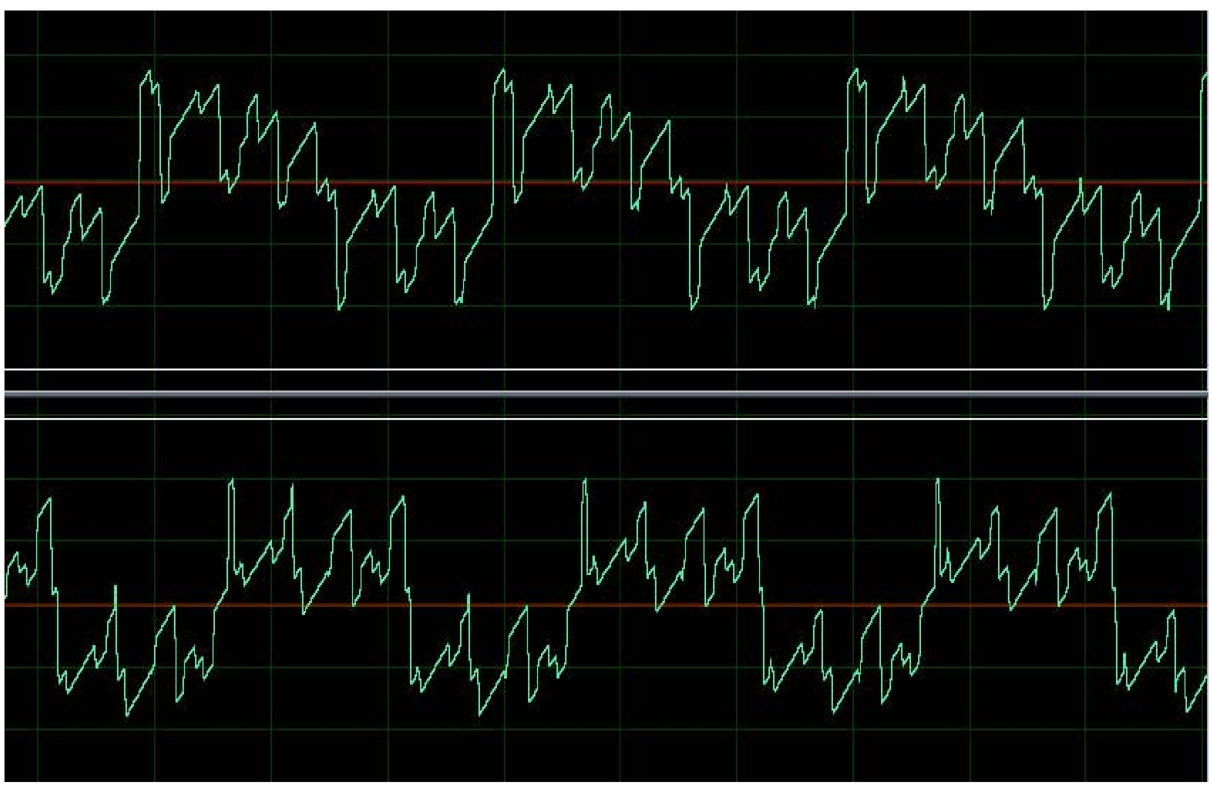


MODE 0011

OSC1 + (OSC 2+OSC3)/2

In this (linear) combination mode the OSC1 waveform is added to half-amplitude OSC2 and OSC3 waveforms. The OSC3 waveform is set to squarewave.

This can produce some rich classical synthesizer sounds, for example when OSC1 is set to hex-saw and OSC2 to saw at an octave above.



Mode 0011 combination of an OSC1 hex-square and an OSC2 saw

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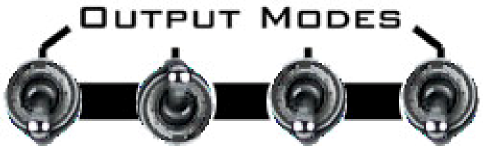
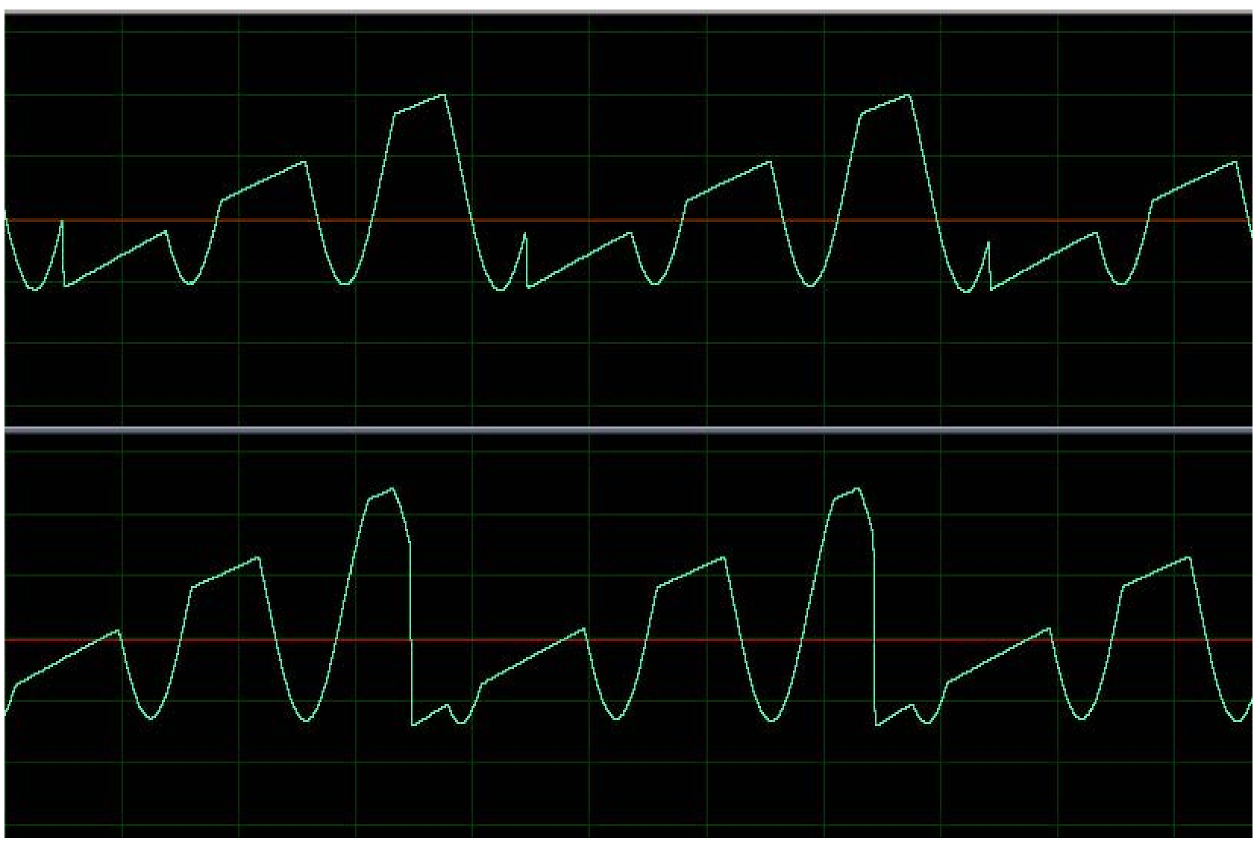


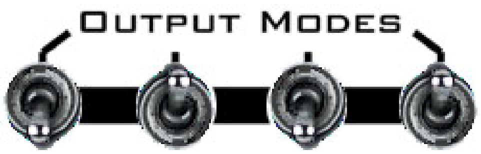
MODE 0100

MINIMUM(OSC1, OSC 2)

In this mode the output is the minimum of the OSC1 and OSC2 waveforms.



Mode 0100 combination of an OSC1 sawtooth and an OSC2 sinusoid with three times the frequency of OSC1

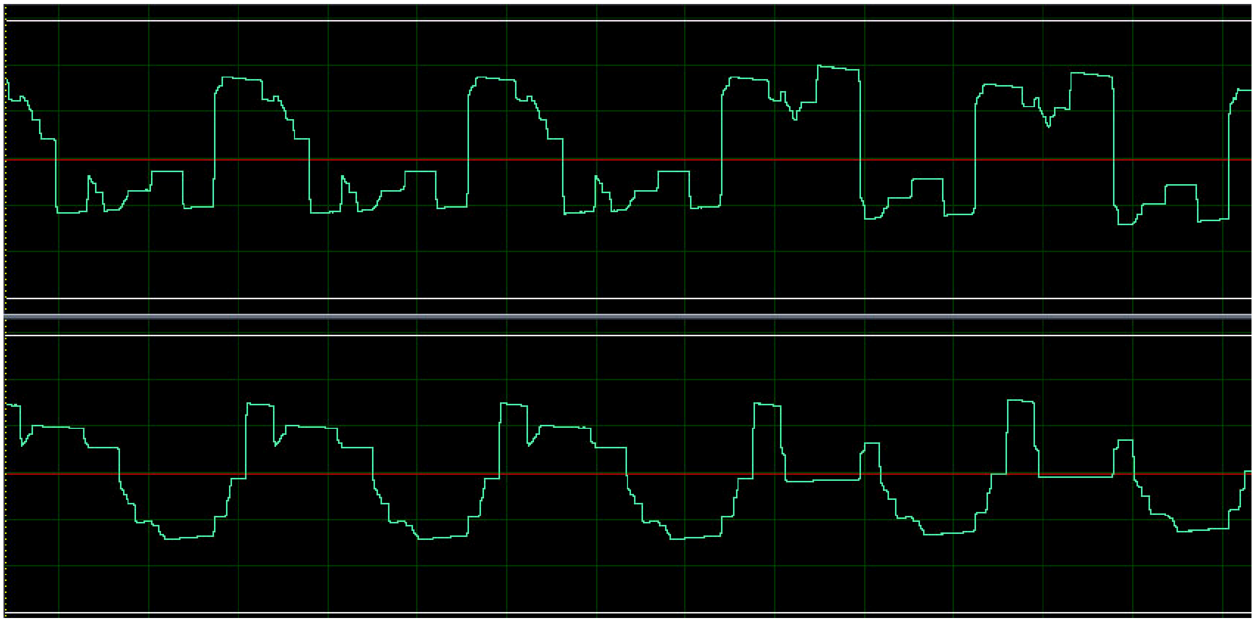


MODE 0101

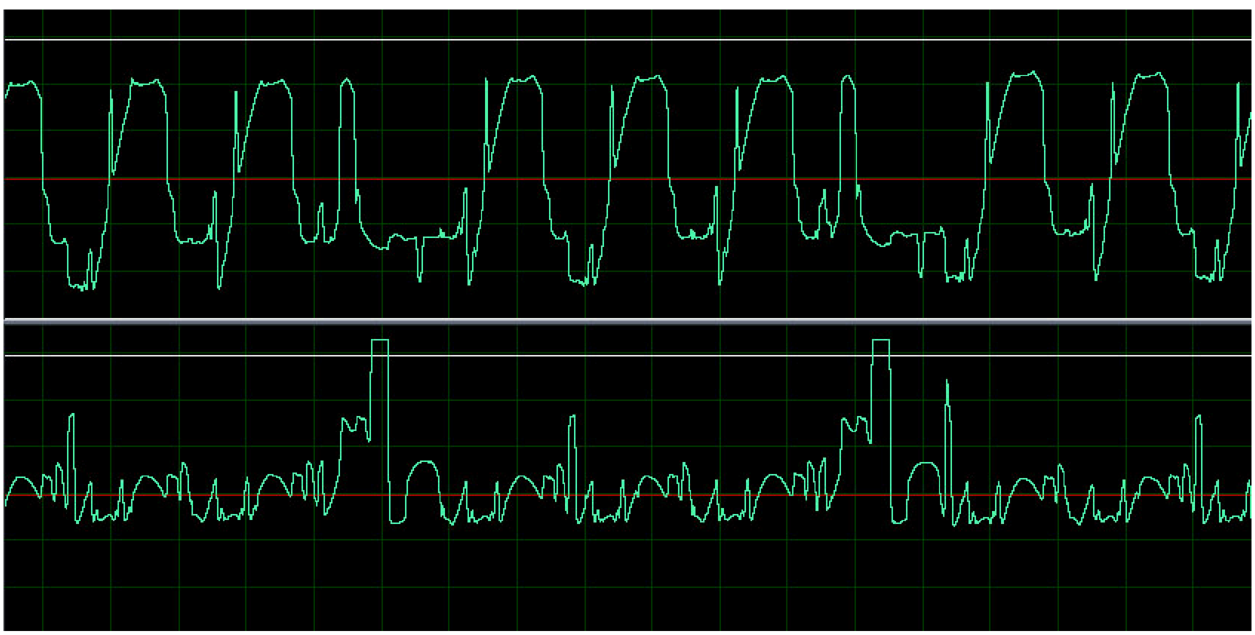
Bitwise C-Element of OSC1 and OSC2 with OSC2 Phase Perturbation

