



# Wiard Waveform City Manual

Please see the [Classic VCO Manual](#) for information on the oscillator portion of the module.

## WAVEFORM CITY

(Model GR-341)

### Operating Manual and Application Notes by Darwin Grosse and Grant Richter Waveform City - An Overview

The Wiard Synthesizer Waveform City is the first in a new breed of modules that are aware of the past, but move into the future. The Waveform City module is a combination VCO (analog Voltage Controlled Oscillator), VCDO (Voltage Controlled Digital Oscillator), AR envelope generator and VCA. It includes extensive control of parameters, and an extensive patch bay for connection with other modules and analog synths.

As a synthesizer enthusiast, and (probably) the owner of other analog synths and modules, extensive discussions on VCO's and VCA's are probably not required. However, the digital oscillator section of the Waveform City is quite unique, and deserves some introduction here.

The primary goal of the Waveform City module was to create a patchable synth that would allow for voltage control of digital samples - a method introduced by the Digisound modules of the past. The Digisound modules provided four 'banks' of waveforms, with each bank containing 8 different waveforms. The user was able to manipulate the bank and waveform selection manually, and control the pitch of the waveform with a standard 1V/Oct voltage. However, the Digisound modules brought up significant issues, such as:

- More waveforms are required.
- More waveforms in each bank are required.
- Each waveform should contain more samples.
- Some built-in, pre-patched (or normalized) functions, like an envelope or VCA, would help in easily creating complex patches.

- There needs to be a way to more easily create your own ROM sets.

The Waveform City module will be available as an alternative for this type of system. It has 16 banks, each containing 16 waveforms. Each waveform is an 8-bit, 256 sample waveform, and is designed with zero-crossing points at the beginning and end of each sample. In order to have complete pitch control, it is linked (via phase-locked loop) to a standard analog VCO, and it contains a separate (but normalised) AR envelope and VCA. Waveform selection is available through voltage control, allowing for dramatic sweeps through the waveforms, and self-modulation is possible, providing for outrageous FM and buzzing sounds. It was decided to stick with 8-bit samples, providing a bit of grunge with the sampled sounds (similar to PPG and Microwave oscillators).

## The Control Deck

The control deck for the Waveform City module encapsulated an extensive amount of functionality in only ten knobs, two switches and eight LEDs. Control functions are:

### LIGHTS



Wave and Bank numbers are represented on four LEDs each. green LEDs are wave number and orange LEDs are bank number. The LEDs represent the wave and bank number in binary. The least significant bit is to the right.

The order of lights is as follows:

L E D 8	L E D 4	L E D 2	L E D 1	D E C
				0
			O N	1
		O N		2
		O N	O N	3

	O N			4
	O N		O N	5
	O N	O N		6
	O N	O N	O N	7
O N				8
O N			O N	9
O N		O N		10
O N		O N	O N	11
O N	O N			12
O N	O N		O N	13
O N	O N	O N		14
O N	O N	O N	O N	15



## Control Knobs

**Coarse:** The coarse control determine the 'base pitch' for the module's output. Frequency modulation (whether via 1V/Oct or linear FM) will make adjustments to this base frequency. **Fine:** The fine control allows you to adjust the 'base pitch' at a more detailed level. This is generally used to 'tune' the instrument to other devices.

**F.C. Attn (Frequency Control Attenuation):** This control determine that amount of effect of a voltage applied to the attn in patch point. You can use this for a variety of effects that do not conform to a standard 1V/Oct range. **Synch:** The synch control determine to what level the Waveform City module will attempt to sync to another oscillator connected to the synch in patch point. By adjusting this control, you can vary between soft, medium and hard sync.

**Wave:** Using the wave control, you can manually determine which wave (in the current bank) is output. Also, when sweeping the wavetable, the wave control determines the 'lowest' wave that will be sounded. As the wavetable position is changed, the leftmost LEDs (on

the top of the module) will identify which waveform is currently selected (using binary notation).

**Bank:** The bank control determines which of the 16 banks is current. As the bank selection is changed, the rightmost LEDs will identify which bank is selected (using binary notation).

**Wave Env:** The wave env control controls to what extent the voltage applied to the w. env in patch point sweeps the wavetable. Since the w. env in patch point is generally normalized to the AR envelope output, this control is normally used to determine the extent of envelope modulation of the wave table position.

**Volume:** The volume control determines the base level of the VCA's output. Since the VCA is normalized to the VCDO output, it is generally used for the base output level of the digital oscillator.

**Attack and Release:** These controls are used to set the attack and release times of the AR envelope. Since the AR envelope is generally normalized to wavetable position selection, these functions are normally used to determine the speed in which the envelope scans the wavetable

**Low/High Switch:** This determine the speed at which the internal phase-locked loop will follow the VCO frequency. When set to Low, the loop will divide incoming pulse by 256 in order to provide a slow tracking (useful for sequencing and modulation waveforms). When set to High, there is no division of the incoming pulses, and the VCDO will directly track the internal VCO.

**10V/+5V Switch:** This switch sets the output to either a 0 to +10V range, or a -5 to +5 volt range. This allows the Waveform City module to interface with most analog systems you might have.

## The Patch Bay

The patch bay jacks are the standard interconnection points for the Waveform City module. These are 3.5mm jacks, with connected grounds. The available patch points are:



**Frequency Control Jacks:** Located along the left side of the patch bay are the frequency control jacks - labeled 1V/Oct In, FC In, Attn In, Lin In and Synch In. Since the Waveform City module is actually controlled by the internal VCO, these jacks will control the output of the VCO, and will also provide a timing source for the phase-locked loops that controls the VCDO. **1V/Oct In:** is self-explanatory : for each volt received at this jack, the pitch will be raise by one octave. **FC In:** is a more general frequency modifier, allowing unpitched modifications (like vibrato or pitch sweeping) to occur. The Attn In jack is similar, but is controlled by the FC Attn knob on the control deck. This

can be very useful when creating self-modulation patches. **Lin In:** provides a linear FM input, providing for clangerous FM patches. Finally, the Synch In: input allows the internal VCO to be synched to and external audio source - the extent of which is controlled by the Synch control.

**VCO Outputs:** Since the Waveform City has an integral analog VCO, it would be senseless to deny access to this audio source. The three VCO outputs, labeled Sine Out, Sqr Out and Saw Out provide access to the audio output of the sine, square and sawtooth outputs of the analog VCO.

**VCDO Jacks:** The third vertical row contains the VCDO (Voltage Controlled Digital Oscillator) patch points, labeled Wave out and W. Env In. The wave output jack contains the raw output of the VCDO, and is normalized into the VCA input. The Wave Envelope Input jack can be thought of as the "waveform sweep" input - a voltage applied to this jack will change the waveform selection based on the positions of the Wave and Wave Env controls. This jack is normalized to the AR Envelope output, allowing you to sweep the waveform with no external cabling. However, if you wish to control the wave selection by another module or voltage, you would connect that voltage source to this jack.

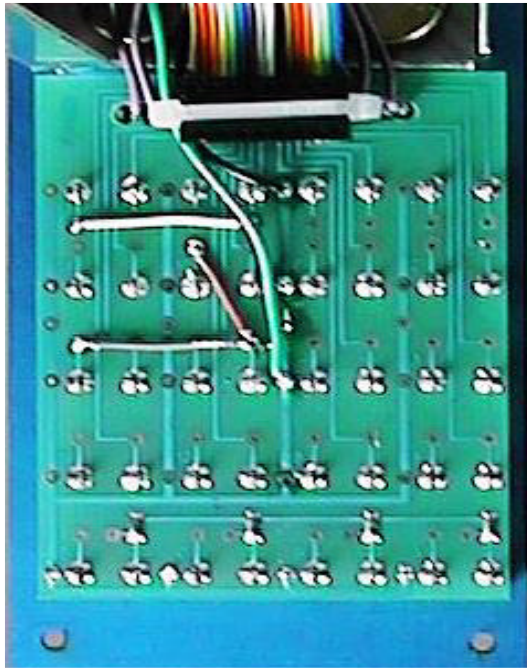
**AR Envelope Controls:** Below the VCDO jacks are the controls for the AR envelope, labeled Env Out and Gate In. The Envelope output jack contains the voltage output, and is normalized to the W. Env In jack. The Gate input jack is used to trigger the envelope. This is a GATE (as opposed to a trigger) input, so the envelope will run only as long as a HIGH voltage is applied to this jack.

