MODEL 52 ~ *VAMPIRE*

Sonically Dense, Complex Oscillator

The Subconscious Communications Model 52 Vampire combines two independent, wide range, triangle core oscillators with manual and voltage controlled waveform modulation mixing and, routing.

In-Panel "normalled" signal routing implements a base configuration for a tandem LFO/VCO complex oscillator. Patching is extensive enough to exploit either oscillator independently.

Quick Summary:

- ⇒ Two Voltage Controlled Oscillators, with one naturally tuning an octave below its companion oscillator with Sync input and 5 output waveforms including Clock.
- ⇒ Main VCO provides Six output waveforms including PWM, Lin/Exp modulation and Sync inputs.
- ⇒ Voltage Controlled "Morph" cross-fader between Main VCO PWM and any other Main VCO waveform,
- ⇒ Voltage Controlled scan for selection of Main VCO waveform cross-fading with PWM,
- ⇒ Amplitude Modulation of External Audio or VCO Sin^2 signals at the LFO frequency rate.
  Two AM window waveforms; a)VOSIM-like Ramp; b) Grain-like Triangle.

The features described above are variously available across some or all of four output channels.

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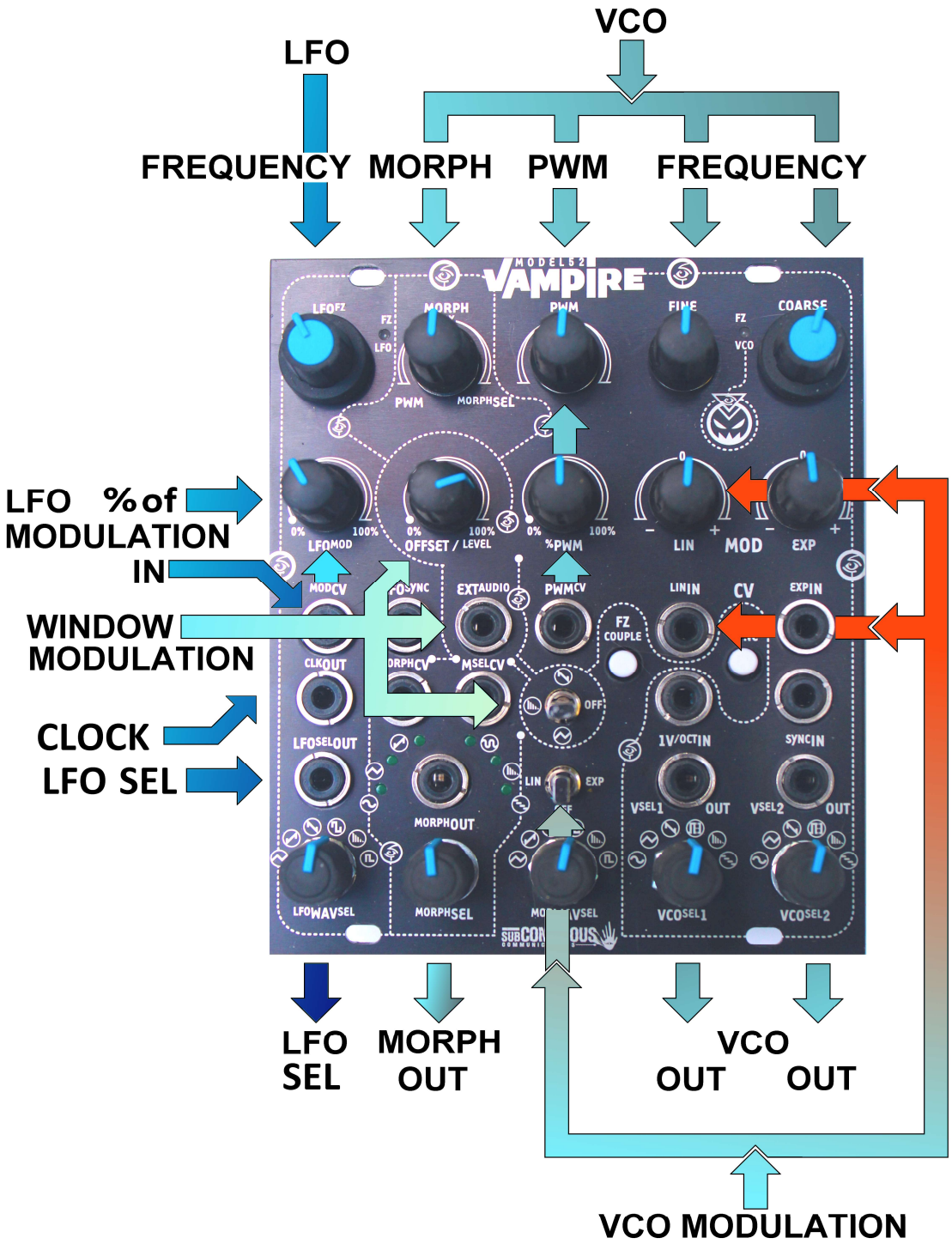
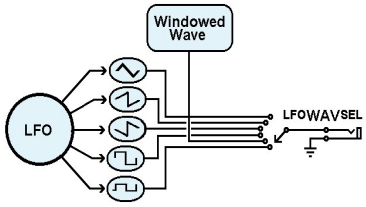
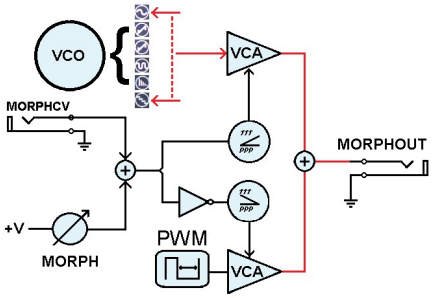
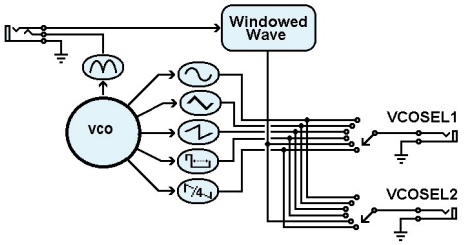
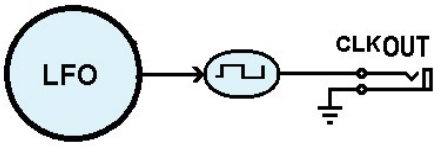
Panel Map:

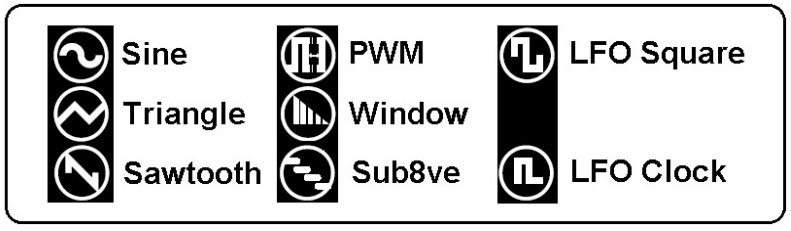
LFO Controls and jacks line up on the left. VCO and Windowed Waves Controls and Jack occupy the middle of the panel. VCO Controls for Frequency and LFO Modulation line up on the module right.



External Outputs

Vampire output occurs on any of four output jacks.		
LFO^{SEL}OUT	**LFO^{SEL}WAV^{SEL}** selects which LFO waveform emits from the **LFO^{SEL}OUT** jack. Triangle, Saw, Reverse-Saw, Square, Windowed Wave, and logic level square LFO Clock are the possibilities.	
MORPH$^{}$OUT	VCO output. A manual or voltage controlled cross-fade between the VCO's PWM waveform and a waveform selected by a voltage controlled select switch. This is the Morph function.	
V^{SEL}1OUT & ***V^{SEL}2OUT***	Two (2) VCO outputs. Each output emits the waveform manually selected on panel. There is no restriction on wave selection. Like waveforms can be selected. Sine, Triangle, Saw, PWM, Windowed Wave and Staircase (/4) are the possibilities.	
CLK$^{}$OUT	LFO 0/+5V "TTL" compatible 50% pulse at LFO frequency rate. Intended to drive or sync companion modules.	

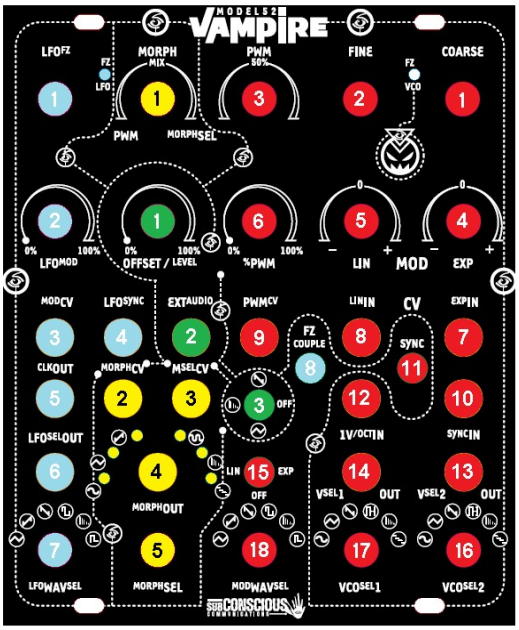
Vampire Lore



The front panel uses symbols to indicate individual waveforms

Who belongs to What?

The graphic below color associates the jacks and controls for the separate functions that comprise the Vampire.

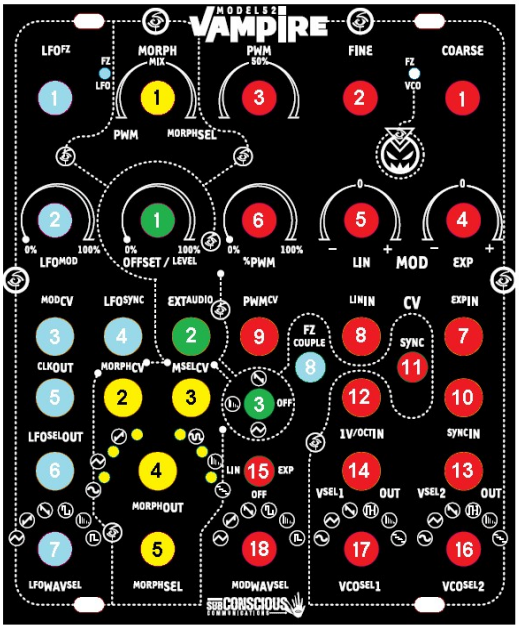


LFO
Morph/Wave Scan
Windowed Wave
VCO

Blue - LFO	
1	LFO Frequency Panel control.
2	LFO modulation input attenuator for signals plugged into ^{MOD}CV (Blue 3)
3	^{MOD}CV LFO modulation input jack.
4	LFO Synchronization Input
5	"TTL" (0-5Vdc) LFO Square wave output
6	Output jack for the LFO output waveform selected by Blue 7
7	LFO output waveform select.
8	Switch: 1V/8ve Input connect/disconnect to LFO
Yellow - MORPH	
1	Degree of cross-fade between (left) PWM and (right) MorphSel Waveform.
2	CV input for modulating the Morph cross-fade
3	VC Input to Morph Wave Select.
4	Morph audio output jack
5	Morph Manual Waveform Select control/VC attenuator.
Green - WINDOWING	
1	Window CV offset. With no LFO waveform, performs like amplitude control
2	Allows patching alternate to normalled Sin2 waveform to be enveloped in Wave Window circuit.
3	Selects waveform window envelope shape Triangle, RvsSaw or No envelope shape.
Red - VCO	
1,2	VCO Frequency Control Coarse and Fine controls.
3	PWM On/Off time spacing (adds with Red 6)
4,5	Bi-polar attenuators for (4) exponential; (5) linear modulation inputs and/or *normalled* MODWAVSEL waveform
6	Attenuator for PWM modulation input jack (Red 9).
7	Exponential modulation input jack. Jack's over *normalled* MODWAVSEL.
8	Linear modulation input jack. Jacks over *normalled* MODWAVSEL.
9	PWM modulation input jack drive
10	External VCO synchronization (when selected by Red 11)
11	Synchronization Switch select (Internal/External)
12	1 volt per octave input to VCO and switch coupled to LFO.
13,14	VCO waveform output selected by companion rotary switch. Red13-Red16 / Red 14-Red17
15	Route MODWAVSEL to VCO Linear or Exponential input.
16,17	Selects waveform to output. Red16 selects Red13. Red17 selects Red14.
18	Select LFO output waveform routing through RED15 to Red 7 or Red (center OFF)