In this mode the output is obtained by applying a *Muller C-Element* operation bitwise on the OSC1 and OSC2 waveform values. A C-Element is like an AND gate for bit transitions – the result goes high only when both input bits are high, and goes low only when both input bits are low. Otherwise (i.e. when the input bits have different values) the output is held constant at whatever its current value is. This in itself provides a mildly interesting, sometimes glitchy, waveform but to spice things up a bit, the output of the C-Element operation is bitwise ANDed with the PH2 input/control signal. The result of this AND operation is then fed back into the OSC2 phase modulation input. The result is that there is a perturbation of OSC2's phase whenever there is a transition (either from high to low or from low to high) of any of the bits in the C-Element output. This magically produces wild fluctuations in the output signal. Turning up the iFM control makes things even more wooly and wacky.

This mode is especially useful as an LFO in generating rather chaotic yet somewhat repetitive signals.

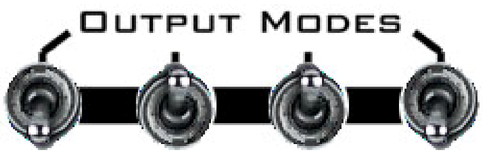


A rather sedate Mode 0101 combination of an OSC1 triangle and an OSC2 square wave



A more raucous Mode 0101 combination of an OSC1 sawtooth and an OSC2 sinusoid with the iFM control turned up

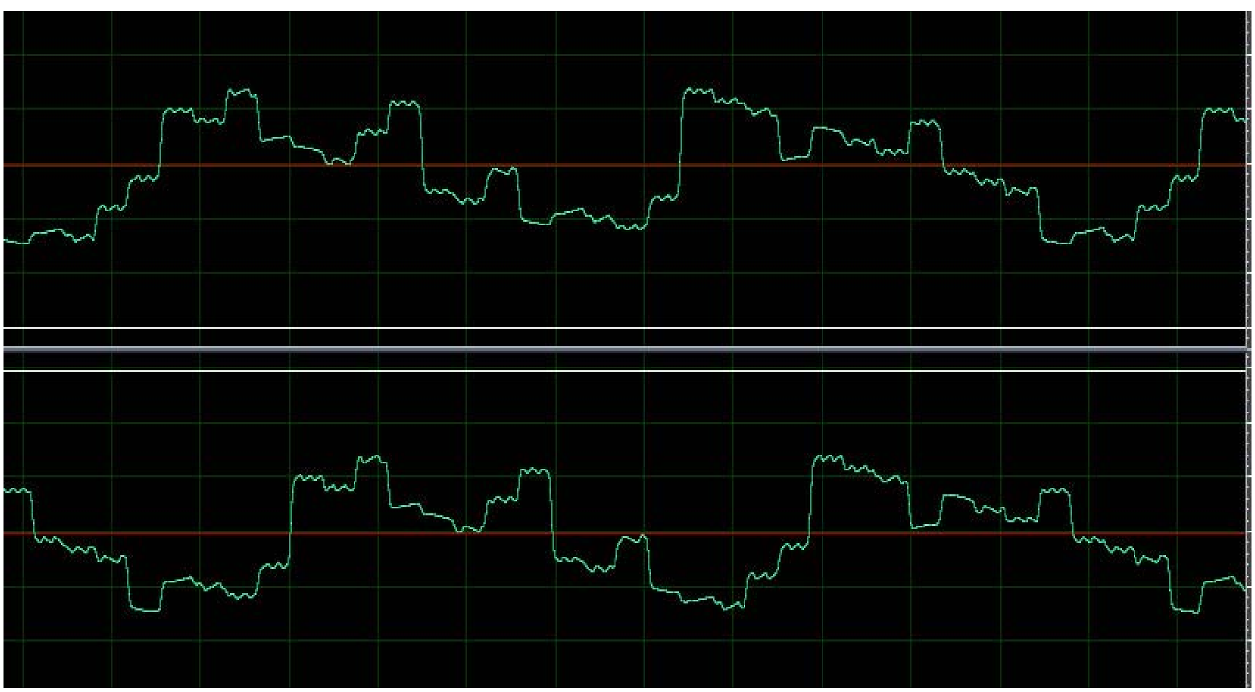
CYLONIX



MODE 0110

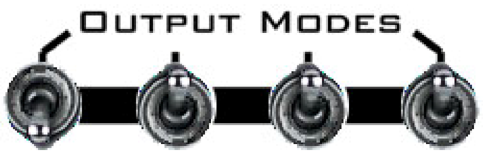
[OSC1(23) OSC2(22) OSC3(21) OSC2(20) OSC1(19)…OSC1(0)]

In this mode the most-significant four bits of the OSC1, OSC2, and OSC3 waveforms are ***interleaved***, bit-by-bit, to produce the output value. The most-significant-bit (bit 23) of the output is taken from the most-significant-bit of OSC1, bit 22 of the output is taken from bit 22 of OSC2, bit 21 of the output is taken from bit 21 of OSC3, bit 20 of the output is taken from bit 20 of OSC2, and the remaining bits (19 down to 0) are taken from OSC1.



Mode 1011 combination of an OSC1 sinusoid and an OSC2 sawtooth

CYLONIX

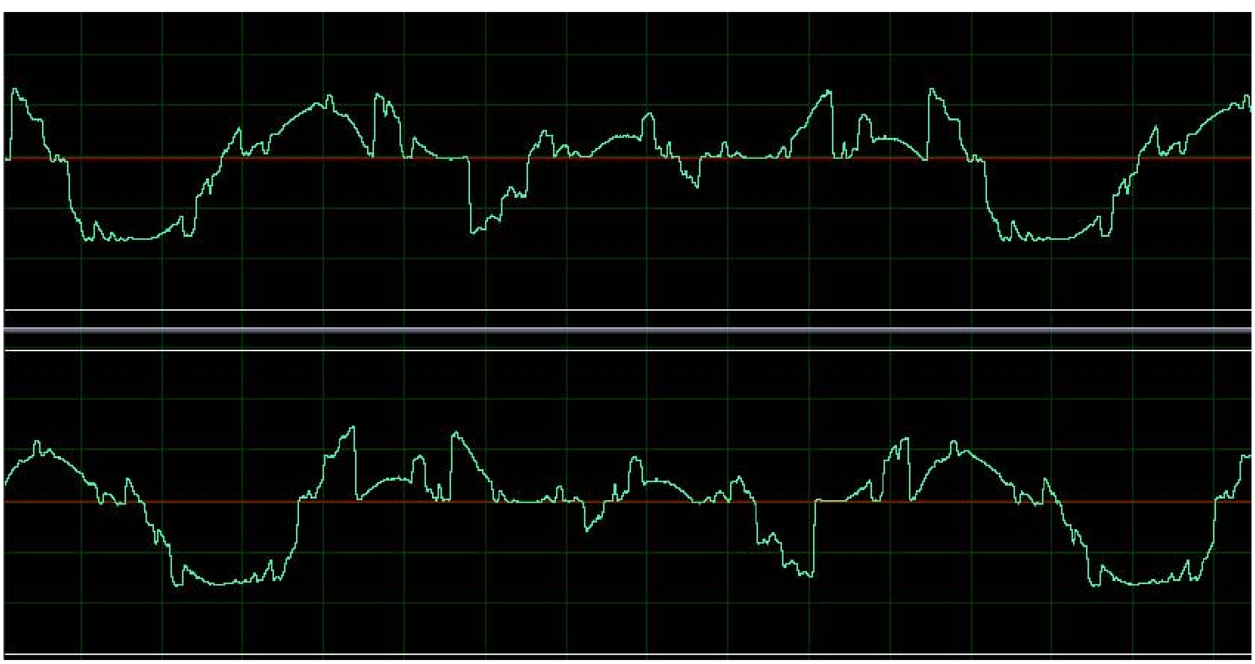


MODE 0111

OSC1 and OSC2

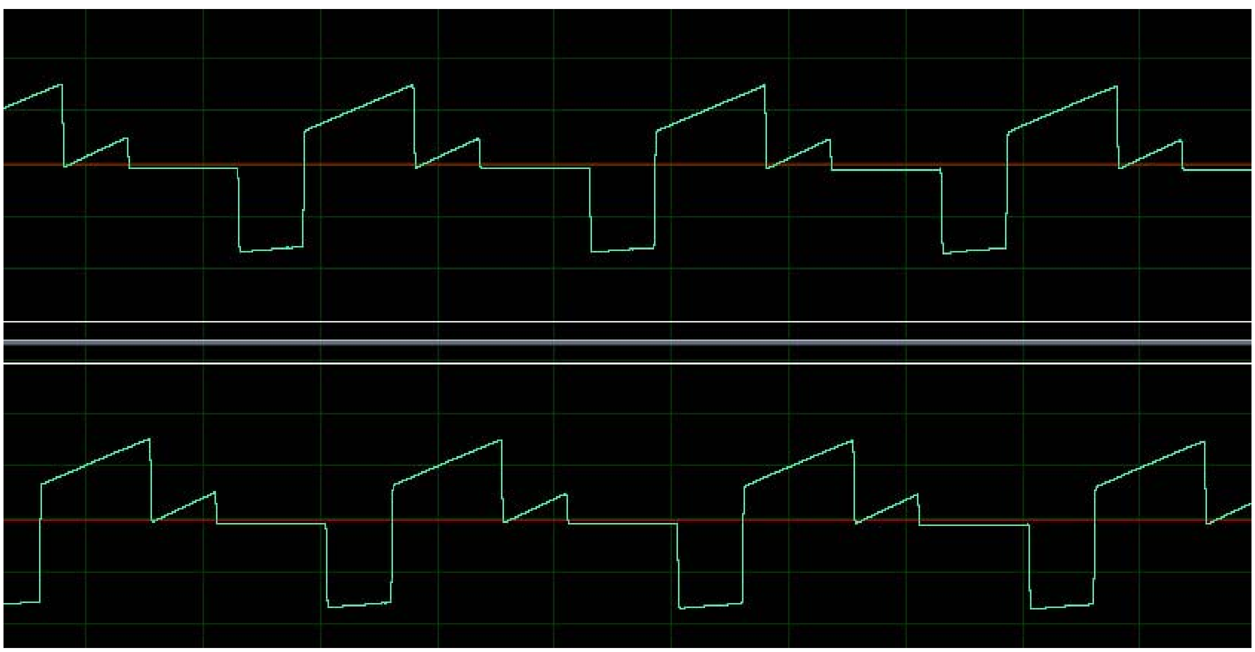
In this mode the output is the bitwise ANDing of the OSC1 and OSC2 waveforms.