**VCA Jacks:** This rightmost vertical row of jacks control the VCA, and are labeled VCA In, VCA Contl and VCA Out (x2). The VCA in is normalized to the VCDO output, and is generally used to create volume adjustments to the VCDO output. The VCA Control input allows you to modulate the output volume with the internal envelope, or with external voltage sources. The VCA outputs will typically go to a mixer, or other external processing devices.

**Multiples:** Any modular system based off 1/8" jacks requires many multiples - connected jacks that allow you to split an incoming voltage or gate to multiple outputs. Since multiples are so



heavily required by these systems, the bottom row of the Waveform City patch bay contains an integral set of multiples.



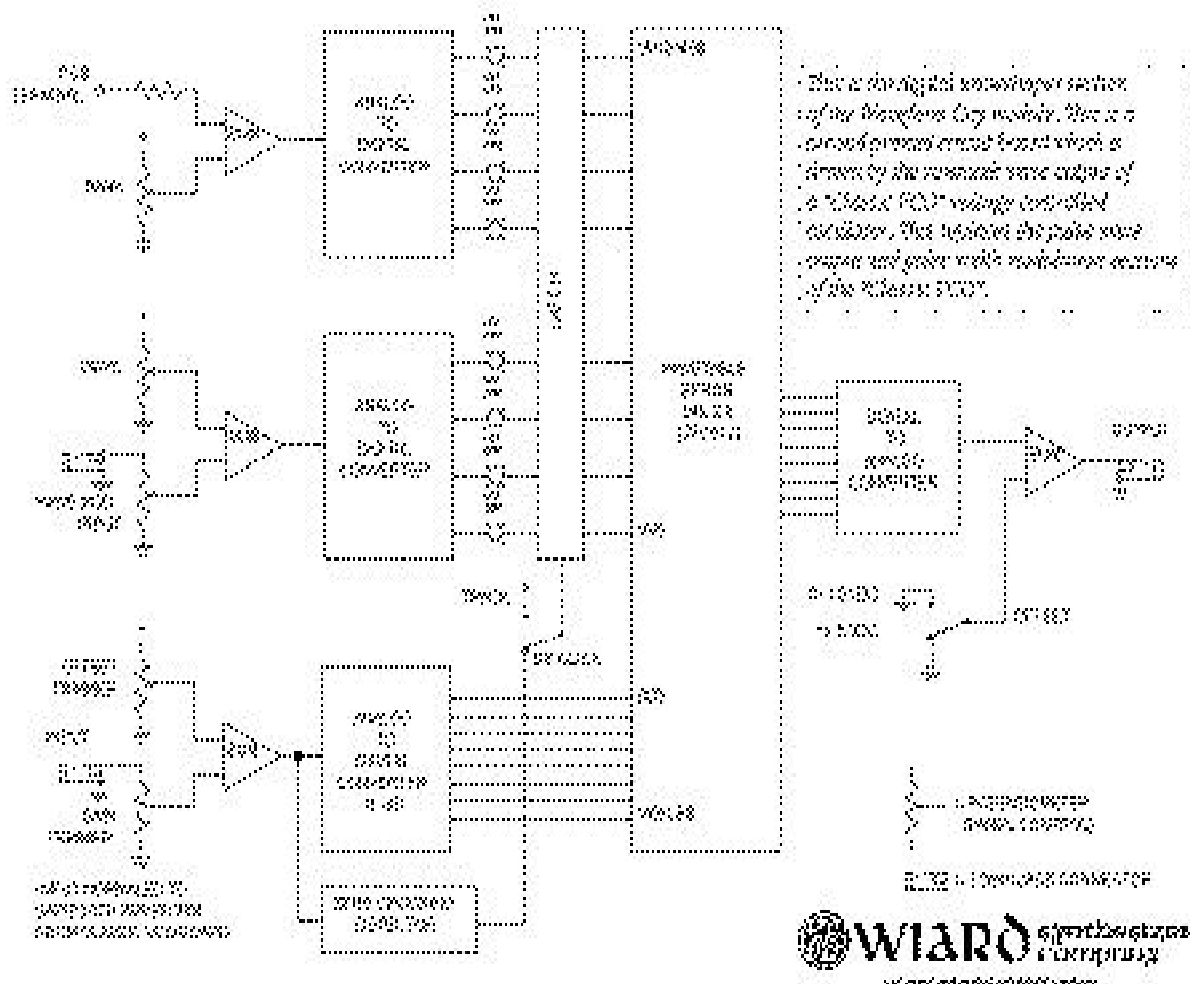
**Prepatch Points:** The primary advantage of using 1/8" jacks over banana connectors is the ability to prepatch connections for patch normalization. All of the available prepatch points are accessible at the back of the module. These also serve as test-points for calibration.

## Section Four - The DCO Wave Banks

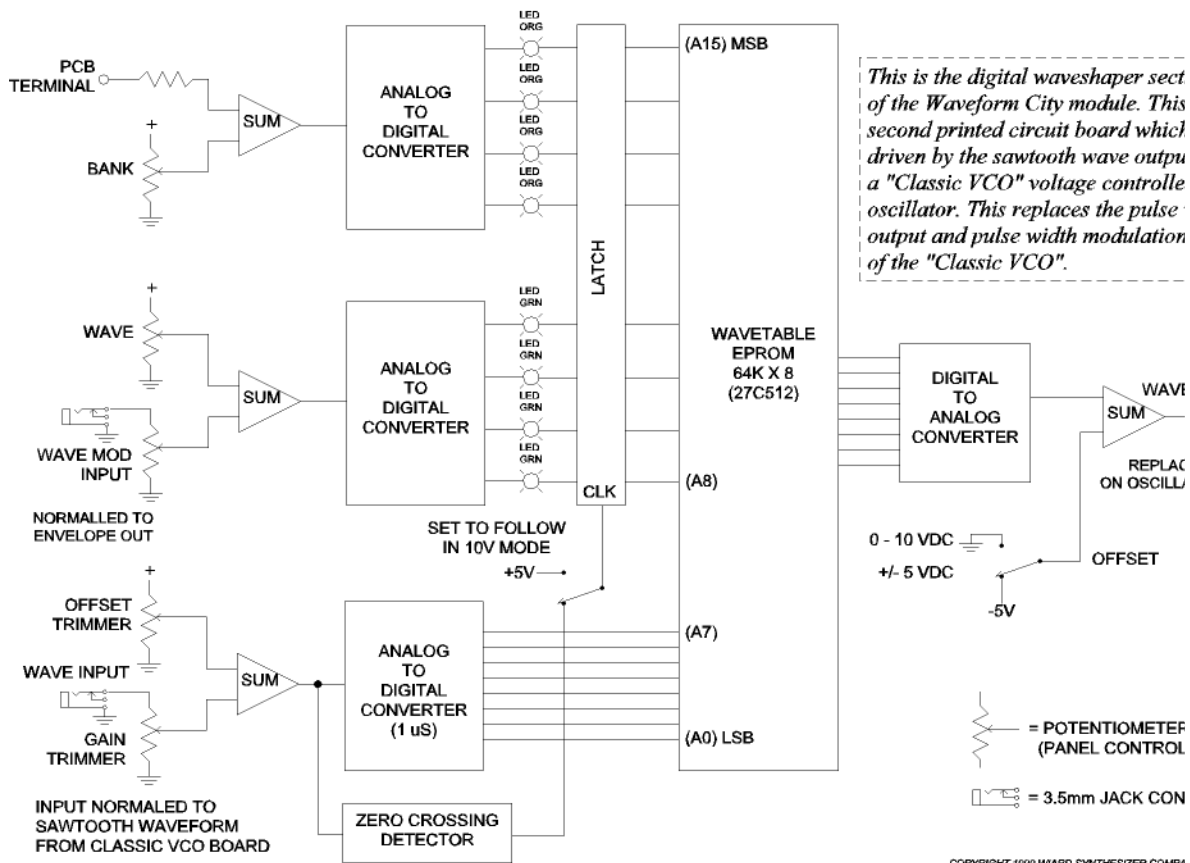
The DCO section of the Waveform City module uses an EPROM for waveform storage. The waveforms are stored in 16 banks of 16 waves, providing a selection of waveforms unmatched by any previous modular synthesizer oscillator.