Panel Row/Column Resource Structure

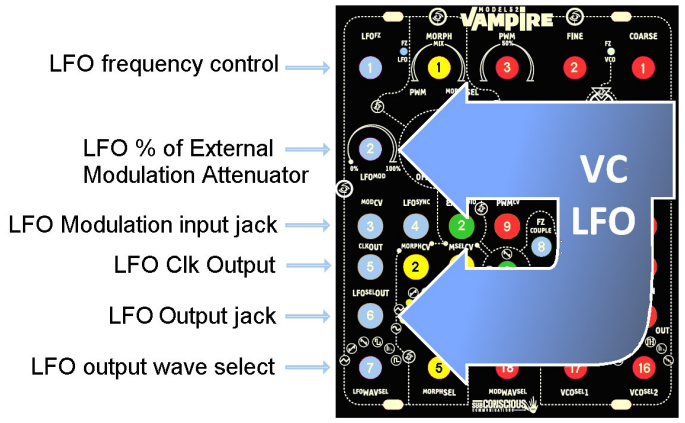
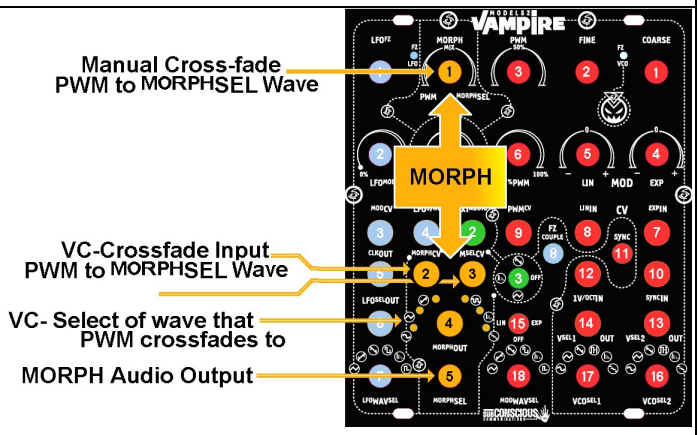
Panel Matrix *Another way of thinking about Panel Controls and Jacks.*					
LFO Freq	MORPH Fade		VCO Pulse - Width	VCO Fine Freq	VCO Coarse Freq
% of LFO-MOD	Window amplitude CV 0-5V level (constant)		% of PWM CV	% and Direction Of Linear Mod	% and Direction Of Expo Linear Mod
LFO Mod Input jack	LFO Sync In	Ext Audio Input	PWM CV input jack	Linear Mod Input Jack	Expo Mod Input Jack
LFO CLOCK Output jack	MORPH Fade CV	MORPH WaveSel	Window Amp-Mod WaveSel	Calibrated 1/Voct Input Jack	VCO Sync Input Jack
LFO External Output jack	MORPH OUTPUT jack		Mod Channel Sel	VCO Output 1 Jack	VCO Output 2 Jack
Waveform Select	MORPH SEL/VC Atten		MOD LFO WaveSel	VCO Output Wave Sel1	VCO OUTPUT WaveSel 2



LFO
Morph/Wave Scan
Windowed Wave
VCO

Audio Reference for Module Features

Module function block feature reference, below:

<table>
<tr><th>The VC- LFO</th><th>MORPH</th></tr>
<tr><td> 
</td><td> 
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<tr><td>LFO Output waveforms:
http://subsamples.skylabit.com/lfo_waves.html</td><td>Morph Crossfade:
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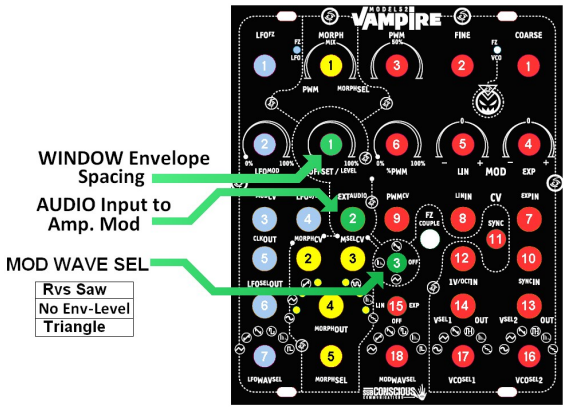
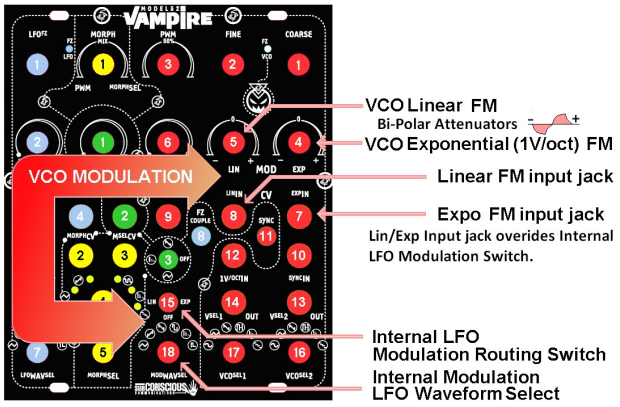
<tr><th>Windowed Waves</th><th>VCO Modulation</th></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Windowed Wave Modulation Examples:
http://subsamples.skylabit.com/vsg_waves.html</td><td>Internal LFO Modulation of VCO:
http://subsamples.skylabit.com/mod_waves.html</td></tr>
</table>

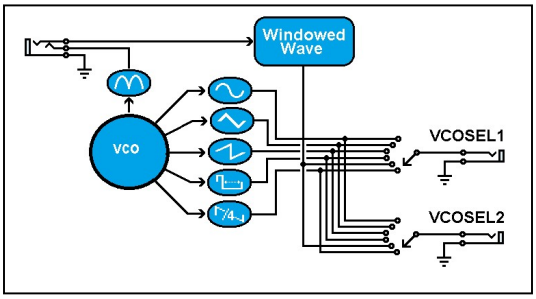
Getting to Know Vampire:

A fast way to become familiar with the Model 52 is to explore internal patch capability.