In an AND operation the result is “1” if both input bits are “1” otherwise the result is “0”. The operation is done on the bits of the sign-magnitude representation of the waveform values. In general, the resulting waveform is quite distorted compared to the OSC1 and OSC2 waveforms.



Mode 0111 combination of an OSC1 triangle and an OSC2 sine

Setting one of the waveforms to square produces a form of gating. The maximum level of the square has all bits equal to one save for the most significant bit, which is zero. The AND operation passes the other signal through unchanged, but sets the most significant bit to zero. For a positive signal there is no effect, but for a negative signal the effect is to shift the signal up into the positive range. The minimum level of the square is all zeros except for the most significant bit, which is one. In this case the AND operation sets any positive signal to zero and sets any negative signal to the most negative value. This effect is demonstrated in the figure below, which has OSC2 set to a square wave, and OSC1 set to sawtooth.



Mode 0111 combination of an OSC1 saw and an OSC2 square

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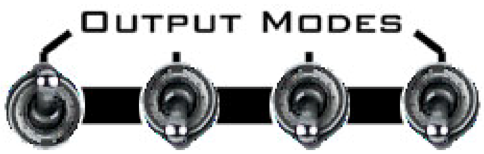
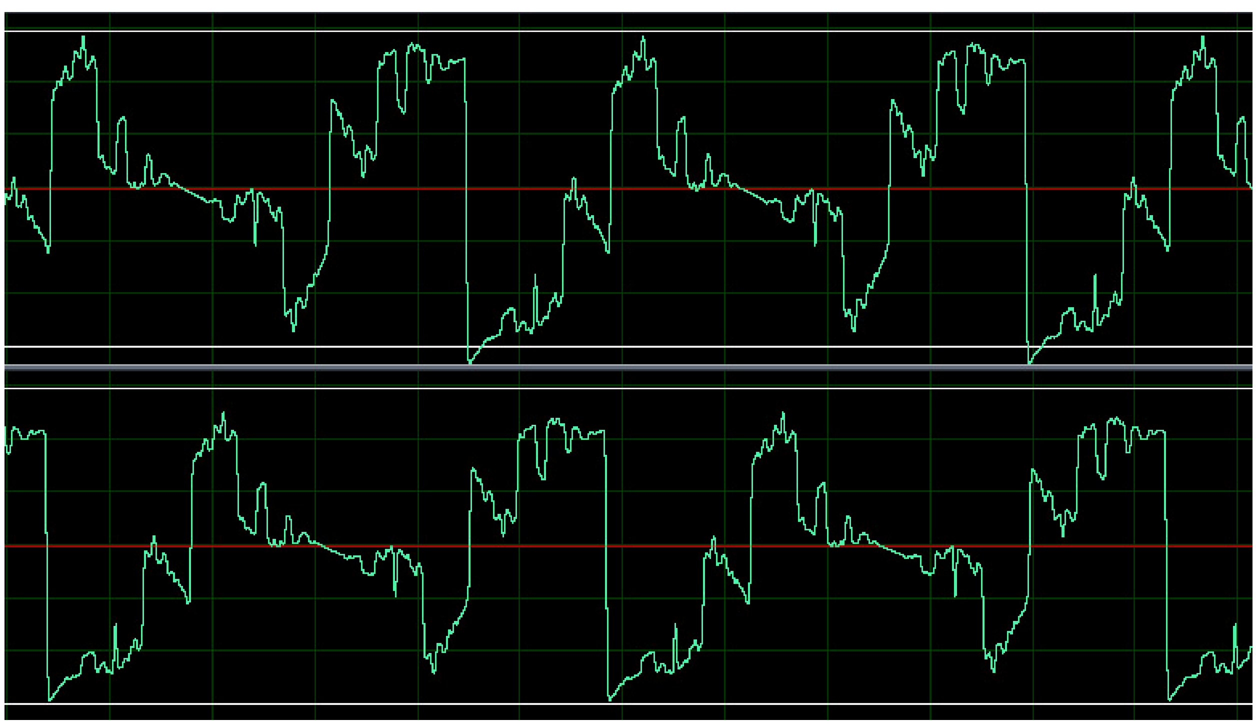


MODE 1000

OSC1 xor OSC 2

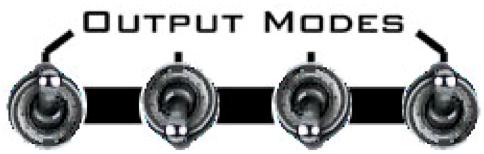
In this mode the OSC1 and OSC2 waveforms are XOR'ed, bit-by-bit.

The n^th bit output by the XOR operation is "0" whenever the n^th bits of OSC1 and OSC2 are the same (i.e. both either "0" or "1"), otherwise the bit is set to "1". The operations are done on the 2's-complement representation of the signal values. Bit-wise xor operations cause a "*bit-rot*" effect on the waveform, which adds high frequency sheen to the sound.



Mode 1100 combination of an OSC1 sawtooth and an OSC2 sinusoid

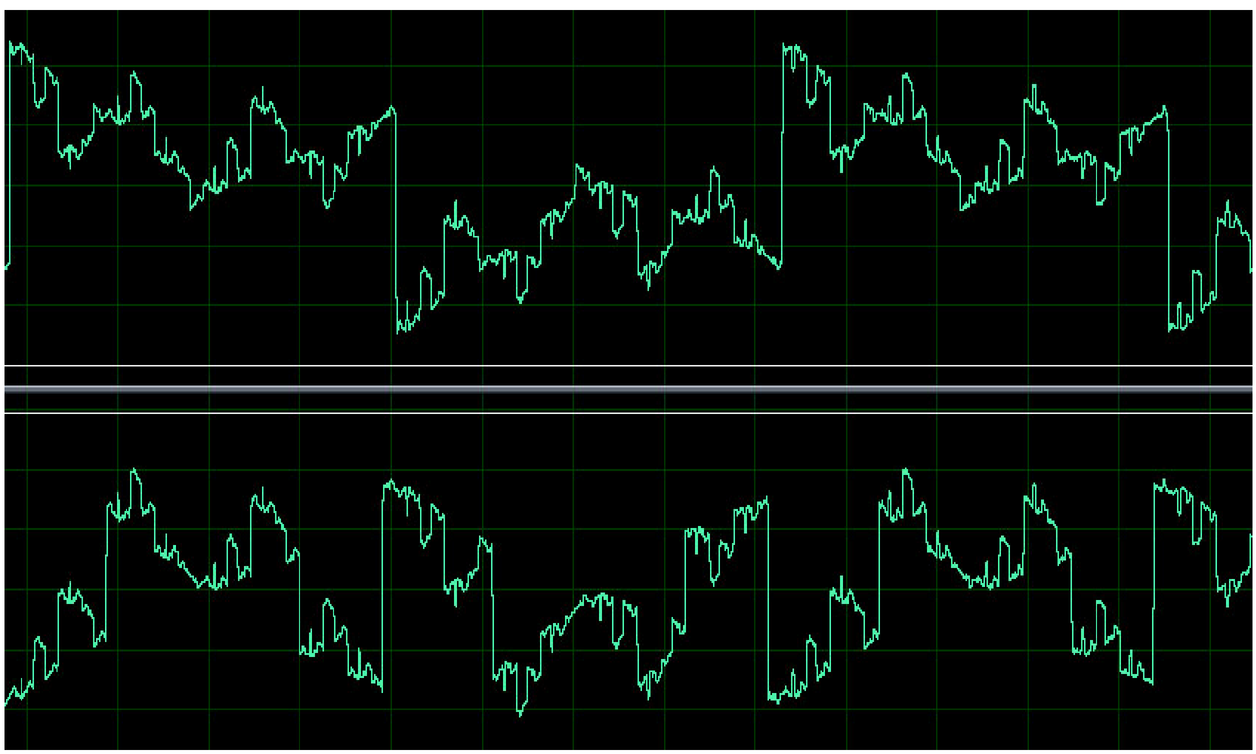
CYLONIX



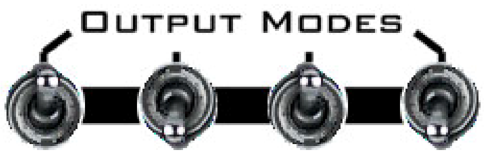
MODE 1001

OSC 2 xor OSC3

In this mode OSC2 is bit-wise XOR'ed with OSC3. As in MODE 0001 the output is passed through an additional waveshaper, whose shapes are selected by the OSC1 SHAPE control.



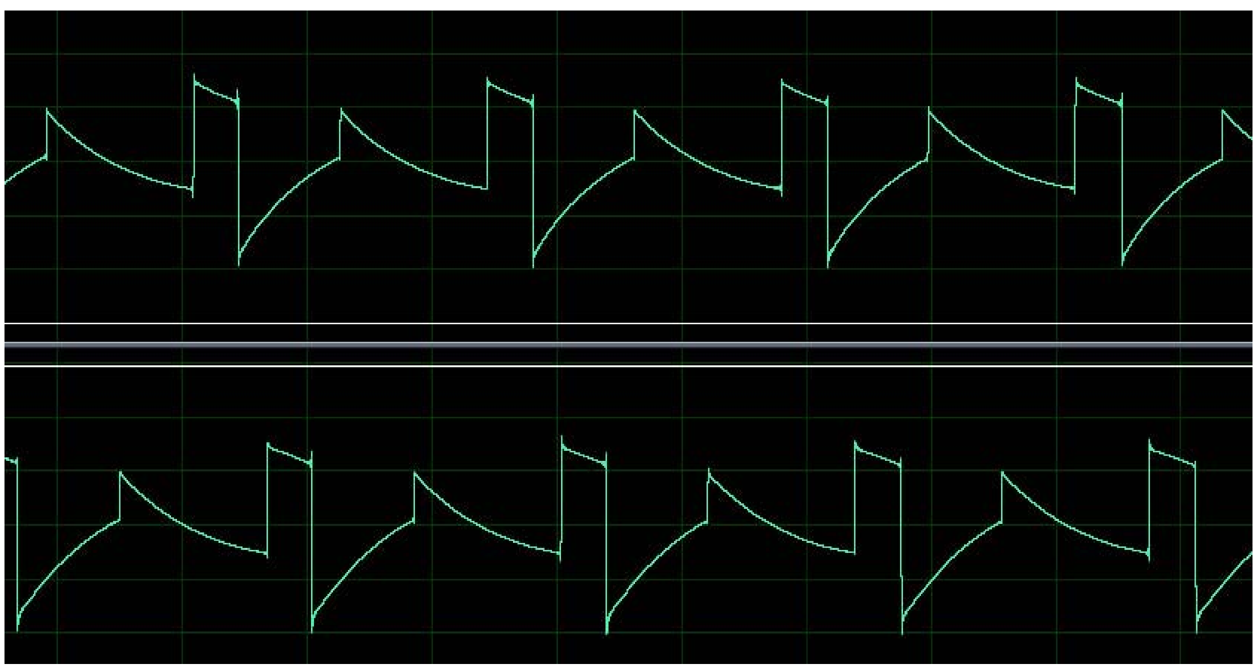
Mode 1001 combination of an OSC2 triangle and the OSC3 triangle, with the post waveshaper set to sawtooth (i.e. no additional shaping).



MODE 1010

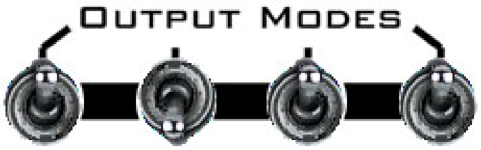
OSC 1 xor OSC2 offset

In this mode OSC1 and OSC2 are shifted up to be positive and then XOR'ed together. After that the result is shifted back down to be bipolar. By turning internal sync on and setting the waveforms of both OSC1 to OSC2 to square, pulse-width modulated pulses can be produced, with the pulse-width set by the PH2 control.



Mode 1010 combination of OSC1 square and OSC2 sinepulse1.