The following pages describe the waves contained in the EPROM shipped with the Waveform City module. Although this is an extensive set of waveforms, always remember that you are free to create or purchase additional EPROM's to customize your synth to your specifications.

WAVEFORM CITY MODULE  
DIGITAL WAVESHAPER SECTION BLOCK DIAGRAM



## WAVEFORM CITY MODULE DIGITAL WAVESHAPER SECTION BLOCK DIAGRAM



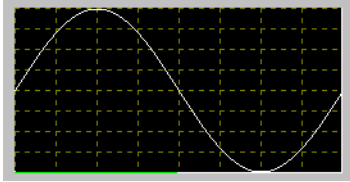
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### Waveform Bank 0 : Waveform City Central

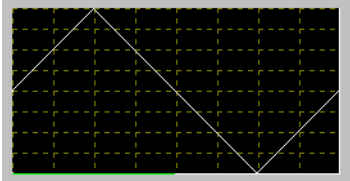
The first bank of waveforms is titled "Waveform City Central", since it contains a number of single cycle waveforms. These waveforms will generally be used without dynamic sweeping of the wavetable - they are meant to augment the waveforms of your existing analog system.



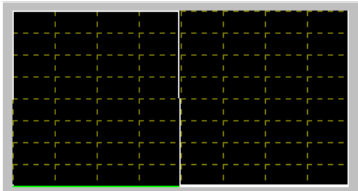
The waveforms in Bank 0 are:



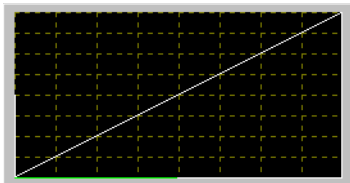
Waveform 0 : A single cycle sine wave.



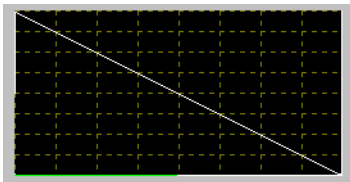
Waveform 1 : A single cycle triangle wave.



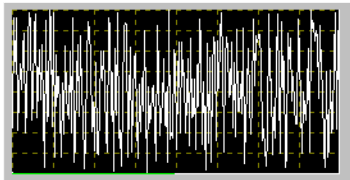
Waveform 2 : A single cycle square wave.



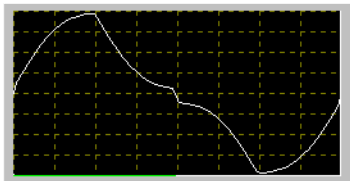
Waveform 3 : A single cycle upramp wave.



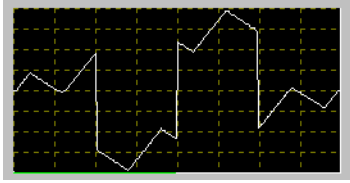
Waveform 4 : A single cycle downramp wave.



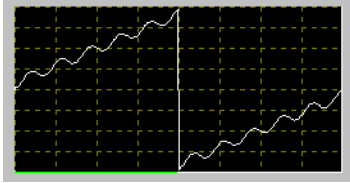
Waveform 5 : A random waveform.



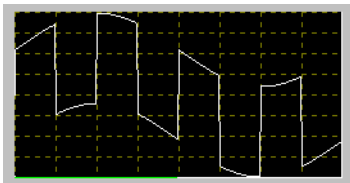
Waveform 6 : The 'Shark Fin' wave.



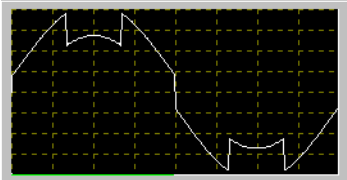
Waveform 7 : The 'Rockies' wave.



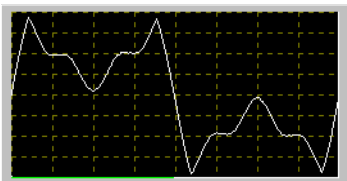
Waveform 8 : A sawtooth wave with mixed 10<sup>th</sup> harmonic sine.



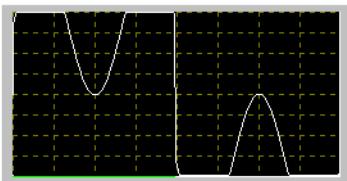
Waveform 9 : A 4<sup>th</sup> harmonic square wave modulated by a single cycle sine wave.



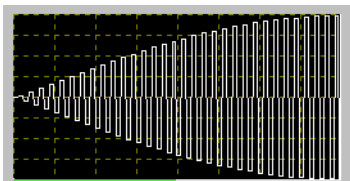
Waveform 10 : The 'Batman' waveform.



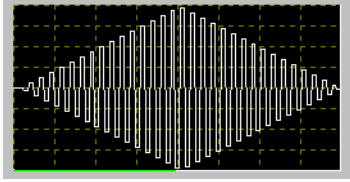
Waveform 11 : The 'Fox' waveform.



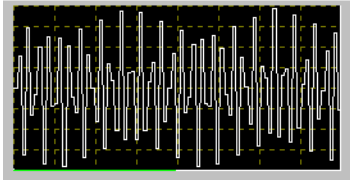
Waveform 12 : The 'Neckbrace' waveform.



Waveform 13 : The 'Radar Beam' wave.



Waveform 14 : The 'Diamond Beam' wave.

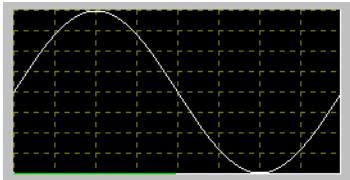


Waveform 15 : The 'Alternating Currents' wave.

## Waveform Bank 1 : Vocal Sines

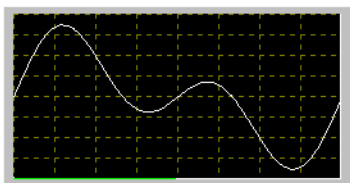
Bank 1 (the second bank) contains a 'morph' from a single cycle sine wave to a rounded saw wave with a fourth harmonic emphasis. This is a useful bank for waveform modulation, since scanning the waveform bank gives the illusion of bandpass filtering. (Note: in some cases - like Bank 1 - not all waveforms are shown. In the case of morphed waveforms, only significant points will be displayed.)

The waveforms in Bank 1 morph from a sine wave ...



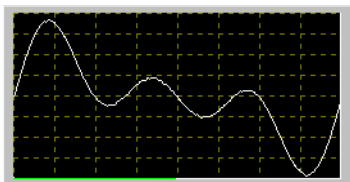
Waveform 0 : A single cycle sine wave

... to a 2<sup>nd</sup> harmonic altered sine ...



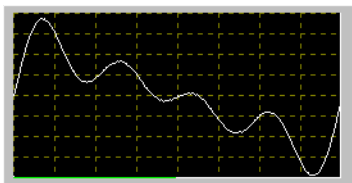
Waveform 3 : Harmonically (by the second) altered sine wave.

... to a 3<sup>rd</sup> harmonic altered sine ...



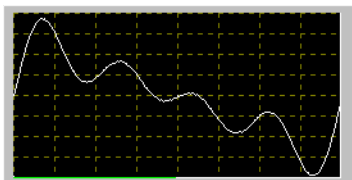
Waveform 7 : Additional harmonic (by the third) alterations.

... to a 4<sup>th</sup> harmonic altered sine ...



Waveform 11 : Additional harmonic (by the fourth) alterations.

... to a 5<sup>th</sup> harmonic altered sine ...

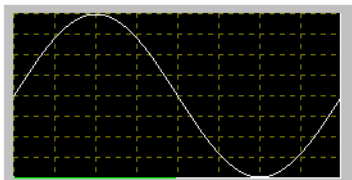


Waveform 15 : Additional harmonic (by the fifth) alterations.