- Connect a cable from either V^{SEL}1OUT or V^{SEL}2OUT (panel bottom right) so you can monitor the audio output of the Vampire oscillator.
- Set rightmost-top, COARSE frequency control to a moderate to low frequency.
- Rotate through the waveform possibilities.

STARTING FROM THE LEFT:

Sine:	Distortion of 1% or less
Triangle:	Core waveform for Vampire oscillators
Saw:	Overtone rich classic oscillator waveform
PWM:	Pulse of variable width panel or VC programmed
Window:	Sin2 or External Input enveloped.
Sub-8ve:	A stair-cased sum of the VCO square wave and two-octave divisions beneath.



In Panel Patches

Patches that only require an output audio cable.

⇒ Audio Out connects to either V^{SEL}1OUT or V^{SEL}2OUT (panel bottom right)
⇒ Set SYNC switch so that FZVCO LED glows green. (No Sync)
⇒ Select a Sine, Triangle or Sawtooth waveform using VCO^{SEL}1 or VCO^{SEL}2 rotary switch.

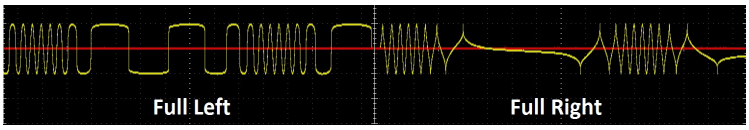
Modulation

Set LIN/OFF/EXP switch (panel lower center) to its middle position. (internal LFO MOD = OFF)
Set LFO^{FZ} (panel top left) to slow rate alternating the FZLFO LED illumination. (MOD Freq)
Set VCO frequency COARSE/FINE (panel top right) to a pleasant pitch (Mod Target -*Carrier*)
Set $^{LFO}WAV^{SEL}$ to the Sawtooth wave. (MOD Waveform)

⇒ Set LIN/OFF/EXP switch to right position (EXPO MOD)
⇒ Rotate EXP panel control from center right and then center left.

The degree of VCO frequency modulation *increases* ...
... positively as the control moves center-right
... negatively as the control moves center-left.

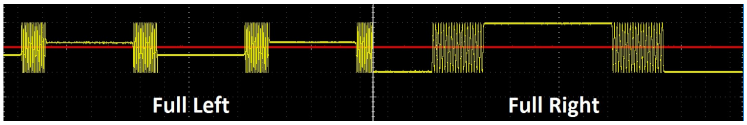
Since "positive" and "negative" may not be intuitive, here what the exp sawtooth mod looks like.



⇒ Set LIN/OFF/EXP switch to right position (LINEAR MOD)
⇒ Rotate LIN panel control from center right and then center left.

The degree of VCO frequency modulation *increases* ...
... positively as the control moves center-right
... negatively as the control moves center-left.

Since "positive" and "negative" may not be intuitive, here what the maximum Linear sawtooth mod looks like.

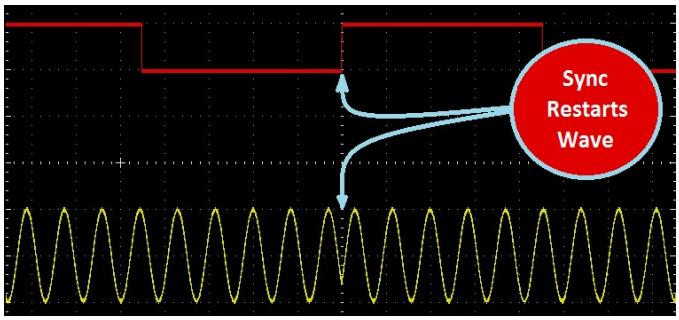


Synchronization

Set LFO Frequency to its audible pitch range
Press the SYNC push-button switch so that FZVCO LED illuminates RED. (Sync = ON)

⇒ Rotate LFO Frequency control (panel top left)
⇒ Rotate VCO COARSE and FINE Frequency controls (panel top right)
LFO frequency should equal or be less than VCO frequency for maximum output.
Differing frequency ratios produce different timbral effects.
⇒ Set LIN/OFF/EXP switch to center position
LFO frequency should equal or be less than VCO frequency for maximum output.
Without Frequency modulation Sync produces a different range of timbral effects.

This is what Sync looks like

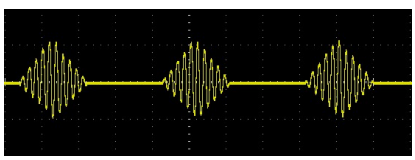


Morph and Morph Sel

⇒ Audio Out connects to MORPHOUT jack. (panel bottom - inside left)
⇒ Set SYNC switch so that FZVCO LED glows green. (No Sync)
⇒ Set MORPH to Full Left (PWM).
Pulse wave sounds. Rotating the PWM control varies Duty cycle of Pulse waveform.
⇒ Set MORPH to Middle Position.
⇒ Rotate MORPHSEL Control Left to right.
LEDs illuminate to indicate which waveform is selected to sound. Control stroke mimics mechanical rotary switches. Far right waveform is Sub-Octave.
⇒ Rotate MORPH control Right to Left / Left to Right.
Cross fade between Pulse wave and Sub-Octave waveform.
⇒ Rotate MORPHSEL Control fully left.
Sine wave is Selected.
⇒ Rotate MORPH control Right to Left /Left To Right.