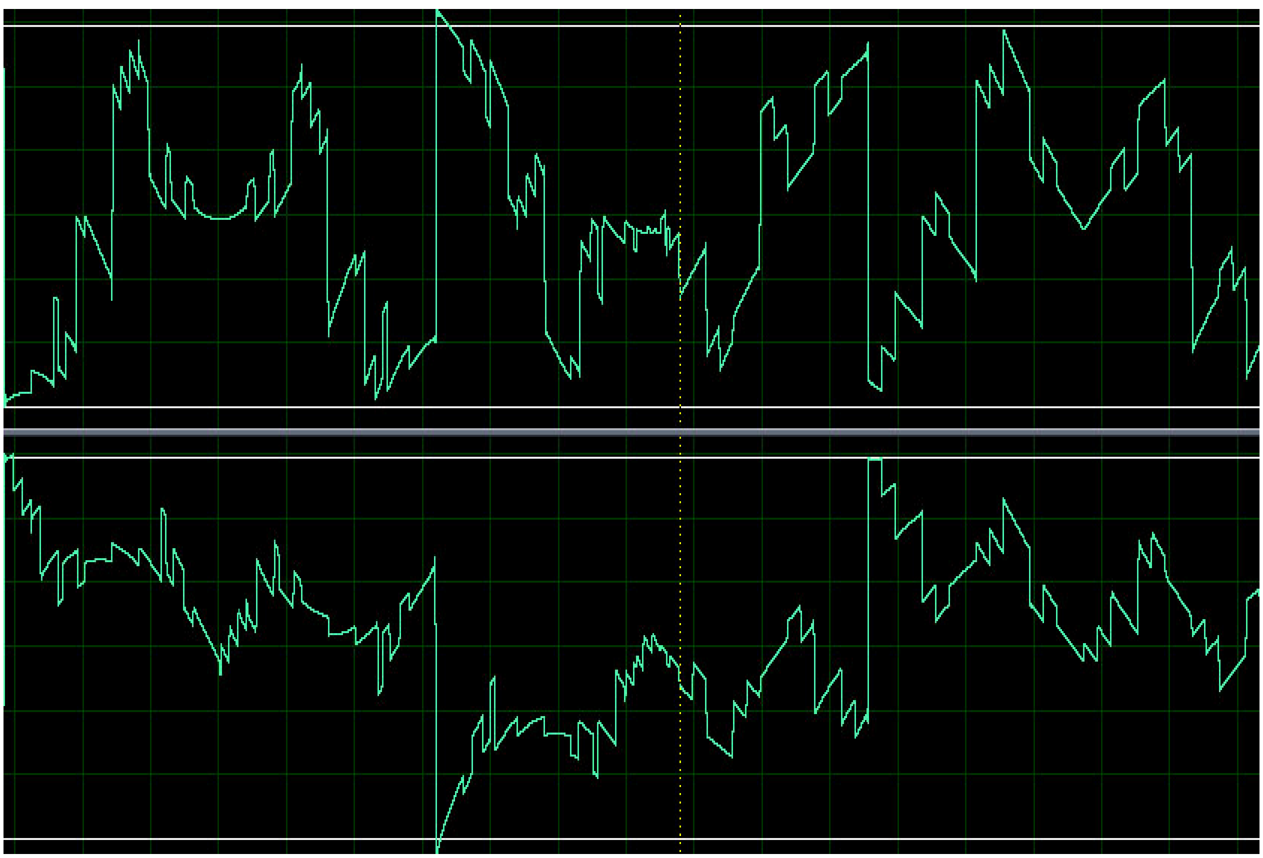
CYLONIX



MODE 1011

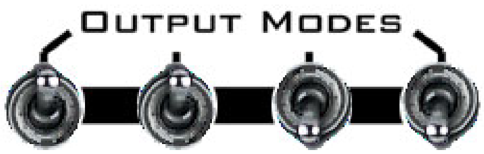
OSC1 xor OSC 3 (reduced to 4 bits)

In this mode, the OSC1 and OSC3 waveforms are XORed, bit-by-bit. The OSC2 waveform is bit-reduced to 4 bits, by zeroing out the 20 lowest order bits.



Mode 1011 with an OSC1 sine wave (left half of image) and then with an OSC1 triangle wave (right half of image)

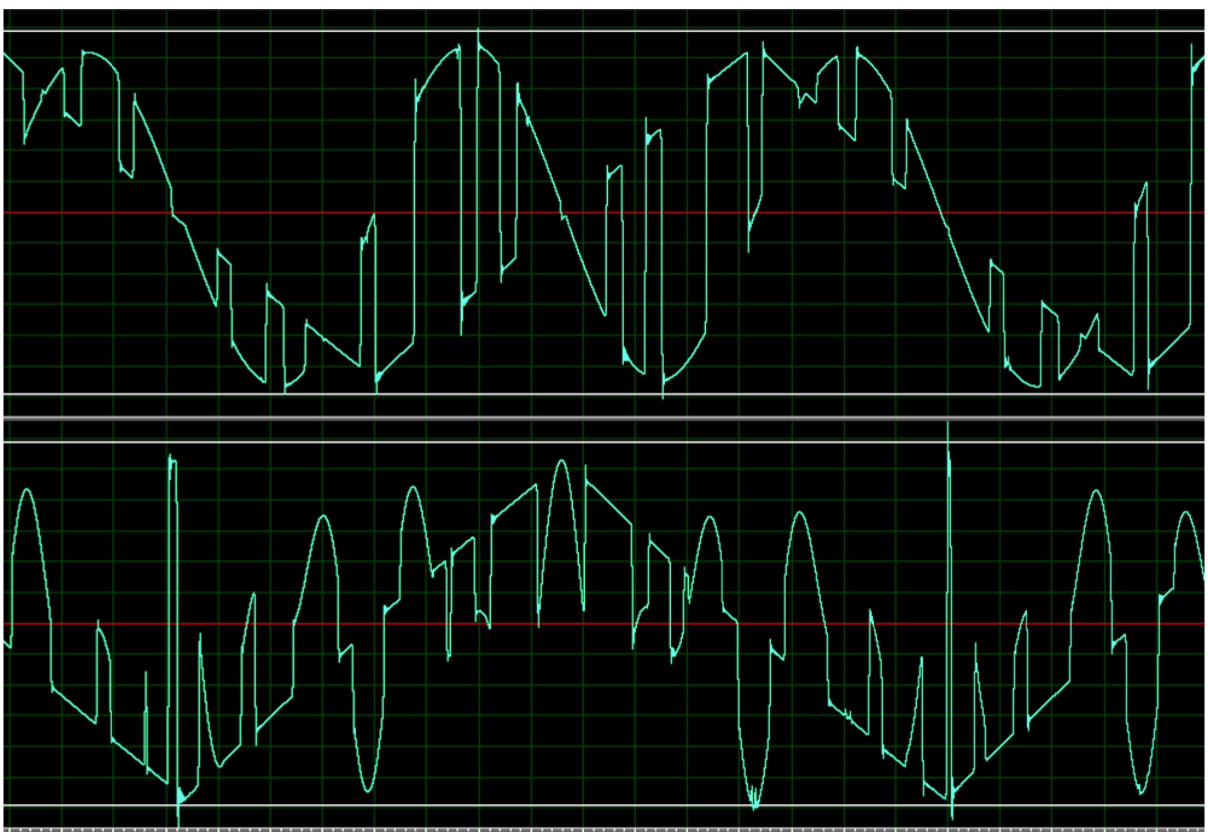
CYLONIX



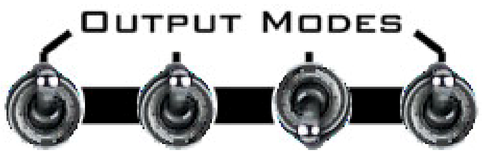
MODE 1100

OSC1 when |OSC2-OSC1| <|OSC2-OSC3|; else OSC3

In this mode the output is switched between osc1 or osc3 depending on which is closest to osc2.



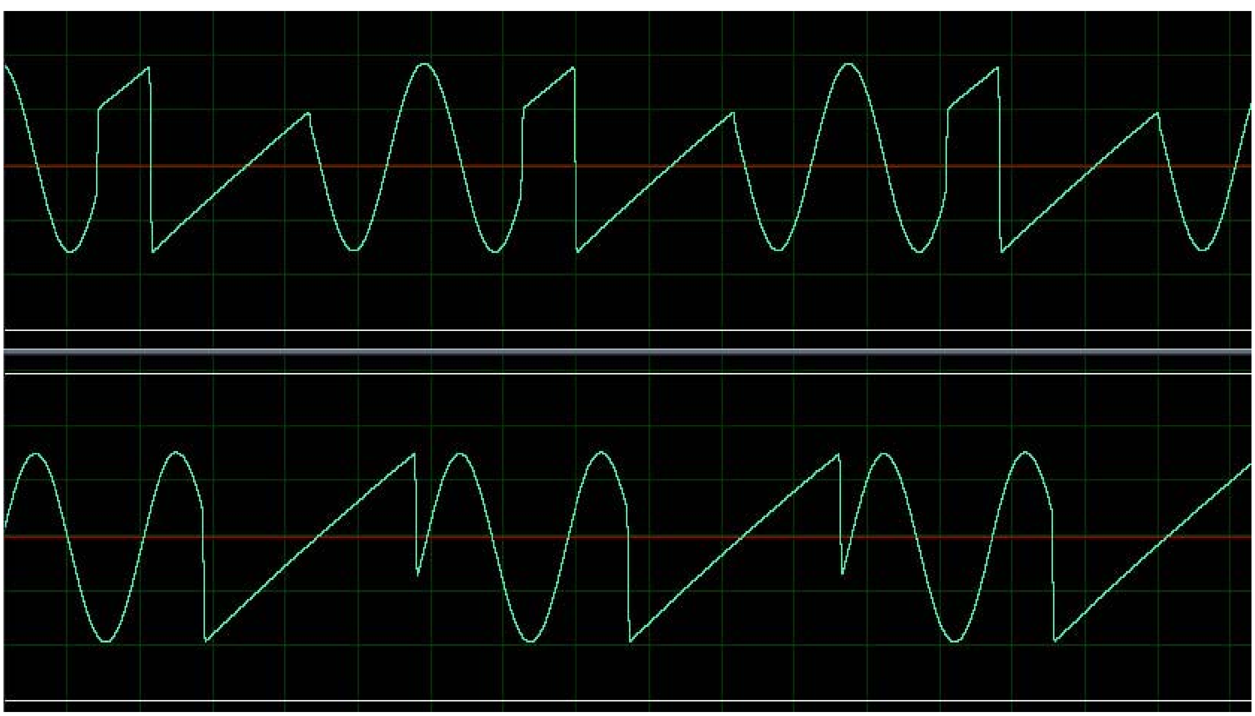
Mode 1100 combination of an OSC1 and an OSC2 sinusoid



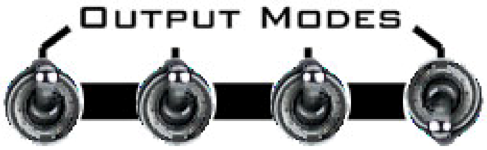
MODE 1101

OSC1 when OSC3(N) = 1; OSC2 when OSC3(N) = 0

In this mode the output alternates between OSC1 and OSC2. OSC2 is passed through whenever the Nth bit of OSC3 is 0, and OSC1 is passed whenever the Nth bit of OSC3 is 1. N is set by the PH2 control or input. For the PH2 control fully counter-clockwise to around 12 o'clock, N is set to 23 (most significant bit). As the PH2 control is turned clockwise, N goes to 22, then to 21, and finally to 20. As N goes from 23 to 22 to 21 to 20, the number of alterations per cycle of OSC3 increases from 2 to 4 to 8 to 16.