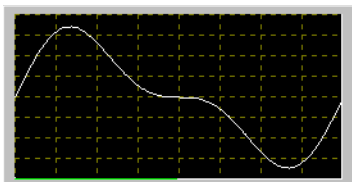
## Waveform Bank 2 : Overblowing

Bank 2 (the third bank - as they are number starting with zero) morphs from the first through the fourth harmonic. Scanning the waveform bank (with a modulation source like an envelope or LFO) gives the illusion of overblowing a sine wave. (Note: again, in some cases not all waveforms are shown. In the case of morphed waveforms, only significant demonstrative waveforms will be displayed.)

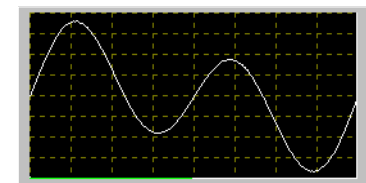
The waveforms in Bank 2 begin by morphing from a sine wave to its second harmonic ...



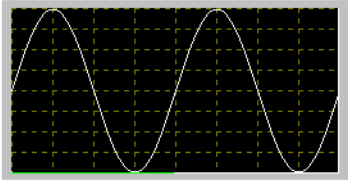
Waveform 0: A single cycle sine wave.



Waveform 1: Partial morph to the second harmonic.

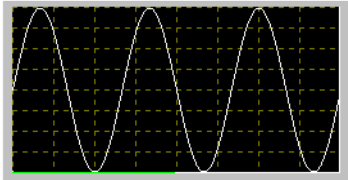


Waveform 2: Further morph into the second harmonic.

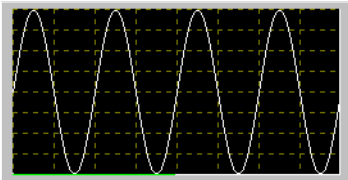


Waveform 3: Full morph into the second harmonic.

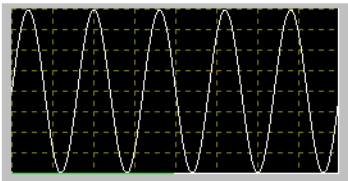
... and does a similar morph into the third, fourth and fifth harmonics.



Waveform 7: Full morph into the third harmonic.



Waveform 11: Full morph into the fourth harmonic.

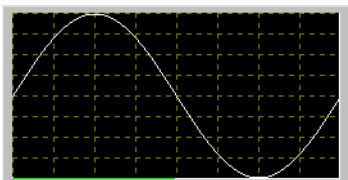


Waveform 15: Full morph into the fifth harmonic.

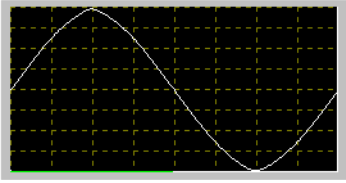
## Waveform Bank 3 : Primary Morph

Bank 3 does a coarse morph (a morph with few transitional steps) through a number of primary waveforms. This bank is useful as both a static waveform source as well as a modulated bank. Scanning the waveform bank provides an increase in harmonic content as you select higher numbered waveforms.

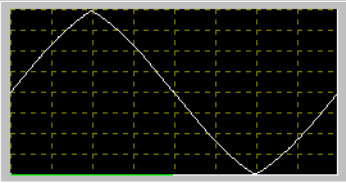
Bank 3 begins by morphing from a sine through a triangle wave...



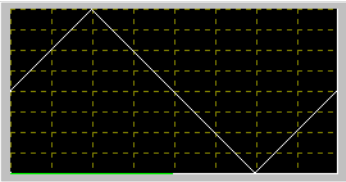
Waveform 0: A single cycle sine wave.



Waveform 1: A partial morph to a triangle wave.

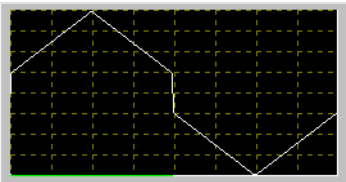


Waveform 2: A further morph to a triangle wave.

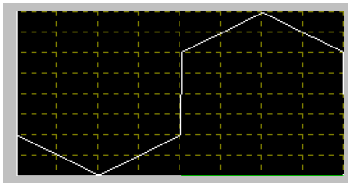


Waveform 3: A full morph to a triangle wave.

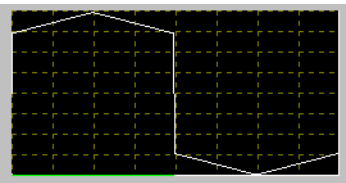
... then continues by morphing into a square wave...



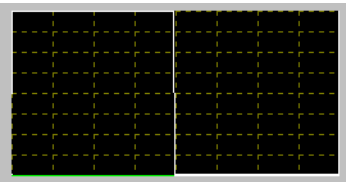
Waveform 4: Partial morph to a square wave.



Waveform 5: Further morph to a square wave.

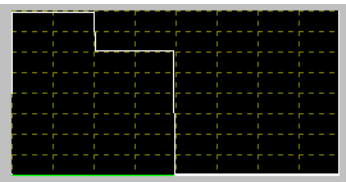


Waveform 6: Further morph to a square wave.

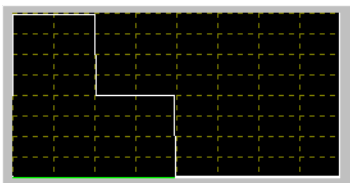


Waveform 7: Full morph to a square wave.

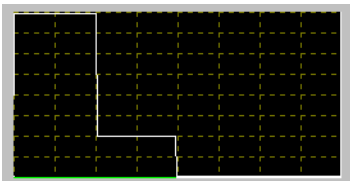
...then continues morphing into a 25% pulse wave...



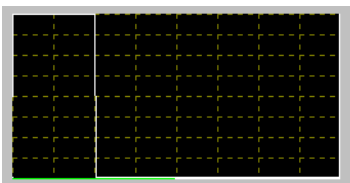
Waveform 8: Partial morph to a pulse wave.



Waveform 9: Further morph to a pulse wave.

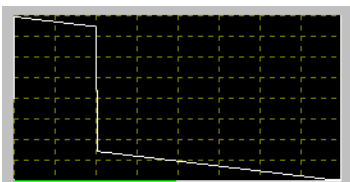


Waveform 10: Further morph to a pulse wave.

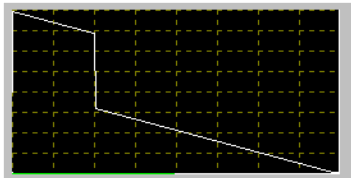


Waveform 11: Full morph to a pulse wave.

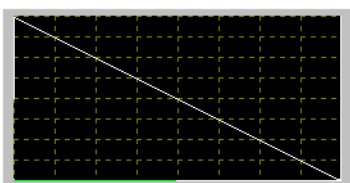
... then concludes by morphing to a downramp wave...



Waveform 12: Partial morph to a downramp.



Waveform 13: Further morph to a downramp.



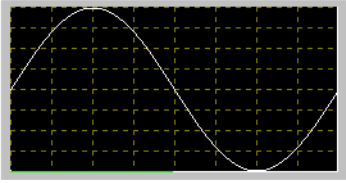
Waveform 15: Complete morph to a downramp.

## Waveform Bank 4 : The Harmonic Series

This bank steps up the harmonic series of a sine wave. It can be very useful for adding overtones in a multi-oscillator setup, and is also useful (with a steady pitch) for creating droning ambient tonescapes.

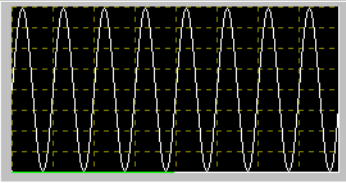
Bank 4 starts with a sine wave...



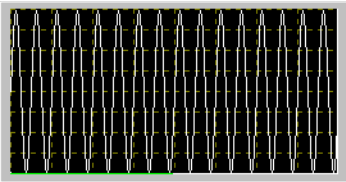


Waveform 0: A single cycle sine wave.

... and steps through the harmonic series.



Waveform 7: The eighth harmonic.