Windowed Waveforms Part 1

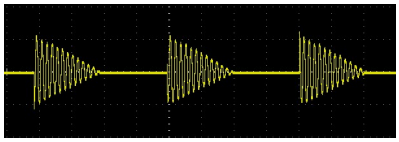
⇒ Audio Out connects to either VSEL1OUT or VSEL2OUT (panel bottom right) or LFOSELOUT
⇒ Select Windowed Wave output for chosen output jack
⇒ Set Window Envelope switch (middle top 3 position switch) to it low most position (triangle envelope). With LFO Frequency set low, a tremolo sounds. Increasing LFO frequency, Sideband harmonics emerge with the classic "take me to your leader" sci-fi effect.
⇒ **Note:** *The Triangle envelope allows for windowing of waveforms without "popping" or "clicks" due to the sloped rise and fall of amplitude. This is the "poor mans" fabrication of classic sound grains.*



- ⇒ Adjust both the VCO and LFO frequencies a wide range of effects from slow crescendo, grating in-harmonic, and evolving resonance can occur.
- ⇒ Rotate the **OFFSET/LEVEL** panel control noticing how the "power" and "duration" of the ping sound is affected.
- ⇒ Set Window Envelope switch (middle top 3 position switch) to it highest position (reverse Sawtooth).
- ⇒ Turn **OFFSET/LEVEL** to minimum.

Windowed Waveforms Part 2

- ⇒ With LFO set very to 1Hz or so ad the VCO to mid-frequency (1kHz) a "ping" occurs.
- ⇒ Rotate the **OFFSET/LEVEL** panel control noticing how the "power" and "duration" of the ping sound is affected.
- ⇒ Adjust both the VCO and LFO frequencies a wide range of effects from slow crescendo, grating in-harmonic, and evolving resonance can occur.
- ⇒ Depress the Sync switch.
- ⇒ Rotate the LFO and VCO Frequency panel controls. Notice how sounds ranging from "growls" to "vocalise" are able to be produced. This is due to the abrupt slope of the reverse Sawtooth waveform which emulates, in part, the abrupt stretching and loosening of the human larynx organ when performing speech. This is a "poor mans" VOSIM.

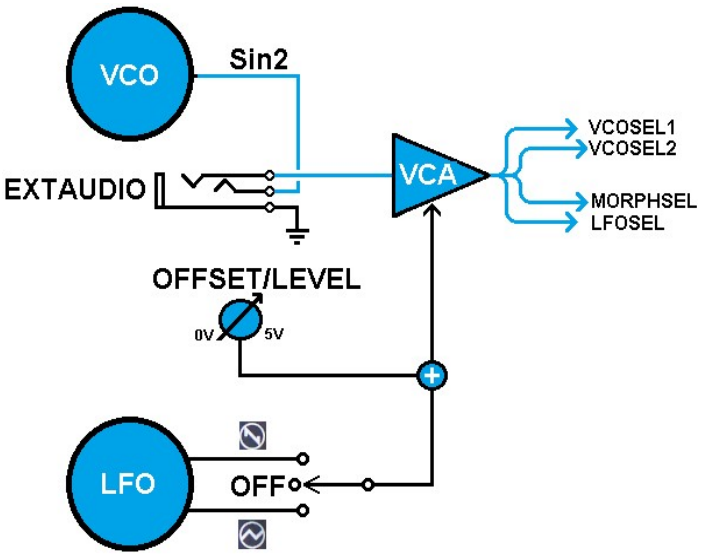


Windowed Waveforms Part 3

- ⇒ Set Window Envelope switch (middle top 3 position switch) to it middle - OFF position.
- ⇒ With VCO Frequency set to any audible pitch. Rotate the "OFFSET/ LEVEL" panel Control**,** note how the "power" and "duration" of the sound increases as the OFFSET/LEVEL control approaches maximum.

  OFFSET/LEVEL controls the spacing between envelopes. When envelopes are switched off it controls the volume of the SIN^2 waveform. This is indeed the only way an unadulterated SIN^2 emits from the Vampire.

How does Waveform Windowing Work ?



The figure left depicts how the VCO Sin^2 waveform inputs to a VCA to be enveloped by either LFO Reverse Sawtooth or Triangle waveforms.

A lever-switch (with a middle OFF position) selects between to modulate the amplitude of the input signal (typically Sin^2).

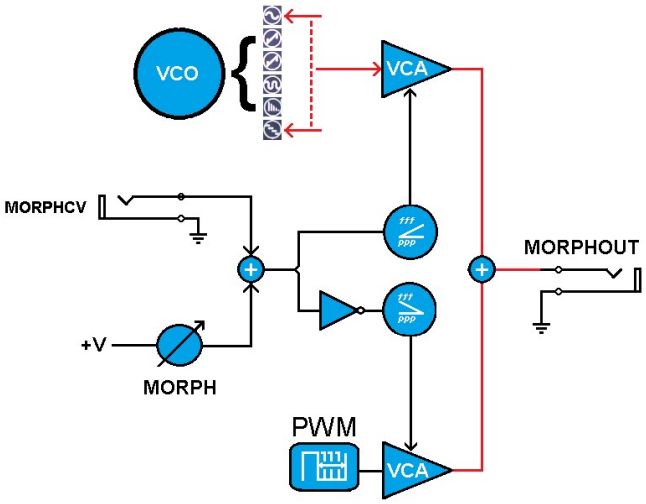
Signals input to EXTAUDIO jack override Sin^2 and input directly to the VCA.

The OFFSET/LEVEL panel control adds to Input level setting regardless of switch position (including OFF).

With no LFO modulating waveform, OFFSET/LEVEL is a manual volume control especially useful when processing external audio.

With active LFO modulation the OFFSET/LEVEL reduces waveform spacing and asymmetrically distorts the waveform.

How does Morph Work ?