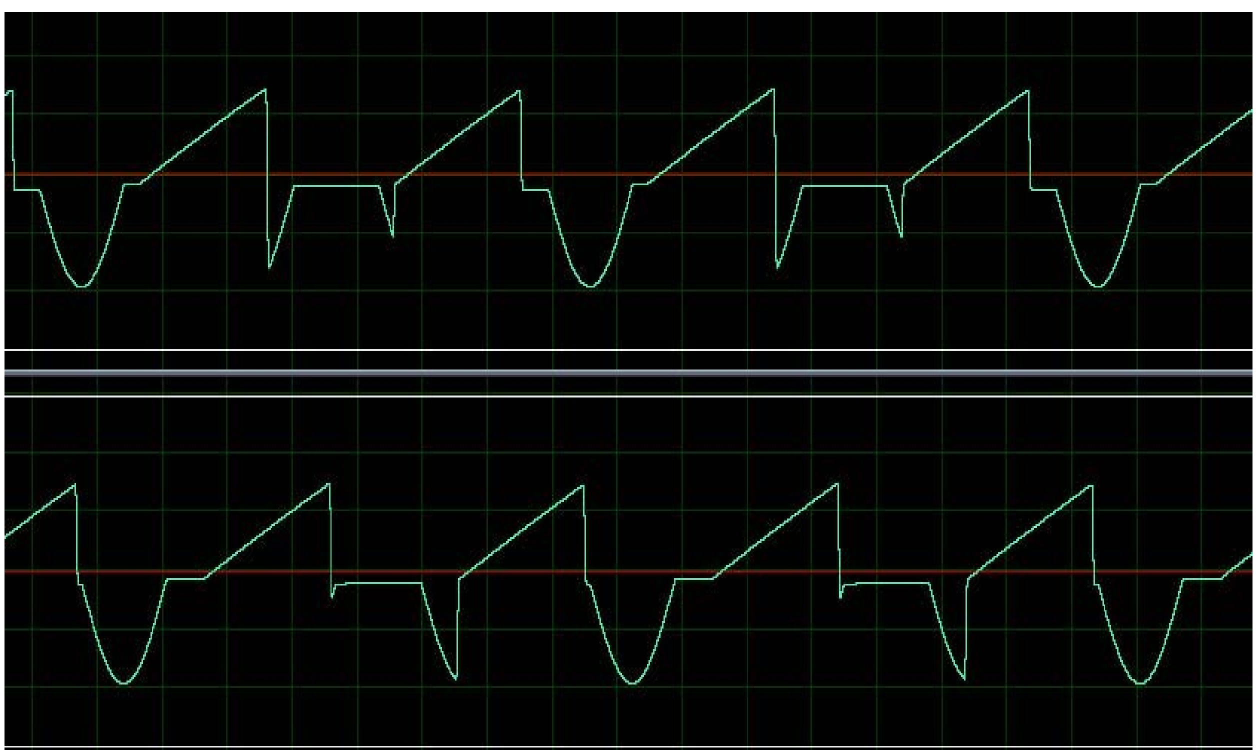
Mode 1101 combination of an OSC1 sawtooth and an OSC2 sinusoid



MODE 1110

Positive part of OSC1 and negative part of OSC2 otherwise zero

In this mode the output is equal to OSC1 if OSC1 is positive, otherwise it is equal to OSC2 if OSC2 is negative. If neither of these conditions hold (i.e. OSC1 is negative and OSC2 is positive) then the output is zero. This produces a waveform with a central flat spot and different shapes in the positive and negative parts.



Mode 1110 combination of an OSC1 sawtooth and an OSC2 sinusoid

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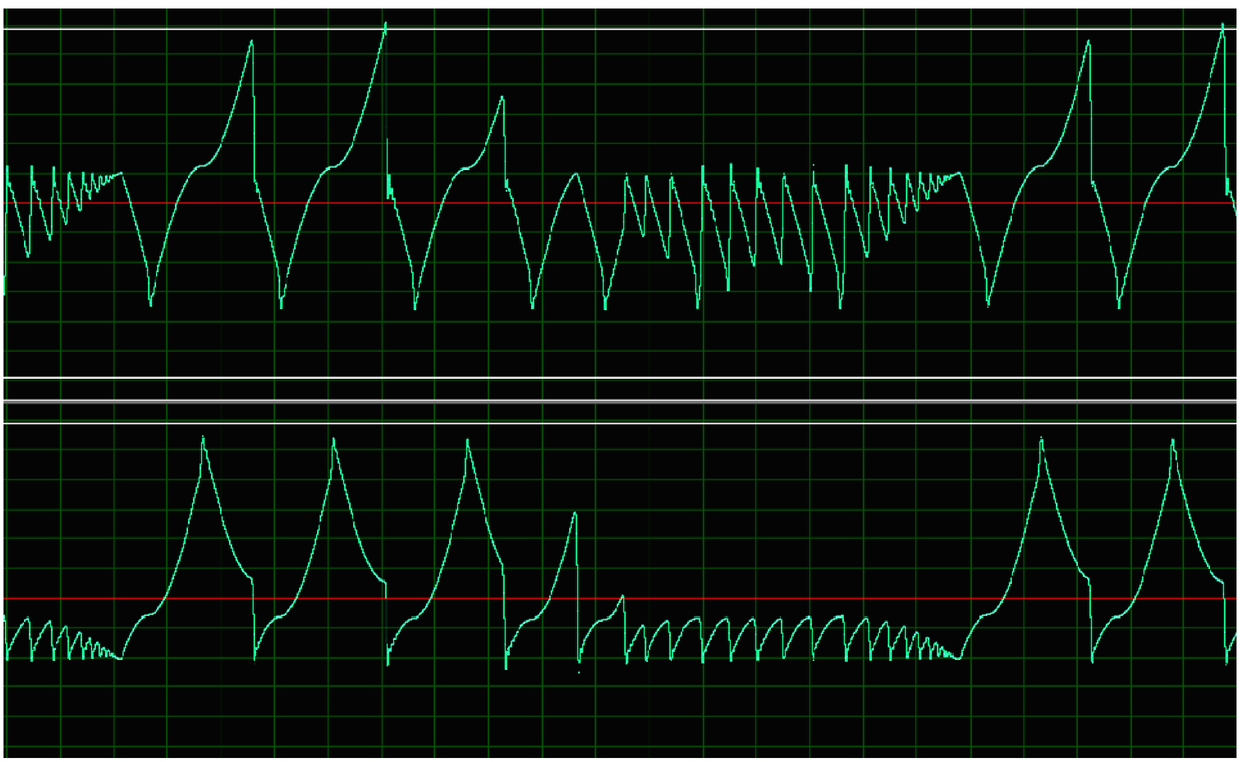
MODE 1111

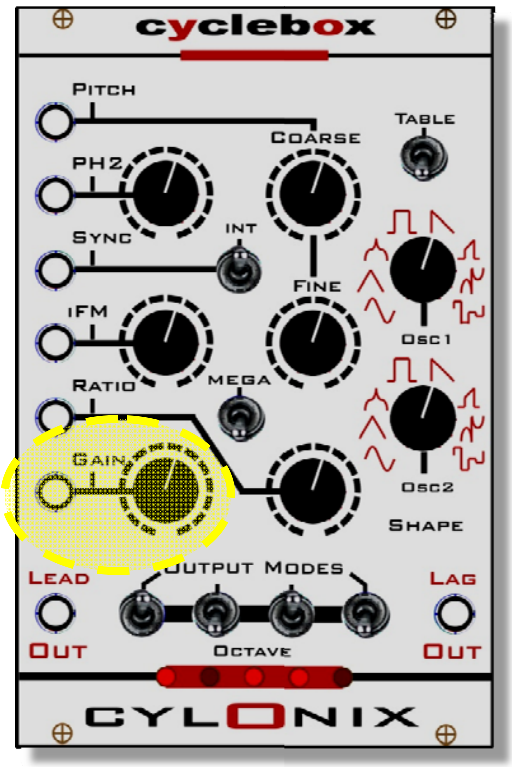
Oscillator 2 with reset when OSC1=OSC2

This mode has the same structure as mode 0001, with one important difference – oscillator 2 is reset (synchronized) to the beginning of its cycle whenever the lag outputs of oscillator 1 and 2 are equal. This can provide decaying runs of pulses in the output of oscillator 2, as it tries to catch up to the value of oscillator 1.



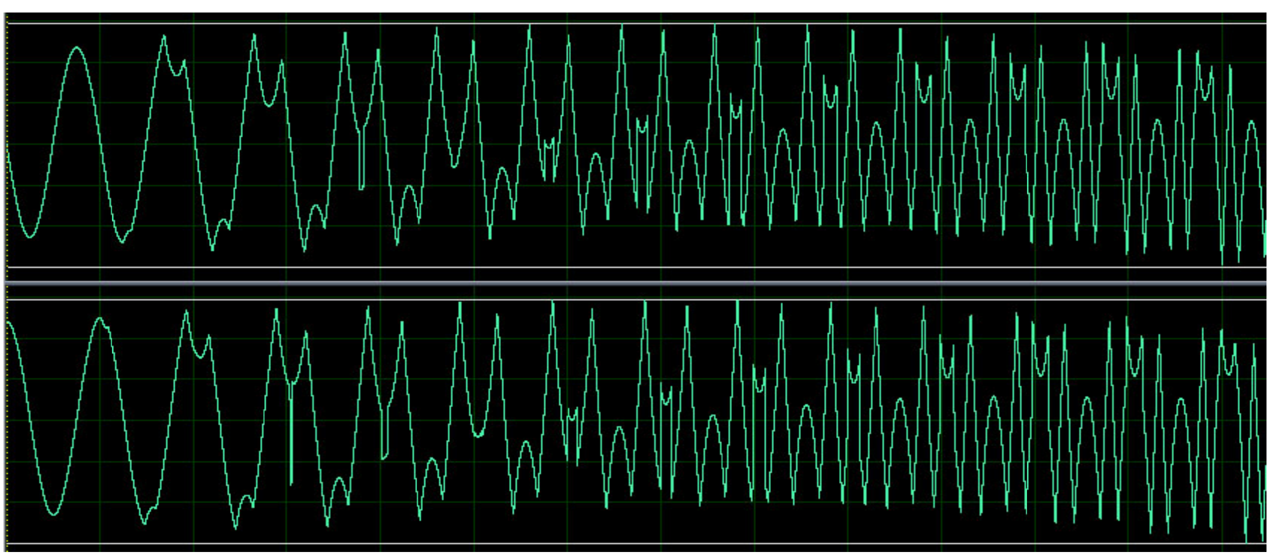
Mode 1111 combination of an OSC1 sinusoid and an OSC2 sinepulse1

Output Gain and Waveform Folding



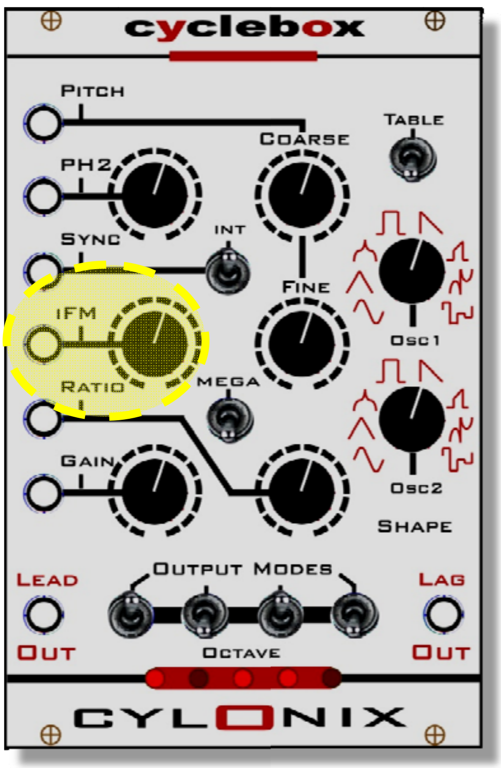
The GAIN input sets the level of the output signals. The gain ranges from 1.0 to about 4.0. The GAIN control knob attenuates the signal input to the GAIN jack. If there is nothing plugged into the GAIN jack, a +12V level is switched in instead. In this case the GAIN control knob varies the gain from 1 to about 4.