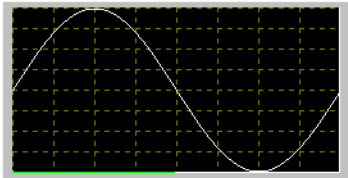


Waveform 15: The fifteenth harmonic (at this point, it gets pretty gritty, since the 256 sample limit causes the sine wave to be stepped. This is good! It adds roughage to your audio diet, making for healthier music...)

## Waveform Bank 5 : Rectification

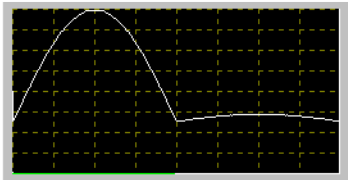
This bank morphs from sine wave, to (roughly) half-rectified sine, to fully-rectified sine. This process adds interesting, subtle harmonics, and is useful for modifying a melodic (lead) line.

Bank 5 starts with a sine wave...



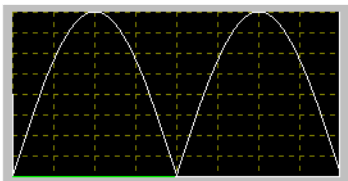
Waveform 0: A single cycle sine wave.

... morphs to a (roughly) half-rectified sine ...



Waveform 7: Near-half-rectified sine wave.

... then morphs to a full-rectified sine ...



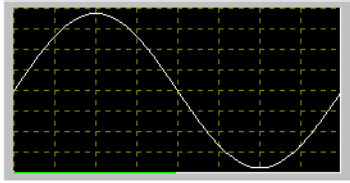
Waveform 15: Fully-rectified sine wave.

## Waveform Bank 6 : Harmonic Mix

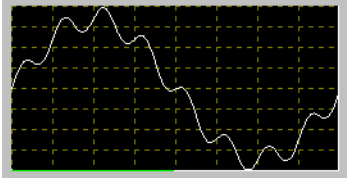
Bank Six begins with a sine wave (at 80% amplitude), and adds the next 15 harmonics at a 20%

amplitude. This adds the harmonic tone while still maintaining a strong fundamental. This bank has a variety of uses, since sweeping the wavetable can add a sub-harmony to any tonal line.

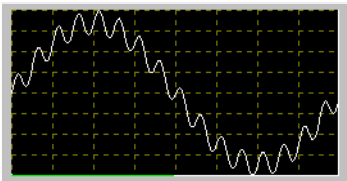
Bank 6 starts with a sine wave, and mixes in a new harmonic level with each waveform.



Waveform 0: A single cycle sine wave.



Waveform 7: The sine wave with a 20% mix of the 8<sup>th</sup> harmonic.

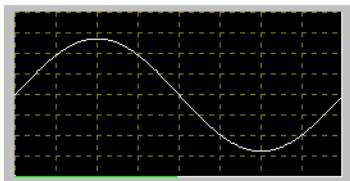


Waveform 15: The sine wave with a 20% mix of the 16<sup>th</sup> harmonic.

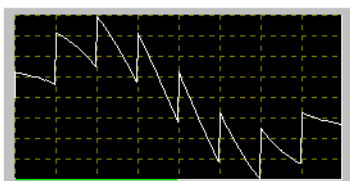
## Waveform Bank 7 : Harmonic Mix #2

Bank Seven is similar to Bank Six: it begins with a sine wave (at 80% amplitude), and adds the next 15 harmonics at a 20% amplitude. However, instead of adding sine wave harmonic tones, it adds sawtooth tones. This adds a 'buzzier' sound, with many low-amplitude 'off-color' harmonics added to the mix.

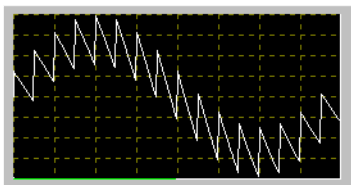
Bank 6 starts with a sine wave, and mixes in a new harmonic sawtooth tone with each waveform.



Waveform 0: A single cycle sine wave.



Waveform 7: The sine wave with a 20% mix of the 8<sup>th</sup> harmonic sawtooth.

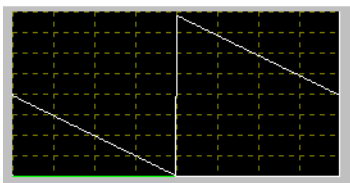


Waveform 15: The sine wave with a 20% mix of the 16<sup>th</sup> harmonic sawtooth.

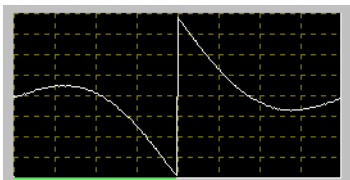
## Waveform Bank 8 : Saw-to-Sine

This bank morphs from a sawtooth wave into a sine wave. Unlike most banks, this one begins with a higher harmonic content, and contains fewer harmonics as you move farther into the bank. This is useful when sweeping the wavetable, giving the equivalent of an 'inverted' filter modulation.

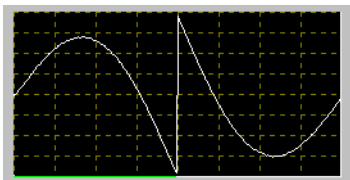
Bank 8 starts with a sawtooth waveform, and morphs into a sine wave.



Waveform 0: A single cycle sawtooth wave.



Waveform 7: Partial morph to sine wave.

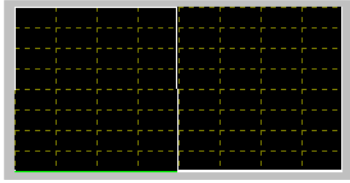


Waveform 15: Full morph to sine wave (phase modified).

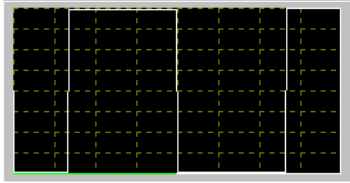
## Waveform Bank 9 : Square Compression

Bank 9 features a funky modulation called 'square wave compression'. Basically, this morphs from a standard square wave into a narrow pulse set, with a high concentration of DC offset. This can either be used as an audio source, or as a pulse source for other moduler systems.

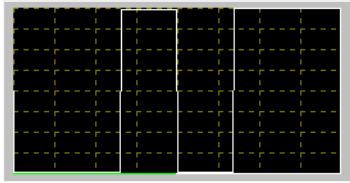
Bank 9 starts with a sawtooth waveform, and morphs into a sine wave.



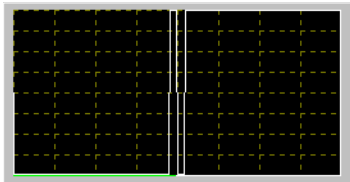
Waveform 0: A single cycle square wave.



Waveform 5: A moderately compressed square wave.



Waveform 10: More compression on the square wave.

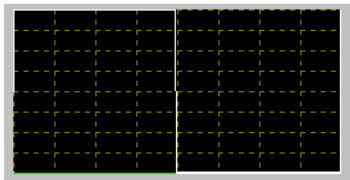


Waveform 15: An extensively compressed square wave.

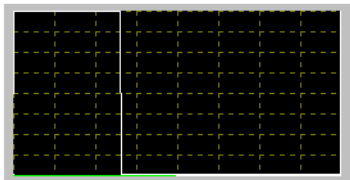
## Waveform Bank 10 : Pulse Modulation

This bank does a pulse modulation, from a 50% pulse wave (a square wave) to a 1% pulse. This waveform series is heavily weighted to the narrower pulses, which contain a more 'radical' sound. As with any other pulse-based wave series, you can use this as an audio source, or as a pulse train for other modules.

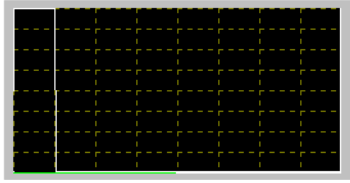
Bank 10 starts with a square wave, and steps through to a 1% pulse wave.



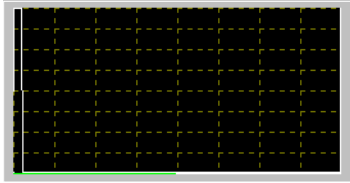
Waveform 0: A single cycle square wave.