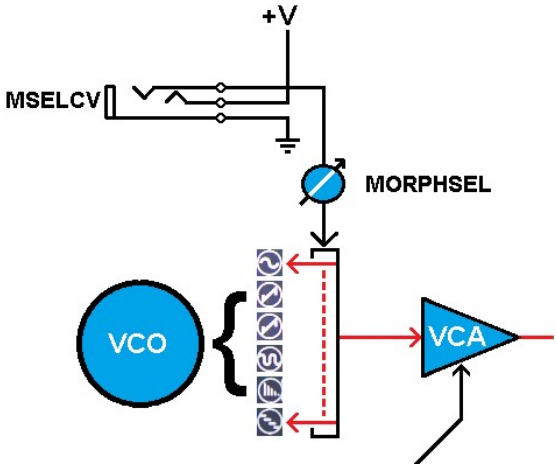
Cross-Fade

Morph cross-fades the VCO PWM square wave with an alternate waveform manually, or with voltage control.

The figure right depicts how the MORPH panel control and MORPHCV *combine* to set the degree of fade between PWM and an alternate waveform.

Wave Select

The alternate Morph waveform is set by the MORPHSEL panel control.



The MORPH panel control is an attenuator.

With no signal plugged to MORPHCV, a reference is supplied so the MORPH control performs as Manual Rotary Waveform Select.

Signals input to MORPHCV jack override the reference with the MORPH panel control acts as an attenuator.

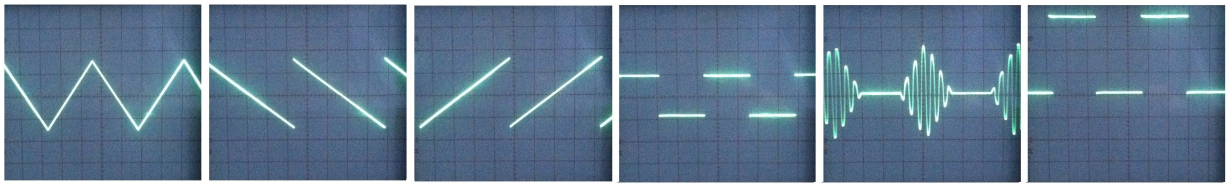
Increasing positive voltage move waveform selection from Sine to Sub-Octave.

Control Voltages more negative than 0V are ignored.

Selecting Windowed Waveforms assumes this waveform is configured to sound.

Specifications:

VCO 1



Frequency Range: .04Hz to 16kHz

Frequency adjusted using the manual LFO^{FZ} control and (when the **FZCOUPLE** switch is activated) by external signals plugged into the 1V/^{OCT}IN jack. Frequency rate indicated by the FZLFO LED flashing green when Frequency is coupled and red when Frequency control is un-coupled.

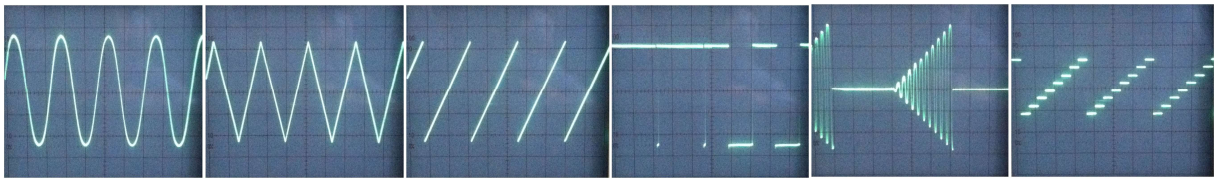
External Modulation: Input attenuator / Exponential response.

Synchronization Input: Resets Waveform low.

Synchronization Output: Unipolar Pulse 0/+5V emits from ^{CLK}OUT jack.

Output Waveforms: Manual Rotary selection for waveform emitted from LFO^{SEL}OUT jack. +/-5Vac C Triangle, Sawtooth, Ramp, Square, Windowed and Unipolar Pulse waveforms.

VCO2



Frequency Range: .5Hz to 24kHz.

Frequency adjusted using the manual **COARSE** and **FINE** panel controls and by external signals plugged into the **1V/^{OCT}IN** jack.

Frequency rate indicated by the **FZVCO** LED flashing GREEN when VCO2 is not internally synchronized to VCO1 and flashes RED when internally synchronized.

External Modulation: Linear and Exponential input response with two modes:

Internal Mode: Any of six VCO1 waveforms, manually selected by **^{MOD}WAV^{SEL}** rotary switch, routes to modulation select switch. *Switched left*, VCO1 drives the **VCO2 LIN MOD** attenuator. *Switched right,* VCO1 drives VCO2 EXP MOD attenuator. Centered, VCO2 is not internally modulated.

External Mode: External signals plugged into either **LIN** or **EXP MOD** jacks overrides any internally routed modulation.

Synchronization: Resets Waveform low with two modes:

Internal Mode: With white SYNC button pressed, VCO1 **^{CLK}OUT** is the source of Synchronization. The FZVCO indicates RED.

External Mode: with white SYNC button not-pressed any signal plugged into the **^{SYNC}** jack is the source of synchronization.

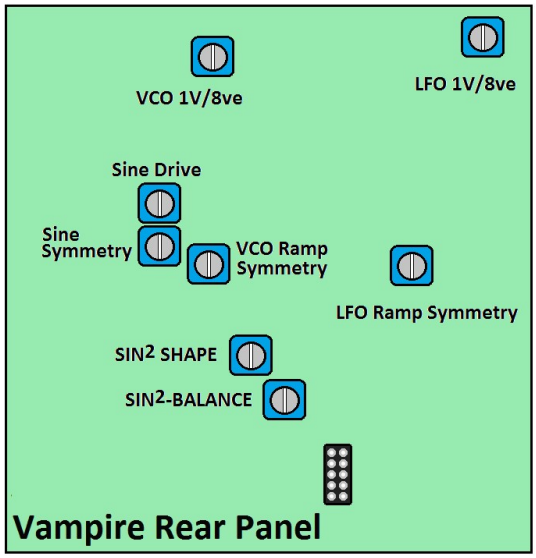
Output Waveforms: VCO2 employs two output modes, manual and voltage controlled. Six waveform types emit from manual waveform outputs. Sine, Triangle, Ramp, PWM Pulse, Windowed and Sub-Octave Staircase.