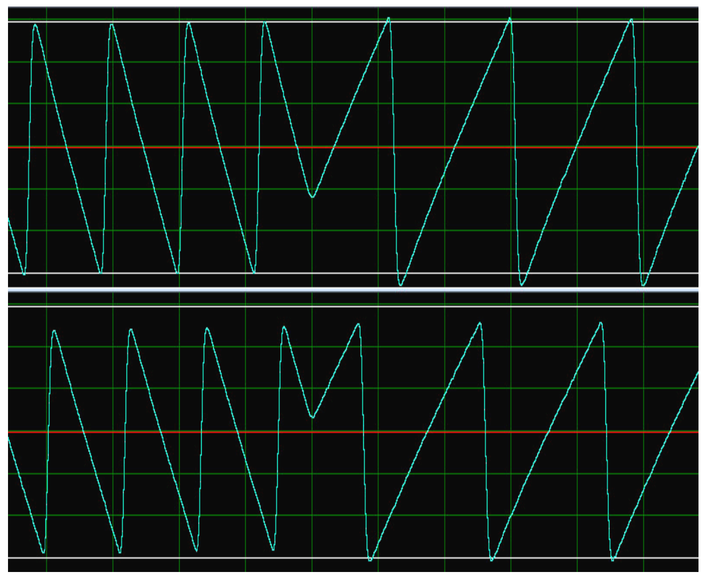
If the gain is higher than 1 the output signal will start folding back on itself in an asymmetrical manner, as shown in the diagram below. Note that increasing the gain amplifies the noise in the output, so for the lowest noise output set the GAIN control fully counter-clockwise. The level shift in the figure below is due to the AC coupling on the soundcard input, and is not actually present in the output wave.



Internal Frequency Modulation

The iFM input and control sets the ***level*** of the internal frequency modulation of OSC1 by the output of OSC2. This modulation is computed at the internal sampling rate of 24MHz, which results in low aliasing noise, and high quality modulation.

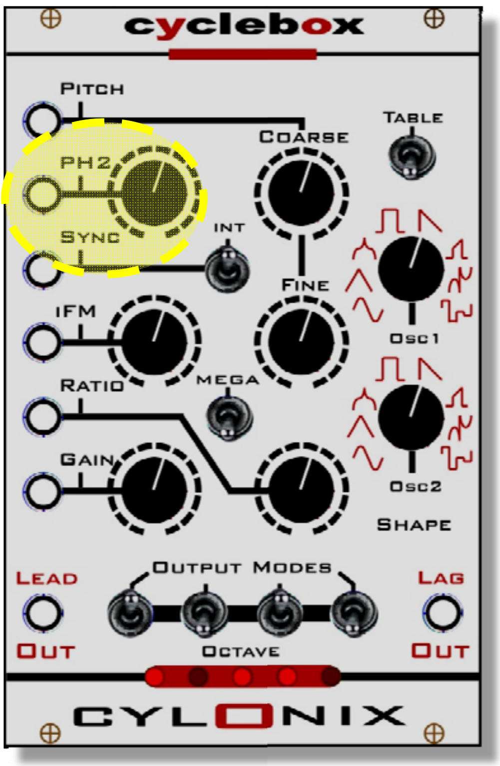




The figure above shows the “through-zero” nature of the frequency modulation. In this example, OSC2 is generating a relatively low-frequency square-wave and OSC1 is generating a sawtooth wave. When the OSC2 wave is positive the frequency of OSC2 is positive and the sawtooth is rising. When the OSC2 wave is negative the frequency of OSC2 passes through zero to negative frequency, causing the sawtooth to fall.

In output mode 0001 the iFM input and control also adjusts the amount of the LAG output that is fed back to the OSC2 phase input. This can produce bending of the OSC2 waveform and even chaotic behaviour.

OSC2 Phase Control



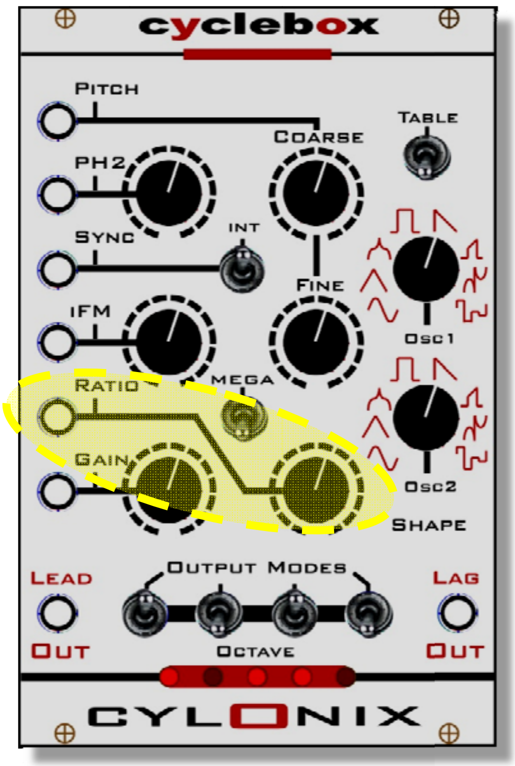
The PH2 control knob attenuates the signal input to the PH2 jack. If there is nothing plugged into the PH2 jack, a +9V level is switched in instead. In this case the PH2 control knob varies the phase of OSC2 over a range of 360 degrees.

The PH2 control is most useful in those output combination modes which involve both oscillators 1 and 2, especially with internal sync turned on.

In output mode 0001 the PH2 input and knob sets the phase difference between the LAG and LEAD outputs. This can be used to provide phase modulation of OSC2.

The PH2 input and control also sets the amount of detuning between the 8 oscillators that create the MEGA waveforms.

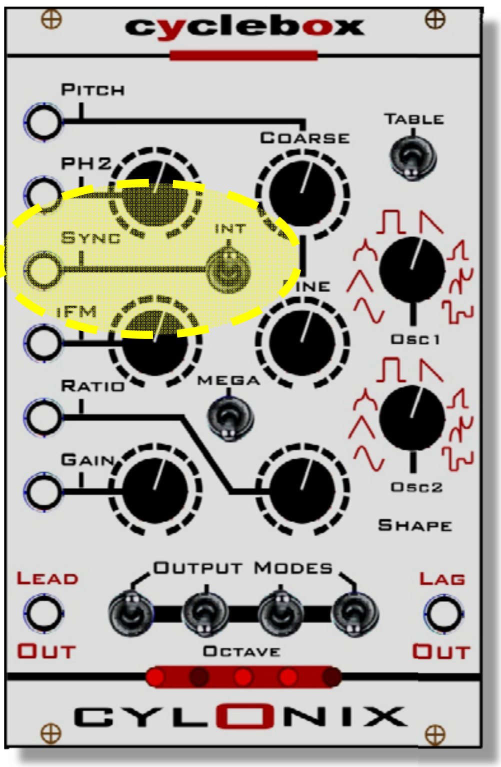
OSC2/OSC1 Ratio



The ratio control sets the offset in pitch between OSC1 and OSC2. The ratio control is very useful when using OSC2 to frequency modulate OSC1.

The RATIO input has a 5V/octave scaling response, except in mode 0010 where it has a 1V/octave scaling. With nothing connected to the RATIO input jack, The RATIO control knob adjusts the RATIO from ¼ to 4 (or -24 to +24 semitones). When a signal is connected to the RATIO input the RATIO control is overridden and has no effect. A 0V input gives a ratio of 1, while a +10V input gives a ratio of 4 (24 semitones), and a -10V input gives a ratio of ¼ (-24 semitones).

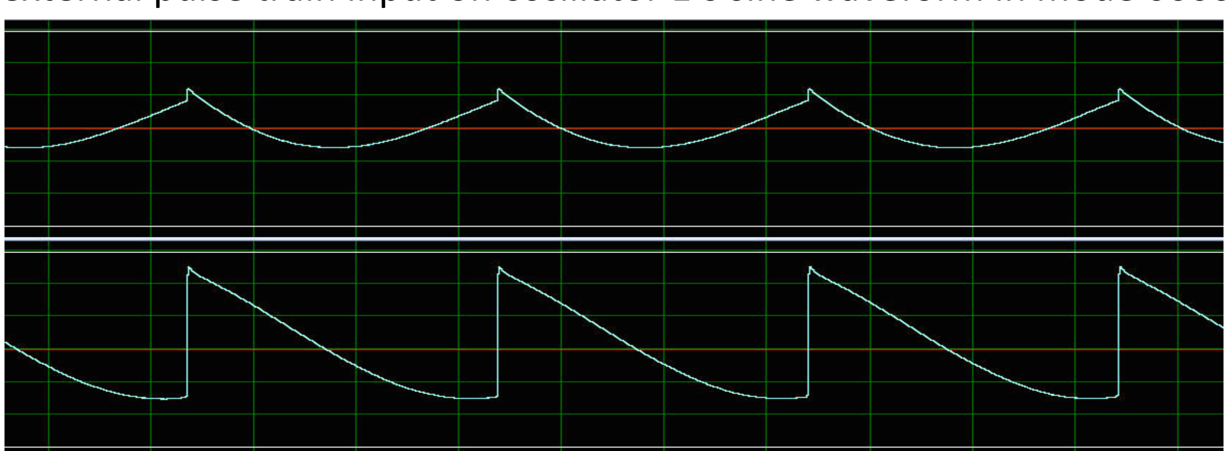
Oscillator Sync



The starting of the Oscillator 1 and Oscillator 2 cycles can be synchronized with either the start of the Oscillator 3 cycle or to the occurrence of an external pulse input to the SYNC jack.

When the INT switch is in the upwards position, oscillators 1 and 2 are synchronized to oscillator 3. This does not have any effect on oscillator 1 (except when the MEGA mode is selected), but there can be a significant effect on oscillator 2.

When a large enough positive pulse is present at the SYNC jack the waveforms of oscillator 1, 2 and 3 are all reset to their beginnings. Connecting a repetitive pulse signal to the SYNC input locks the frequency of the oscillators to that of this pulse signal. The image below shows the effect of synchronizing to an external pulse train input on oscillator 1's sine waveform in mode 0000.



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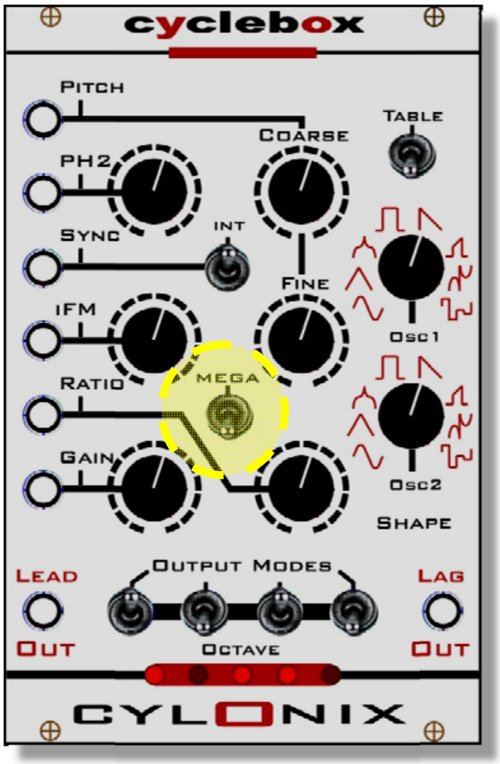
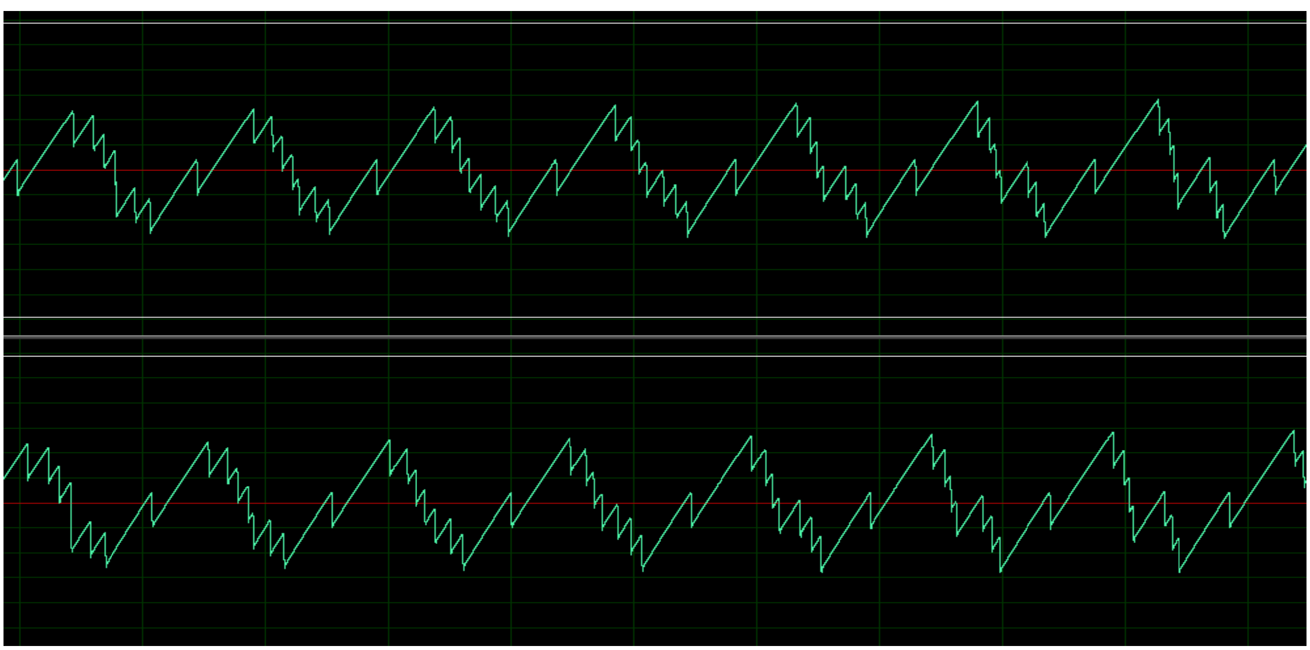
Mega Mode



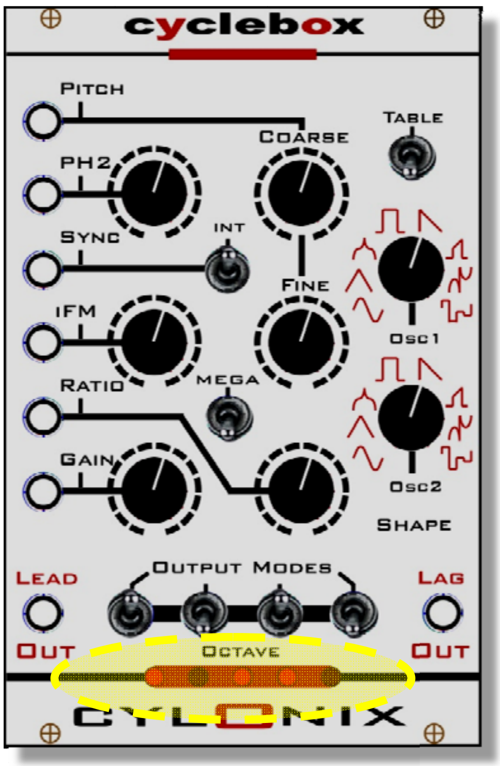
When the MEGA switch is in the "UP" position, 8 copies of OSC1, each slightly detuned, are summed together. This creates a huge sound, especially when used with the saw or square wave shapes. The amount of detuning is controlled by the PH2 control and input.

When a sync pulse is received all of the detuned waveforms are aligned and then move apart with a rate depending on the amount of detuning. This provides a nice bouncy percussive effect.



MEGA mode with OSC1 wave shape set to saw.

OCTAVE/Tuning/LFO Display



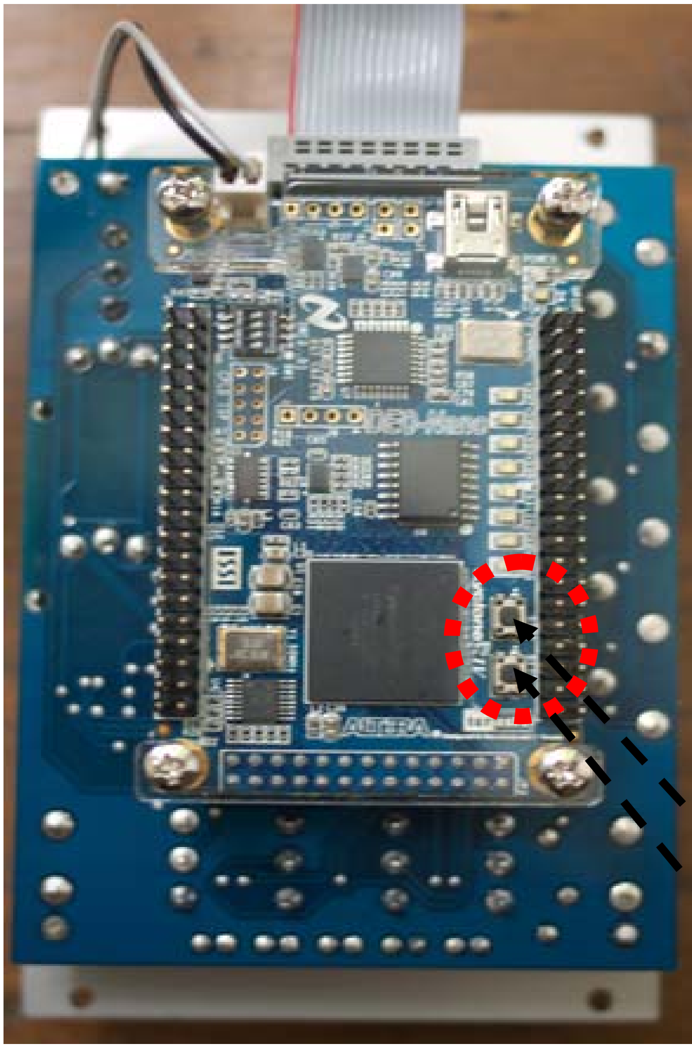
The five LEDs under the OCTAVE label display the current octave of OSC1's pitch. This is displayed as a 5-bit binary number, with 00000 representing the lowest octave (22 octaves below middle-C) and 11111 representing the highest octave (9 octaves above middle-C).

The lowest pitch in a given octave reading is the "C" of that octave. This can be used to tune the oscillator to concert middle-C pitch (261.6 Hertz). To do this, supply a voltage to the Pitch input that is intended to correspond to middle-C. Then adjust the Coarse and Fine pitch controls so that the octave reading transitions from 10111 to 11000. The LEDs will flicker slightly just before the transition. Adjust the Fine pitch control so that the flicker just stops.

The octave reading is displayed for about 4 seconds after a change in the pitch. If there is no change in pitch for 4 seconds a back-and-forth "***Cylon***" scanning pattern is displayed.

If the octave is 10001 or lower (e.g. the Cyclebox is running at an "LFO" frequency), the output level is indicated by the LEDs. The leftmost two LEDs indicate the LEAD output level and the rightmost two LEDs indicate the LAG output level. The left LEDs in each pair light up for negative levels, and the right LEDs light up for positive levels.

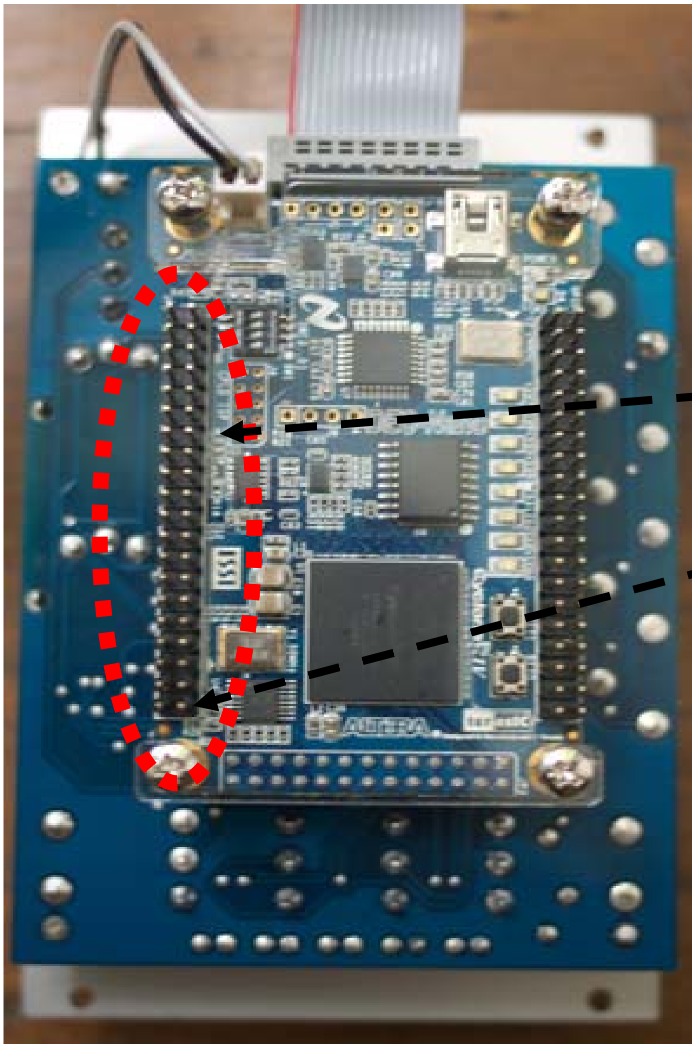
Tuning Scale Adjustment



The 1V/octave scale factor for the PITCH and RATIO inputs is preset at the factory. It should not need to be adjusted again. But if for some reason the tuning scale seems to have gone off, you can do the adjustment yourself with the following procedure:

1. Input a 0-volt signal into the PITCH input (e.g. this could come from the output of a MIDI-CV converter, or from a precision voltage source). Press the ***lower*** of the two push buttons on the rear circuit board.
2. Next, input a 1-volt signal into the PITCH input (e.g. from the MIDI-CV converter one octave higher). Press the ***upper*** of the two push buttons on the rear circuit board. The system should now have the desired 1 Volt per octave tuning scale.
3. This can be used to obtain other tuning scales if needed. The key is to enter two voltages that are intended to represent one octave difference. So, if you wanted to have a ½ volt per octave scaling, the second voltage entered should be ½ volts.

Module Expansion (optional!)

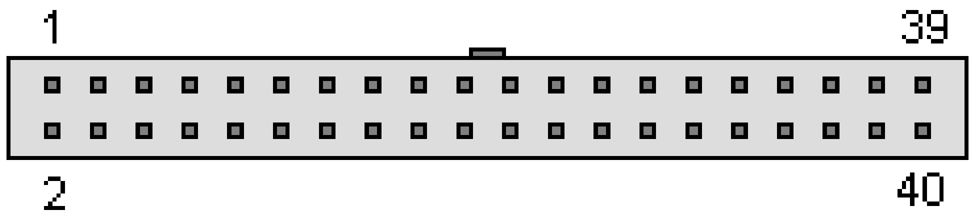


The Cyclebox module can be optionally expanded to provide up to 8 additional operational modes. The expansion modes are accessed via the left-hand (as viewed from the rear) 40-pin IDC connector (labeled GPIO1) on the rear circuit board.

Pin 1 of the connector is on the bottom right of the two rows of pins as seen from the back, as shown in the diagram.

The individual expansion modes are activated when their associated pins are driven low (to ground voltage) and deactivated when the pin is floating. More than one expansion mode can be activated at the same time if desired.

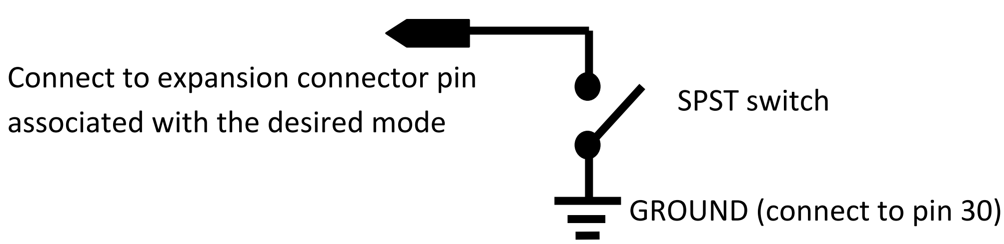
The mapping of the connector pins to the expansion modes is given on the next page.



The following table shows the mapping between expansion modes and the pins on a matching female 40-pin connector to plug in to the left hand expansion connector. Do not connect to any of the other pins.

PIN NUMBER	Expansion Mode
23	Non-through Zero FM
24	Alternative Waveshapes
25	Wide-range MEGA
26	One-Shot
27	Percussive
28	Reverse Soft-Sync
30	**Ground**
31	+2 Octave Shift
32	LFO Mode

An expander module consists of a set of single-pole-single-throw (SPST) switches which pull the appropriate expansion mode lines to ground when switched, as suggested in the following example circuit:



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Description of the Expansion Modes

NON-THROUGH ZERO FM – when selected, this prevents the frequency of OSC1 from going less than zero when frequency modulated (i.e. it prevents through-zero FM). The frequency is held at zero instead of going negative. This gives a different character to the FM sound. Note that the effect is only noticeable when the modulation level is high enough (especially at higher pitches).

ALTERNATE WAVESHAPES – when selected, this changes the OSC1 waveforms (including the wavetable waveforms) as follows:

Sine -> half-wave rectified sine
Triangle -> half-wave rectified triangle
Sinepulse1 -> half-wave rectified sinepulse1
Square -> narrow pulse
Sawtooth -> half-wave rectified sawtooth
Square-saw -> Sine-saw
Sinepulse2 -> full-wave rectified sine
Random -> Noise (obtained from low order bits of the ADC outputs)
Table: random pulses -> different collection of random pulses
Table: truncated saw -> distorted random voltage
Table: bipolar pulses -> square wave resonant filter sweep
Table: saw res filter sweep -> narrow pulse res filter sweep
Table: vowels -> synced afg aliensaws sweep

WIDE-RANGE MEGA – when selected, this spreads out the frequencies of the waveforms in MEGA mode. Two of the waves are shifted up by one octave, one is shifted up by two octaves, and one is shifted down by one octave. The frequencies of the other four waves are unchanged.

ONE-SHOT MODE – when selected, this causes oscillators 1 and 2 to trace out one complete cycle of their waveforms when a sync pulse is received. Once the cycle is complete the waveforms hold their values until another sync pulse is received. If the INT SYNC switch is high, the cycle will be continually restarted at the beginning of each OSC3 cycle (recall that OSC3 runs at half the frequency of OSC1).

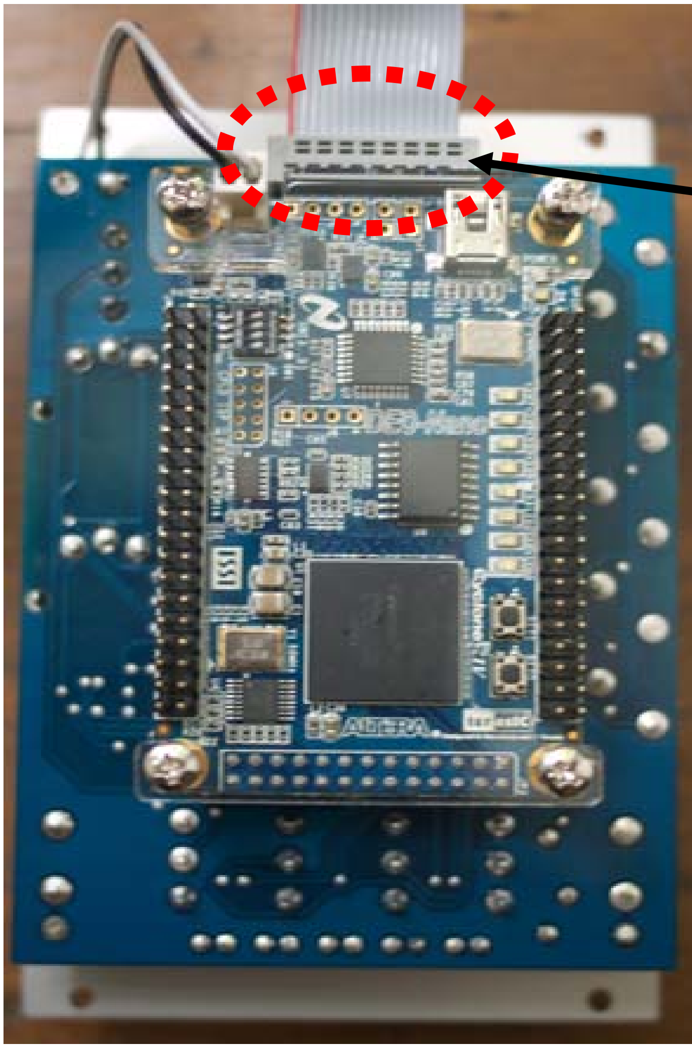
PERCUSSIVE – when selected, this applies an ATTACK-DECAY envelope to the GAIN and IFM control inputs. The GAIN in this mode starts at zero rather than at one, so this provides a volume envelope. In addition, in the MEGA mode, the amount of detuning is set by the envelope, so that the detuning goes to zero as the decay proceeds. This means that the separate waveforms making up the MEGA wave will all come into tune with each other, providing a smoother sound at the end of the cycle. The ATTACK time is very short and is not adjustable. The DECAY time is set by the PH2 control, with longer times for lower PH2 input values. The purpose of this mode is to provide short impulsive bass and percussive sounds with the Cyclebox alone. It is particularly effective in creating impulsive FM sounds, and in MEGA mode.

REVERSE SYNC – when selected, the effect of the sync input pulses is to time reverse the waveforms output by OSC1 and OSC2. This provides a smoother “soft sync” effect than the normal sync mode which resets the oscillators to the beginning of their cycles.

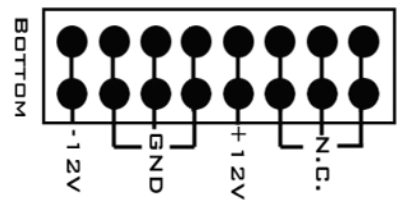
+2 OCTAVE SHIFT – when selected, this shifts the oscillator pitches up by 2 octaves. Note that this shift can be combined with the LFO MODE to give a downward shift of 3 octaves if desired.

LFO MODE – when selected, this shifts the oscillator pitches down by 5 octaves. The purpose is to allow easy setting of low frequencies without having to input large negative voltages into the PITCH input.

Power Supply Connection

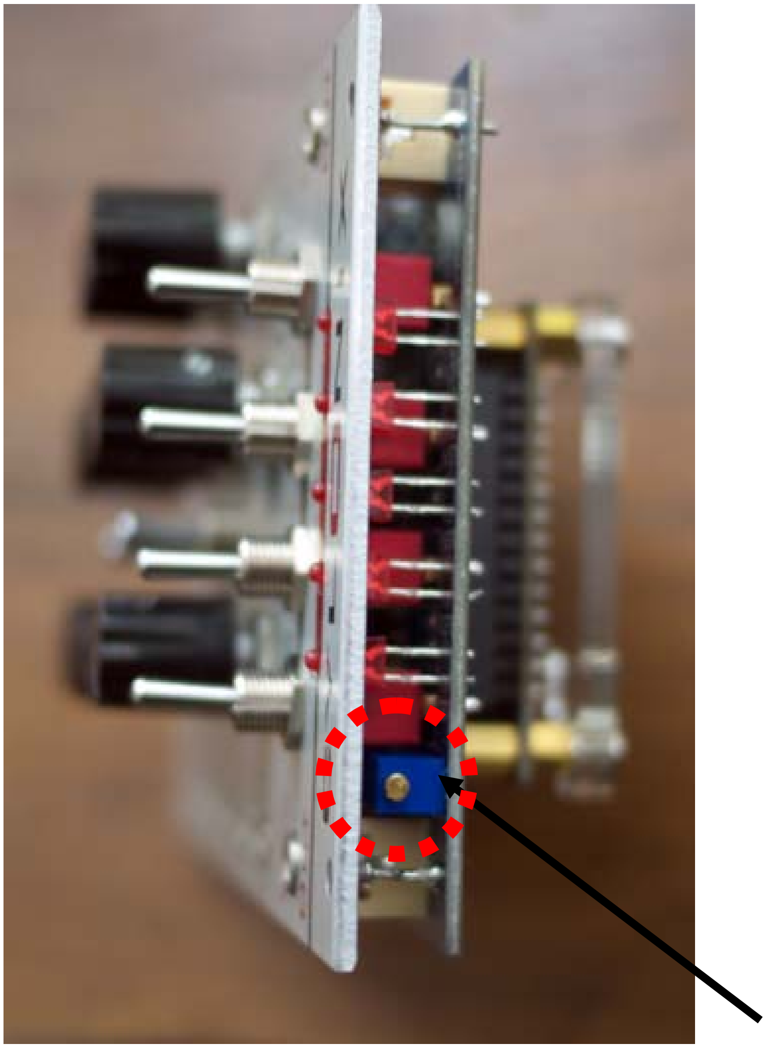


Power Supply Connector



The cable to the power supply must be connected with the red stripe on the left hand side of the board as seen from the rear of the module.

Output Offset Adjustment



To set the output offset voltage (normally this should be set to zero so that the output waveforms are symmetric about zero volts), connect an oscilloscope or voltmeter to the LAG output. Set the output mode switches to 1000 (leftmost switch up, the others down). Select the wave shapes for OSC1 and OSC2 to SQUARE. With these settings the LAG output should be constant. Turn the ***offset adjust trimpot***, located on the ***bottom*** of the front panel circuit board, so that the output voltage is zero.

Electrical and Mechanical Specifications

Power Supply requirement: +12V@150mA and -12V@5mA
This is the maximum expected current draw, which occurs at very high frequencies. In typical usage the current draw will be between 100mA and 120mA.

The Cyclebox module has protection against reversal of the power supply voltages. However, reversal of the power connector will cause a short-circuit of the +12V from the power supply and the +5V if it is present, possibly causing damage to the power supply.

Input Voltage Range: ± 10 Volts on all inputs.

Output Voltage Range: ± 5 Volts

Input Impedance: 10KOhms on the PH2 and iFM inputs, 100KOhms on the SYNC input, and 1MOhm on the PITCH, RATIO and GAIN inputs.

Size: 16 HP wide (3.2 inches) x 3U high (5.25 inches) x 1.75 inches deep (45 mm) (measured from the back of the front plate). The front plate is 2mm thick.

COMPLIANCE NOTICE

This product is considered to be a subassembly to a digital device and as such is intended for use in a system that complies with applicable regulations.

It is recommended that the module be contained in an electromagnetically shielded metal enclosure and that connections to the front panel jacks be made using shielded cables.

Changes or modifications to the module not expressly approved by Cylonix for compliance could void the user's authority to operate the equipment.