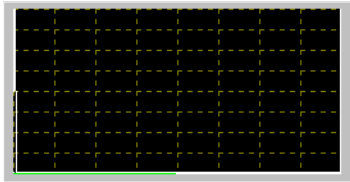
Waveform 4: Partially through the modulation.



Waveform 9: Further through the modulation.



Waveform 13: Nearing the limit of the pulse series.

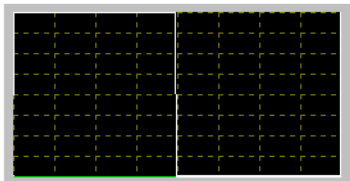


Waveform 15: Finally, the 1% pulse wave.

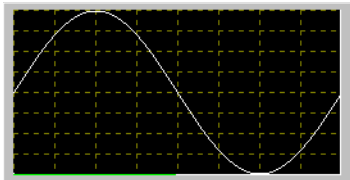
## Waveform Bank 11 : Wave-Sequence #1

This bank contains a number of individual waveforms, at a variety of harmonic points, allowing for an interesting 'wave-sequence' by sweeping the wavetable in sync with rhythmic elements in your music. In addition, there are waveforms in this bank that are not found elsewhere on the Waveform City module - these, of course, can be used as standard output waveforms.

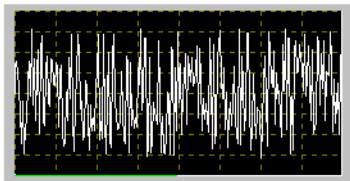
The waveforms in Bank 11 are:



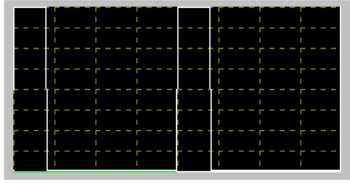
Waveform 0 : A single cycle square wave.



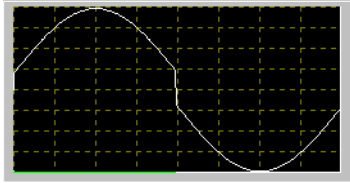
Waveform 1 : A single cycle sine wave.



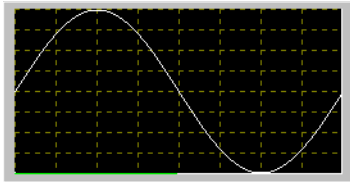
Waveform 2 : A noisy wave.



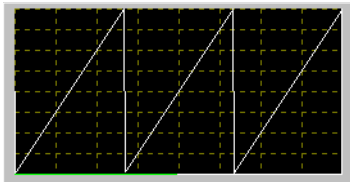
Waveform 3 : A dual cycle 20% pulse wave.



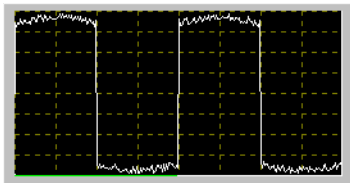
Waveform 4 : A morphed sine/square wave.



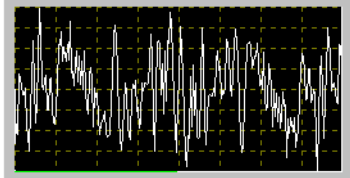
Waveform 5 : Another sine wave.



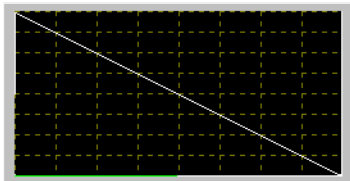
Waveform 6 : A third harmonic upramp wave.



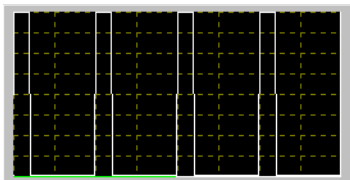
Waveform 7 : A noisy square wave.



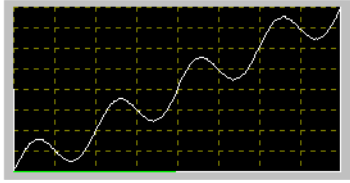
Waveform 8 : A different random wave.



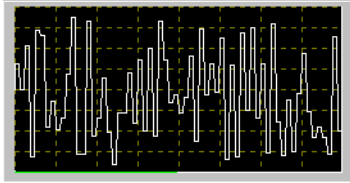
Waveform 9 : A single cycle downramp wave.



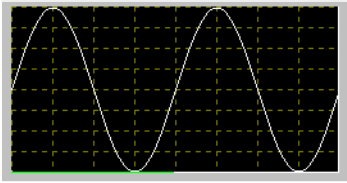
Waveform 10 : A fourth harmonic narrow pulse wave.



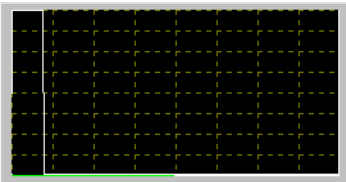
Waveform 11 : A mixed upramp and fourth harmonic sine wave.



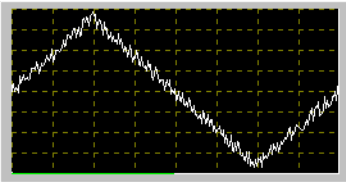
Waveform 12 : A 'stepped' random waveform.



Waveform 13 : A second harmonic sine wave.



Waveform 14 : A 10% duty cycle pulse wave.

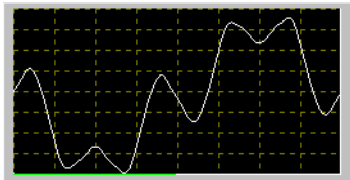


Waveform 15 : A static-y triangle wave.

## Waveform Bank 12 : Wave-Sequence #2

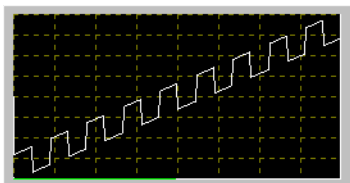
Bank 12, like bank 11, contains a number of individual waveforms, at a variety of harmonic points, allowing for another 'wave-sequence'.

The waveforms in Bank 12 are:

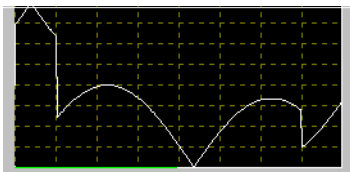


Waveform 0 : The 'Hillside' wave.

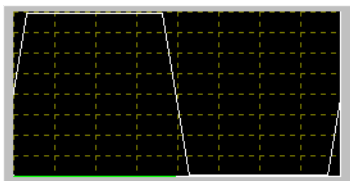




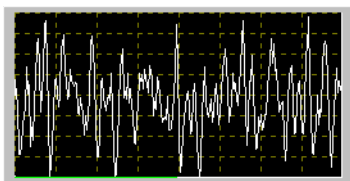
Waveform 1 : A mixture of a single cycle upramp and ninth-harmonic square.



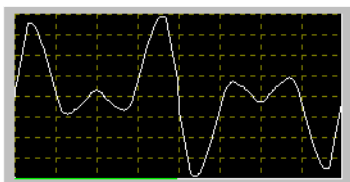
Waveform 2 : The 'Chapel Hills' waveform.



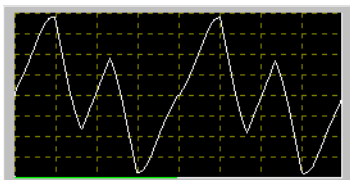
Waveform 3 : A non-optimal square wave.



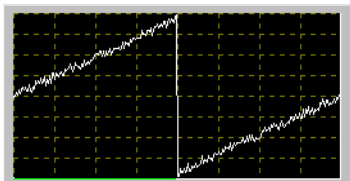
Waveform 4 : A sharp random wave.



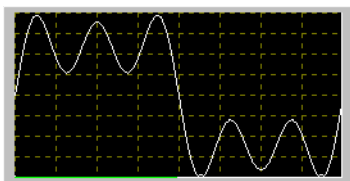
Waveform 5 : The 'FruitBat' waveform.



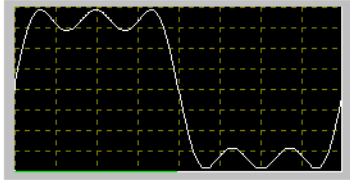
Waveform 6 : The 'Swiss Alps' wave.