Manual Outputs: Two Rotary switches (**VCO^{SEL}1**; **VCO^{SEL}2**) select one of six possible output waveforms to emit from **VCO^{SEL}1 OUT** and **VCO^{SEL}2 OUT** jacks.

Power Requirement: 130mA from +12Vdc; 100mA from -12Vdc.

Calibration:

The figure right depicts the rear module panel locations for miniature controls which are used to calibrate the Model 52 Vampire to published specification.



These adjustments allow calibration for:

- Control Voltage to Frequency Response (1 Volt per Octave) for both the LFO and VCO
- Purity of the VCO Sine Wave
- Symmetry of the LFO and VCO Sawtooth waveforms.
- VCO Sin2 Shape and Symmetry.

I. Tuning VCO Control Voltage Response.

The top two adjustments, as depicted, are (Left) VCO 1V/8^{ve}, (Right) LFO 1V/8^{ve}.

What's required:

1 A control voltage source where precise 1Vdc steps can be applied to the Model 52 VCO and LFO.

Examples:

- Standard, calibrated 1V/8ve Synthesizer keyboard.
- MIDI Keyboard or Sequencer with MIDI2CV attached.
- Akai Max49 CV Keyboard
- Rotary switch connecting to precision voltage dividers.

2 A method to monitor the frequency of the LFO/VCO output. While a Frequency counter, oscilloscope, FFT computer programs work, the preferred method is to listen to the LFO and VCO equally mixed. The oscillators are tuned by listening for "beats".

Note: Wait 10 m*inutes after Vampire powers up before tuning the oscillators.*

Begin:

Make Sure:

- Sync is un-pressed (FzVCO LED = green)
- Fz Couple is un-pressed (FzLFO LED = green)
- All modulation is OFF (LIN/EXP switch = OFF)

The Big Idea:
*In the following procedure, we alternate between a low frequency reference called the "basis note" and higher octaves. When at the higher frequency we adjust the oscillators **1V/8ve** trim pot for minimum beat. When returning to the basis note we adjust the oscillator frequency using the panel control to achieve unison. Each alternation lowers the error. With practice this can be very quick.*

Procedure Part One: Tune the VCO

1 Set the LFO to a low frequency say 110Hz (A2). It is used as a low end pitch reference. The LFO's note is called the "basis note".

2 Plug a control voltage source capable of producing 1Vdc increments for tuning VCO into the 1V/^{OCT}IN jack adjust it for 2Vdc. Adjust the VCO Coarse/Fine Frequency control for unison with the LFO (absolute minimum "phase beating" .. say, once for several seconds)

3 Raise the Control Voltage into the VCO by 1Vdc. Adjust the VCO's 1V/8ve *trim pot* (on PCB) for the slowest possible beating with LFO basis note.

4 Lower the VCO control voltage source by 1 VDC. Adjust the VCO Coarse/Fine Frequency panel control for unison with the LFO with absolute minimum beating.

5 Lower the control voltage source by 1 octave (back to basis note). Adjust VCO Frequency panel control to achieve slowest beating with LFO.

6 Raise control voltage by 1 octave Adjust the VCO's 1V/8ve *trim pot* (on PCB) for the slowest possible beating.

7 Return to the basis note with which we began this procedure. Iterate back and forth until basis and octave note beat very, very slowly.

NOTE: *This should not be hard to tune between 1 octave only. If it is troublesome .. pick a different waveform type for monitor, check to ensure your octave voltage reference is accurate.*

Procedure Part Two: Tune the LFO

8 The VCO is now tuned. Adjust the control voltage so that the VCO is once again in unison with the LFO basis note.

9 Press the FzCOUPLE switch. Adjust the LFO^{Fz} panel control for minimum beating with the VCO frequency but tune the LFO 1 octave lower than the VCO.

10 Raise control voltage by one octave (1Vdc). Adjust the LFO1V/8^{ve} trim pot (on PCB) for absolute minimum beating.

11 Lower the control voltage by one octave. Using the LFO^{FZ} panel control, adjust the LFO for minimum phase beating with the VCO.

12 Raise the control voltage by two octaves (2Vdc). Adjust the LFO1V/8^{ve} trim pot (on PCB) for absolute minimum beating.

13 Lower the control voltage by two octaves. Using the LFO^{FZ} panel control, adjust the LFO for minimum beat with the VCO .

Note: *Electrically the LFO is optimized to sound one octave lower than the VCO. Maximum accuracy for frequency tracking between the VCO and LFO is when the VCO is one octave higher. Since the VCO is tuned, if we adjust the LFO to track maximally with the VCO then it too is in tune.*

The technique is simple.

Using panel controls adjust the VCO and LFO for minimum beating at a low (110Hz or lower) frequency. Raising the 1v/OCTIN control voltage by 1Vdc should cause both the LFO and VCO to transpose exactly one octave. Since the VCO is tuned, we adjust LFO 1V/8ve Trim Pot for minimum beating with the VCO. In this way we iterate between manual adjustment at the low end and trim pot adjustment at the high frequency end.

II. Adjusting VCO Sine Wave Purity

Two adjustments are provided for the VCO Sine output waveform. SINE DRIVE controls how the Triangle wave fed to the SINE Wave shaping circuit has it's peak rounded and its linear slope curve. SINE SYM controls the centering and symmetry of the sine waveform.

What's required:

- Small screwdriver flat.
- Oscilloscope or Distortion Meter .
- Alternatively, FFT based audio evaluation software
- Minimally, ability to listen to the SINE waveform with good fidelity.

Begin:

Make Sure:

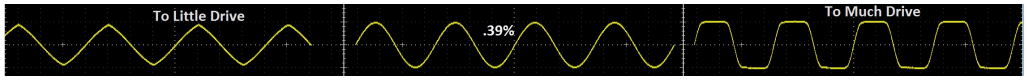
- Module has been powered up for 5 minutes.
- Sync is un-pressed (FzVCO LED = green)
- All modulation is OFF (LIN/EXP switch = OFF)

Procedure: Sine Adjustments

1 Set the LFO to a low frequency say 110Hz (A2). This is especially important if you are using your ear to adjust the SINE purity.

2 Adjust the SINE DRIVE trim pot for greatest suppression of overtones. If listening .. adjust for dullest (purest) sound achievable. If using an oscilloscope, adjust drive to just round the triangle peak without flatness. If using a distortion meter or Audio analysis software, adjust for minimum distortion (less than 1% full range)

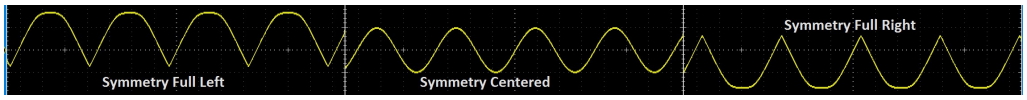
Note: *Too little* SINE DRIVE *retains the Triangle Shape with increasing slope curve and peak rounding as the control is increased. To much drive and the waveform starts to become square with sloped shoulders.*



3 Once adjusting SINE DRIVE for "best cosmetic shape", dullest sound, or minimum instrumented distortion, adjust the SINE SYM trim pot.

4 Adjust for most symmetrical shape centered around zero, "dullest sound", or minimum instrumented distortion.

Note: To little SINE SYM and the distorted waveform presents the largest share of its waveshape above zero with a sharp peak extending below zero.



III. Adjusting VCO / LFO Sawtooth Symmetry

Two adjustments are provided for adjusting Sawtooth Symmetry one for the VCO and the other for the LFO.

What's required:

- Small screwdriver flat.
- Oscilloscope
- Minimally, ability to listen to the Sawtooth waveform with good fidelity.

Begin:

Make Sure:

- Module has been powered up for 5 minutes.
- Sync is un-pressed (FzVCO LED = green)
- All modulation is OFF (LIN/EXP switch = OFF)

Procedure Part 1: LFO Sawtooth Symmetry Adjustment

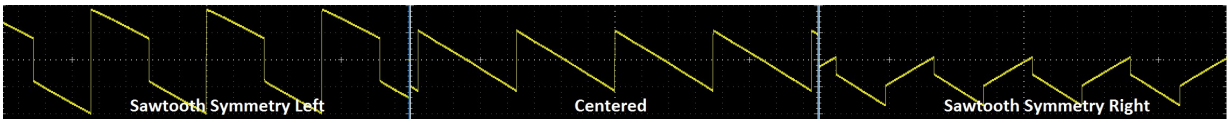
1 Plug audio output to $^{LFO}Wav^{Sel}$. Select third waveform, the reverse sawtooth (ramp).

2 Set the LFO to a low frequency say 110Hz (A2). This is especially important if you are using your ear to adjust the Sawtooth symmetry.

3 If using an oscilloscope, adjust the LFO RAMP Symmetry trim pot for least interrupted, best stitched slope.

4 If listening .. notice that at far left the sound is that of a 50% duty cycle Square wave with plenty of harmonics. Progressing toward the trim pot center the fundamental pitch increases and the harmonics lessen. Proceeding toward the right the fundamental dominates and distortion increases. If

adjusting by ear go fully right and then proceed toward the center until fundamental begins to be suppressed.



Procedure Part 2: VCO Sawtooth Symmetry Adjustment

5 Plug audio output to VCO ^{SEL}1. Select third waveform, the reverse sawtooth (ramp).

6 As before, if using an oscilloscope, adjust the LFO RAMP Symmetry trim pot for least interrupted, best stitched slope.

7 If listening .. notice that at far left the sound is that of a 50% duty cycle Square wave with plenty of harmonics. Progressing toward the trim pot center the fundamental pitch increases and the harmonics lessen. Proceeding toward the right the fundamental dominates and distortion increases. If adjusting by ear go fully right and then proceed toward the center until fundamental begins to be suppressed.

IV. Adjusting SIN^2 Waveform Shape and Symmetry

What's required:

- Small screwdriver flat.
- Oscilloscope

NOTE: *Neo, Gandalf and Science Officer Spock could no doubt just adjust the SIN^2 using their "ears" the rest of us should use an oscilloscope.*

Begin:

Make Sure:

- Module has been powered up for 5 minutes.
- Sync is un-pressed (FzVCO LED = green)
- All modulation is OFF (LIN/EXP switch = OFF)
- Window Wave Select Switch = OFF.
- OFFSET/LEVEL panel control = Fully On

Procedure: SIN^2 Shape and Symmetry Calibration

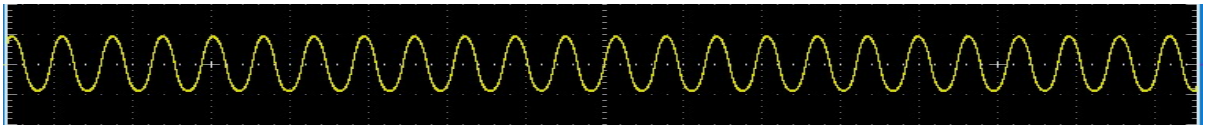
Note: *This is a troublesome adjustment not to be made unless necessary.*

1 Plug audio output to **^{LFO}Wav^{Sel}.** Select fifth waveform, *SIN^2*.

2 Set the VCO to a low frequency say 110Hz (A2).

3 Set the oscilloscope so that many cycles display across the graticule.

4 Waveform should present successive cycles of similar amplitude.



5 The SIN2 SHAPE sets the maximum positive excursion of every other waveform cycle.
The SIN2 BAL sets the minimum negative excursion of every other waveform cycle. Alternate turns of these two adjustments are required to "walk" the waveform into symmetry.

6 Using the SIN2 SHAPE trim pot, adjust waveform so that every other cycle just peaks at +5Vdc.

7 Using the SIN2 BAL trim pot, adjust waveform so the every other cycle bottoms out at -5Vdc.

Note: *The SIN2 adjustments are interactive with each other they must be adjusted alternately until symmetry is attained.*