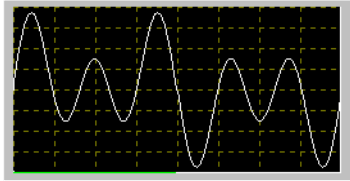
Waveform 7 : A noisy sawtooth wave.



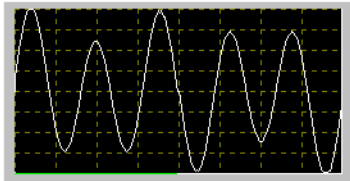
Waveform 8 : A square/third-harmonic sine mixed wave.



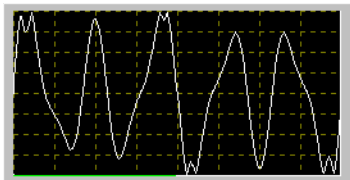
Waveform 9 : A square/third-harmonic sine mixed (at a lower level) wave.



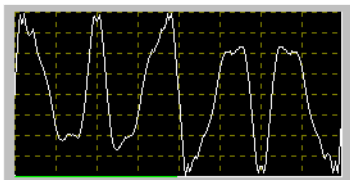
Waveform 10 : A dual sine mixed wave.



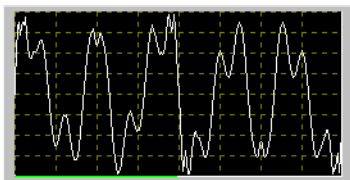
Waveform 11 : A more dynamic dual sine mixed wave.



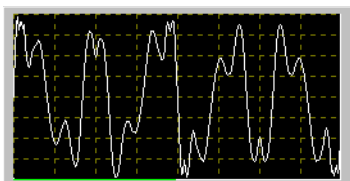
Waveform 12 : A distorted, spikey wave.



Waveform 13 : Another distorted spiked wave..



Waveform 14 : A more dynamic spiked wave.



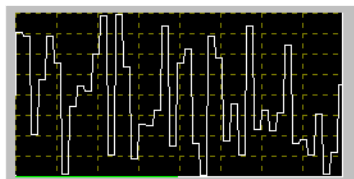
Waveform 15 : Another spiked waveform.

## Waveform Bank 13 : Sequences #1

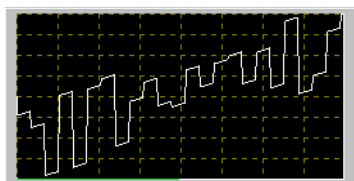
The waveforms in Bank 13 are made for use as cyclical sequences. If you run the Waveform City module at extremely low rates (especially by setting the rate switch to low), the output of the

VCDO will be an excellent source for interesting pitch and filter modulations.

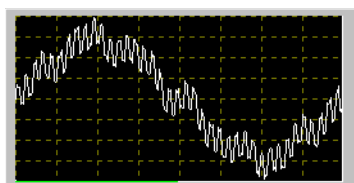
The sequence waveforms in Bank 13 are:



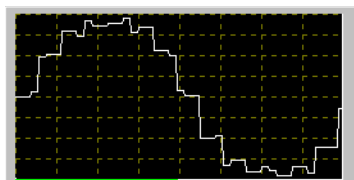
Waveform 0



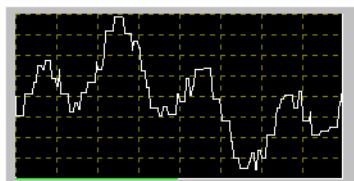
Waveform 1



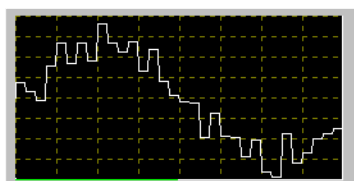
Waveform 2



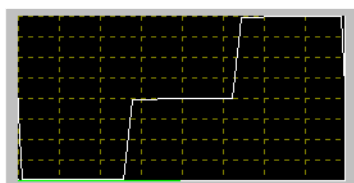
Waveform 3



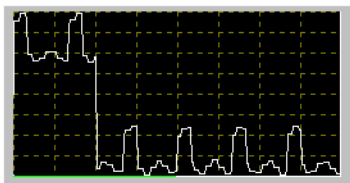
Waveform 4



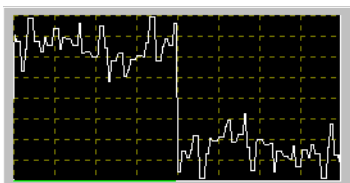
Waveform 5



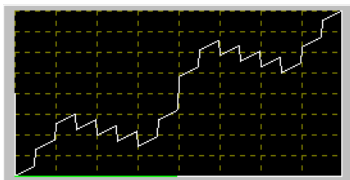
Waveform 6



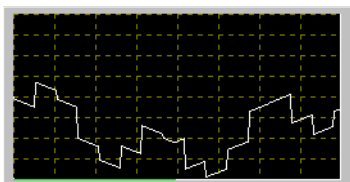
Waveform 7



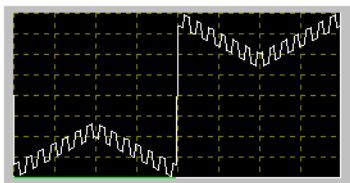
Waveform 8



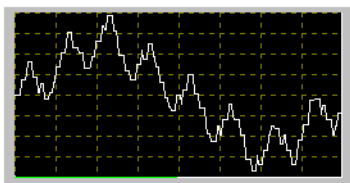
Waveform 9



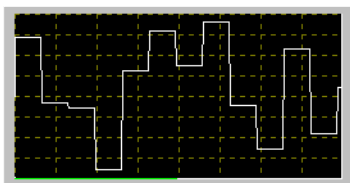
Waveform 11



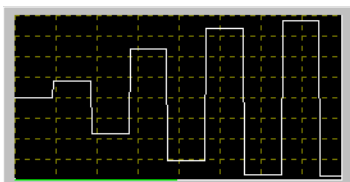
Waveform 12



Waveform 13



Waveform 14

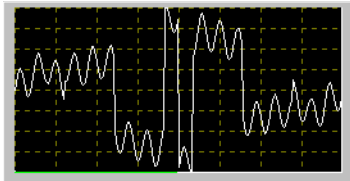


Waveform 15

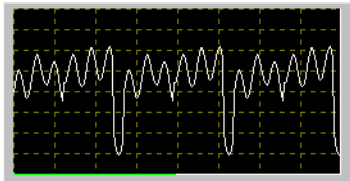
## Waveform Bank 14 : Sequences #2

The waveforms in Bank 14, like Bank 13 are made for use as cyclical sequences. These sequence generally have 'rounded edges', so are more useful as controller sequences for filters or VCA's.

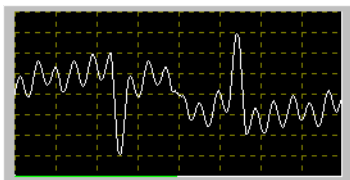
The sequence waveforms in Bank 14 are:



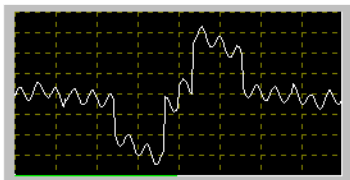
Waveform 0



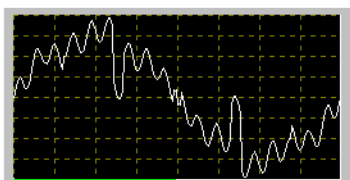
Waveform 1



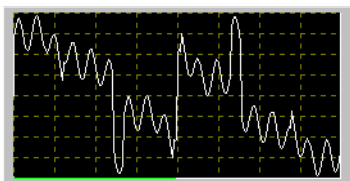
Waveform 2



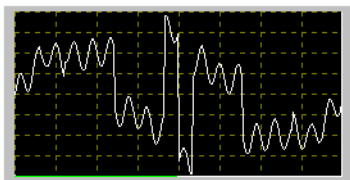
Waveform 3



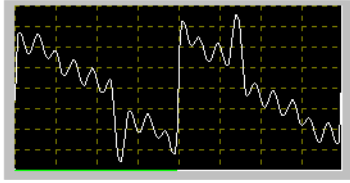
Waveform 4



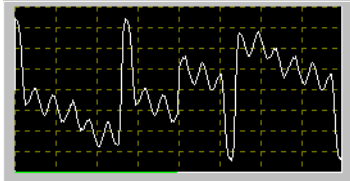
Waveform 5



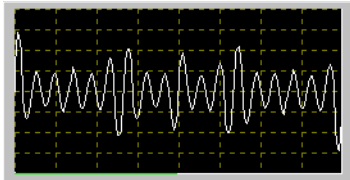
Waveform 6



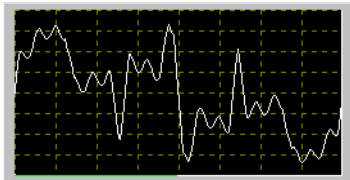
Waveform 7



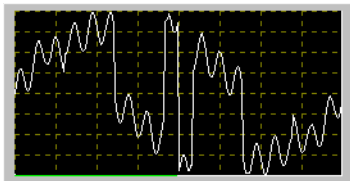
Waveform 8



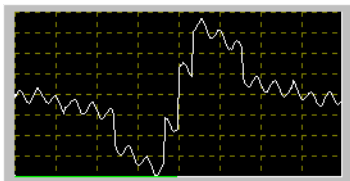
Waveform 9



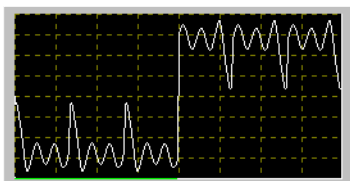
Waveform 10



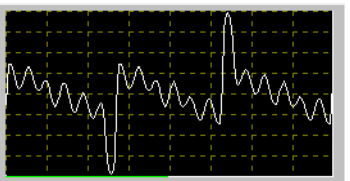
Waveform 11



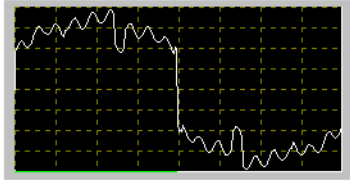
Waveform 12



Waveform 13



Waveform 14



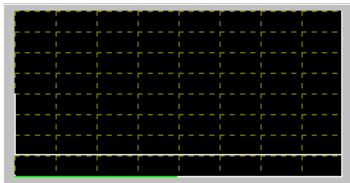
Waveform 15

## Waveform Bank 15 : Quantization

This is the output of the analog sawtooth with the pitch controlled by the waveform generator. The quantizer is being stepped by applying a linear envelope to the "Wave Envelope In" jack.

Bank 15 provides the levels required for using the Waveform City module as a quantizer. By modifying the wave selection voltage, you can select from any of 16 voltage levels. The outputs are all 'linear' waveforms, so no audio output is available from this bank.

Bank 15 starts with a linear wave at full negative DC offset, and steps (in equal steps) through 16 DC offsets.

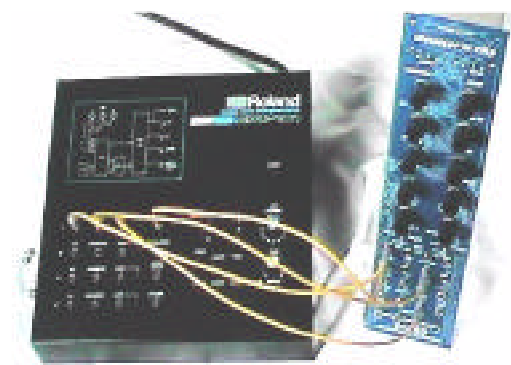


Waveform 2: A low DC offset.



Waveform 15: A high DC offset.

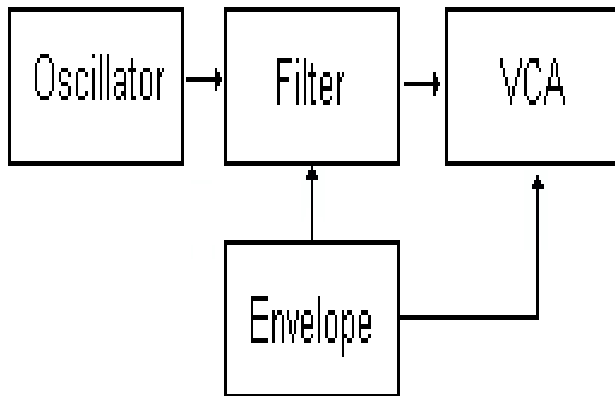
## Application Note #1 : Standalone Monosynth



The Waveform City module, unlike many synth modules, contains enough functionality to act as a standalone monosynth - albeit one that is easily patched into a bigger system. Before we examine a standalone patch, let's look at what is expected.

A standard (simple) monosynth typically uses the following signal flow:





where an oscillator's audio output is modified by a filter (possibly modified by an envelope), and the filter's output amplitude is controlled by a VCA (also, possibly modified by an envelope).

Since the Waveform City either a) contains these elements; or b) can emulate these elements, we can patch the module as a simple monosynth. So, the oscillator, envelope and VCA are found on the module... how do we do a filter? Many of the waveform banks of the Waveform City contain 'morphs' from a low-harmonic content sound to a high-harmonic content sound. This is exactly what a filter does - it varies the level of higher harmonics of a passed sound.

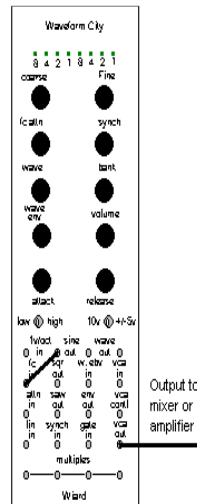
Consider the following (simple) patch:



## Application Note #2 : Self-Modulation

With any modular system, many unique sounds can be made by modulating a module by itself. This can produce clangorous, metallic sounds, or beautiful spacey sweeps. Given the breadth of functionality contained within the Waveform City module, extensive self-modulation can produce very robust patches.

Consider the following patch:



With this patch, we are using the output of the VCO sine wave to modulate its own frequency, and therefore affecting the output of the VCDO. This is a classic self modulation routing, and provides a very metallic tone. If you sweep the Coarse frequency knob, you will notice that, rather than changing the base pitch, you are now affecting the harmonic structure of the tone.

Another self-modulating patch is:



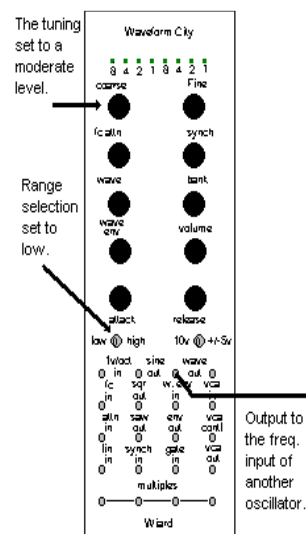
This patch uses the output of the digital waveform generator to modulate the VCO. This is effective in with the "Range" switch set to both High and Low. A variety of very tortured sounds can be created this way. The following patches use various sweeps of the wave table while feeding back as above. The output is taken from the analog sine wave output.

## Application Note #3 : Sequencing

If you've gone through the waveform listings, you will notice that banks 13 and 14 contain waveforms that are to be used for sequencing. How can you use this module for sequencing other synths?

An important point needs to be made about this function - this does not mean you can sequence songs using a module! Rather, it identifies certain waveforms as having content that is useful for sending to other modules as control voltages.

Check out this patch:



By setting the range to low, we guarantee a very slow output from the VCDO. By using bank 13 or 14, you can see that the result is a stepped tone that varies widely. If the connected oscillator has a frequency modulation attenuator, try adjusting it to make the sequence more-or-less tonal.

While banks 13 and 14 are specifically made to provide sequencing functionality, any waveform can be used for the creation of either note-based, or CV-control sequences. If you have two Waveform City modules, try sequencing one with the other - weeks of fun with that!

## Application Note #4 : Of Modules and Men...

As a last application note, let's insert the Waveform City module into a larger analog modular system. By combining the various sub-modules and interfaces of the Waveform City with sequencers, LFO's and oscillators, you can create incredibly complex voices with effects that cannot be obtained by other modular systems:

