

This is the manual for

# THE EKDAHL Polygamist

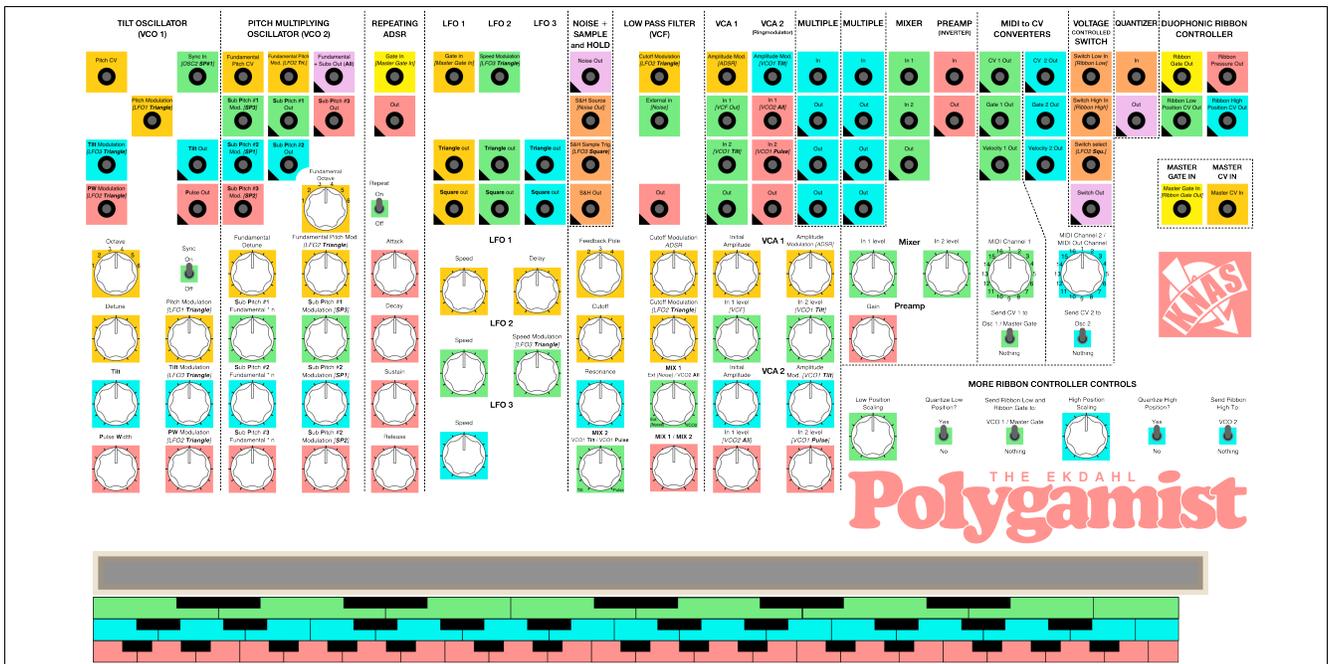
by



© copysomething stuff 2012  
document version 1.0  
last edited 2013-07-30

## Table of Contents

1. Intro.....	3
1.1 Basic description.....	3
1.2 General design and usage philosophy.....	4
2 In depth Module Description.....	5
2.1 Tilt Oscillator - VCO 1.....	5
2.2 Pitch multiplying oscillator - VCO 2.....	6
2.3 Repeating ADSR (Attack/Decay/Sustain/Release).....	6
2.4 Low Frequency Oscillators (LFOs).....	7
2.5 Sample-And-Hold and Noise source.....	7
2.6 Low pass filter (VCF).....	8
2.7 Voltage Controlled Amplifiers (VCAs).....	8
2.8 CV/Audio Mixer.....	8
2.9 CV/Audio Preamp / Inverter.....	8
2.10 MIDI-To-CV converters.....	9
2.11 Voltage Controlled Switch.....	9
2.12 Quantizer.....	9
2.13 Duo phonic ribbon controller.....	10
2.14 Master Gate and CV jacks.....	10
3. Calibration procedures.....	10
3.1 Oscillator scale tuning.....	11
3.2 Tilt Offset calibration.....	13
3.3 Pitch Multiplying Oscillator Offset calibration.....	14
3.4 Pitch Multiplying Oscillator Sine shape calibrations.....	15
3.5 VCF V/Oct.....	15
3.6 Ribbon calibration.....	16
5. Specifications.....	17



## 1. Intro

Thank you for buying the Ekdahl Polygamist, or just showing enough interest to read the manual anyway! The development of this synthesizer has been a long hard road and Knas is proud to present this instrument.

In short, the Ekdahl Polygamist is a semi-modular, analog synthesizer which is *not* intended to be another “phat bass synth” but rather a machine with which you quickly can create complex sounds capable of molesting peoples ear drums. The design has features not commonly seen in stand-alone units and employs a greater range of expression than is common, this includes features like non-standard oscillator design, greatly expanded ADSR/LFO times and other not-so-common features.

The Ekdahl Polygamist can be used as a stand-alone unit, utilizing it's duo phonic, pressure-sensitive *ribbon controller*. It can also be slaved to other devices, using the dual *MIDI-to-CV* converter or through direct CV control.

### 1.1 Basic description

The Ekdahl Polygamist features:

- 2 x VCOs
- 1 x ADSR
- 3 x LFOs

- 1 x Sample & Hold
- 1 x Noise source
- 1 x VCF
- 2 x VCAs (1 ring-modulator type)
- 2 x Multiples
- 1 x CV/Audio mixer
- 1 x CV/Audio preamp / Inverter
- 2 x MIDI-to-CV converters
- 1 x Voltage controlled switch
- 1 x Quantizer
- 1 x Duo phonic ribbon controller (with MIDI out)

## 1.2 General design and usage philosophy

The Ekdahl Polygamist is semi-modular which means that the various functions are organized in "modules", however unlike with a truly modular synth, these "modules" cannot be removed. Further more, while the synth is patchable, it is normalized (pre-patched) in a certain way. The normalization can be overridden through the use of external 3.5mm phono cables, the normalized connections are indicated on the synthesizers front panel at each "modulation"-knob and input jack by having the normalized source written within brackets ([ ]).

The synthesizer features an extensive input/output indication scheme which is comprised of large square LEDs that show polarity and progression of the current modulation. These LEDs have a "top" and "bottom" position where the top part of the LED will glow if the modulation is positive and the bottom part will glow if the modulation is negative. A output signal is indicated by a red LED, a input signal is indicated by a green LED. The indication is **always** done at full strength of the incoming signal, regardless of the current modulation depth - this so you can visually monitor your modulation before you apply it.

The Ekdahl Polygamist follows the standard of 1 Volt / Octave CV (Control voltage) and positive-going gates, the output of the latter is 0-12V and all gate inputs accept signals as low as 2.5 Volts. Audio and CV signals are at compatible levels throughout the synthesizer and can be interchanged.

## 2 In depth Module Description

### 2.1 Tilt Oscillator - VCO 1

The *Tilt Oscillators* main feature is that it has the ability to "tilt" it's main waveform from a ramp, to triangle, to sawtooth. (Please note that the circuit does in fact *tilt* the waveform, it does not morph in between the three different waveforms.)

Speaking technically, both the sawtooth and the ramp have both odd and even harmonics. On the other hand the triangle wave only contains odd harmonics, thus tilting it from a ramp / sawtooth to a triangle wave effectively alters the harmonic content of the oscillator output.

Putting it in human terms, the sound goes from harsh, to mellow, to harsh. Changing the tilt is much like changing the cutoff on a low-pass filter without adding any resonance, the result is something like "beeeooooowwwwoooooe".

The Tilt can be controlled both through the use of a knob or via CV.

The *Tilt Oscillator* also employs a pulse output that has variable *pulse-width*, this too can be controlled either via a knob or CV. Changing the pulse width makes the sound go from full to nasal. The pulse-width can also be used to completely turn the waveform output off, furthermore the pulse output can be used as a constant voltage source by setting the pulse-width to either extreme.

Last but not least the oscillator incorporates hard synchronization, this means that the oscillator can be reset to it's starting point by an external voltage source. Most commonly, the synchronization is used in conjunction with another VCO to either make sure the two oscillators are in perfect pitch with each other, or to create specific harmonic effects.

The oscillator includes a 6-octave rotary selector switch and a detune knob for perfect pitch, it also has a internal trimmer (accessible from the front of the unit) that sets the Volt/Octave scaling.

## 2.2 Pitch multiplying oscillator - VCO 2

The pitch multiplying oscillator is an all analog approach of doing additive synthesis. Additive synthesis is a technique where you start with a fundamental waveform that does not have any harmonics - sine wave - and you add harmonics by simply adding more sine waves at a different pitch. This is the premise behind famous synthesizers like the Yamaha DX7. This should be put in opposition to classic analog synthesis - subtractive synthesis - where you usually start with a waveform rich in harmonics (square wave / sawtooth wave) and use a filter to *remove* the harmonics.

The basic idea behind the oscillator is to have one fundamental waveform which controls 3 sub pitches. The frequencies of the sub pitches is a direct multiple of the fundamental frequency, the multiplication rate can be set with the "Sub Pitch #x Fundamental \* n" knobs<sup>1</sup> and can also be CV controlled. The fundamental and sub pitches are all "sine"<sup>2</sup>, and as sine waves do not have any harmonics the sub pitches can be considered user definable harmonics<sup>3</sup>.

The sub-pitches will always "sync up" at the full transition of the fundamental, this will result in "cut" waveforms on the sub-pitches. E.g. if sub pitch #1 is set to scale at 2.5 times the fundamental, the output will actually be two and a half waveforms for every period of the fundamental.

The CV control of the sub pitches is linear and they are normalized to each others audio output, by modulating the pitch scaling with each other, very complex waveforms can be created. Due to the circuitry of the sub pitches, chaos can be generated by modulating all three sub pitches with each other as they effectively form a feedback loop.

Through playing with the feedback and sub pitches, one can create the most satisfactory ear-hell.

The oscillator includes a 6-octave rotary selector switch and a detune knob for perfect pitch, it also has a internal trimmer (accessible from the front of the unit) that sets the Volt/Octave scaling. It also has 4 trimmers associated with tuning the sound of the sub pitches<sup>4</sup>

## 2.3 Repeating ADSR (Attack/Decay/Sustain/Release)

---

1 Example: if the first sub pitches multiplication rate is 3 and the fundamental frequency rate is 200Hz, the sub pitches frequency will be  $3 * 200 = 600\text{Hz}$

2 It should be noted that the output waveform is not entirely pure but resembles a sine-wave more then anything else

3 These aren't technically harmonics as they are not necessarily "in harmony" with the fundamental, technically they are "upper partials"

4 Please see the calibration section in regards to the trimmers

What is special about the ADSR is that it has a very wide time constant range on all parameters, going from approximately 1ms to infinity<sup>5</sup>. Utilizing the repeat mode, the attack and decay phase can be repeated for as long as the *gate* voltage is applied. By using very short *attack* and *decay* times and enabling the *repeat*, the ADSRs output can be used as a gated oscillator.

## 2.4 Low Frequency Oscillators (LFOs)

The Ekdahl Polygamist has three *LFOs*, all with their own features. All have both a *triangle* and *square-wave* output and each of the *LFOs* have their own specific frequency range, going from minutes to audio frequency.

It should be noted here that the *triangle* and *square-wave* outputs are always at opposite phase (inverted from each other), the LED indicating the speed reflects the *triangle* output thus for using the *square-wave* output one has to consider the LEDs as upside down.

LFO 1 can be reset by using a *gate* signal, this means the waveform is set back to its starting point of -12V (for the *triangle* output). The reset can for instance be used for *oscillator synchronization*<sup>6</sup> making the LFO useful as an extra audio oscillator. It also features a *delay* on the *triangle* output, meaning it will fade in given the time constant set with the *delay*-knob.

LFO 2 is cv-controllable, hence the frequency can be controlled with an external voltage.

LFO 3 is a standard utility LFO.

## 2.5 Sample-And-Hold and Noise source

The *Noise Out* jack outputs a constant white noise signal.

The Sample-And-Hold (S&H) is a basically a voltage sampler that can store any given voltage within the standard range. When triggered through the *trig* input, the circuit will momentarily sample the current voltage on its *source* jack and output that voltage on its *out* jack. It will keep this output voltage until a new trigger is engaged.

S&Hs are commonly used to create *random voltage*, a *noise source* could be considered a random voltage generator, but it changes too rapidly to generally be useful as such. By connecting a noise source to the

---

<sup>5</sup> Not guaranteed, I could simply not measure any decline in amplitude after 2 hours and stopped measuring.

<sup>6</sup> See section 2.1

S&H source jack and a *LFO* to the *trig* jack, every time the *LFO* reaches its peak it will engage sampling of the noise source hence the output of the S&H will be a random voltage that changes at a rate less than audio rate (given of course that the *LFO* speed is set to less than audio rate).

## 2.6 Low pass filter (VCF)

The Low pass filter is a four pole filter that has selectable feedback pole, the feedback can be had on either the 2<sup>nd</sup>, 3<sup>rd</sup> or 4<sup>th</sup> pole, the output is always on the 4<sup>th</sup> pole.

It employs a sophisticated mixer section that allows for maximum flexibility given the rather simple layout; *Mix 1* sets the balance in between the *Noise source* (or external in) and the *All* output of *VCO 2*. *Mix 2* sets the balance in between *VCO 1's Tilt* and *Pulse* output. *Mix 1 / Mix 2* sets the balance in between the previous two mixes and sends that final mix into the filter.

## 2.7 Voltage Controlled Amplifiers (VCAs)

*VCA 1* is a standard amplifier that employs *de-clicking*, this means that the *modulation*-input has a passive filter on it that inhibits very fast signals from creating an audible "click" in the resulting sound. These clicks can be a real nuisance when making for instance a low bass sound.

*VCA 2* doubles as a *ring-modulator*; the *modulation* input is rectified, meaning any signals below 0 volts has a sign change (e.g. -3 volts becomes +3 volts), this makes it better than *VCA 1* for audio-rate modulation. *VCA 2* does not incorporate the *de-clicker* thus it's better for percussive sounds.

The two *VCAs* have their *Out* jacks mirrored on the back of the synthesizer and are to be used as master output jacks.

## 2.8 CV/Audio Mixer

The CV Audio mixer is a buffered, DC coupled mixer that can be used with either CV or Audio signals

## 2.9 CV/Audio Preamp / Inverter

This unit has a maximum gain of 10 times, it also inverts it's output meaning any CV will come out "upside down".

This unit has its *In* jack mirrored on the back of the synthesizer for

ease of interfacing, both *In* jacks can be used at the same time.

## 2.10 MIDI-To-CV converters

The two MIDI-To-CV converters are stand-alone when set to respond to different MIDI channels, they enter a duo phonic mode once they're set to the same channel. The Velocity output responds both to actual key velocity as well as the *channel pressure* MIDI message for continuous control.

The channel selector for *MIDI-To-CV channel 2* also selects the MIDI output channel for the Ribbon Controller. The Ribbon controller can be used in two modes; *quantized* or *normal*, selected in the Ribbon controller section.

In *quantized* mode the ribbon controller outputs *Note on* and *Note off* messages, automatically outputting a new *Note On / Note off* message if sliding from one note to another.

In non-quantized mode the ribbon controller only outputs a new *Note on* message when sliding over to a new octave, outputting *pitch bend* messages in between regular notes. To make an external MIDI device respond properly to this, the device needs to be set to a MIDI pitch bend range of 12 notes (1 octave). The *Note on* messages outputted are accompanied by a *velocity* value equivalent to the pressure measured by the ribbon controller.

The two CV outputs of the MIDI-To-CV can be automatically routed to the two VCOs.

## 2.11 Voltage Controlled Switch

The voltage controlled switch is used for selecting and outputting one out of two sources with a voltage.

E.g. the inputs of the switch are normalized to the *low* and *high* outputs of the ribbon controller and the *switch select* jack is normalized to *LFO2*. By turning the *speed* knob of *LFO2* so that it changes ~5-10 times per second and placing two fingers on the ribbon controller you make the output jump in between reflecting the position of your high and low finger. Now by connecting the switches *Switch Out* jack to the CV in jacks of one of the oscillators, you have a 2-note arpeggiator!

## 2.12 Quantizer

The Quantizer takes a continuous, analog, non-stepped voltage and

*quantizes* it to the nearest voltage that represents a whole note (e.g. 1.03 volts would represent a slightly detuned note and would be outputted as 1.0 volts).

### 2.13 Duo phonic ribbon controller

The ribbon controller in the Ekdahl Polygamist is duo phonic, meaning it can read and output two signals. When a finger is touching the ribbon controller surface, the position of the finger is outputted on the *Ribbon Low Position CV Out* jack and the pressure with which the finger is applied is outputted on the *Ribbon Pressure Out* jack.

If a second finger is put on the ribbon controller **above** the first finger, the position of this finger will be outputted on the *Ribbon High Position CV Out* jack.

If only one finger is depressed the *Ribbon Low Position CV Out* and *Ribbon High Position CV Out* jacks will have the same value. While one or more fingers are on the Ribbon Controller, if enough pressure is applied the *Ribbon Gate Out* jack will reflect this by going from 0V to +12V.

The ribbon controller spans one octave by default, this span can be greatly widened by turning up the *Low* and *High Position Scaling*-knobs - note that the low and high can be individually scaled to their own range. Both positions can also be individually *quantized*<sup>7</sup> as well as automatically sent to the two VCOs.

The duo phonic controller also employs *pedal hold*. By connecting compatible foot pedals to the *pedal hold* jacks on the back of the unit, the low and/or high ribbon controller positions can be held.

### 2.14 Master Gate and CV jacks

These two jacks are supposed to make it easier to interface the Ekdahl Polygamist with a CV-capable master keyboard, sequencer etc. The *Master Gate In* jack is connected to the *ADSR Gate In* jack and the *LF01 Gate In* jack. The *Master CV In* jack is connected to the two oscillators.

## 3. Calibration procedures

The calibration procedures for The Ekdahl Polygamist will be outlined per section below, each section will be explained using two different approaches:

---

<sup>7</sup> See section 2.11

The non-technical, or listening approach - this approach does not require any special knowledge or measurement equipment. It should be able to be performed by anyone at home with nothing but a screwdriver and a good set of ears. It could be useful to have a reference instrument or a tuner for the scaling procedures. The non-technical approach *might* result in a slightly less accurate performance of the synthesizer but is some times - in my opinion - more useful as this machine is in fact made to generate *sound*, not perfect numbers on a display.

The technical approach requires both a oscilloscope and a highly accurate digital multi-meter that can measure DC voltage and frequency in the standard audio range (20hZ - 22kHz).

Each calibration is done on the front of the synthesizer through the various holes marked *VCO 1 - V/Oct*, *VCO 2 - V/Oct* etc. Inside each hole is a trim potentiometer (resistor) and by inserting a thin and long flat-head screwdriver and turning the head of the potentiometer, calibration is achieved. Each potentiometer has 12 turns so it can take some screwing around to get it right.

### 3.1 Oscillator scale tuning

This section applies to both the Tilt Oscillator and the Pitch Multiplying oscillator, the objective is to make sure that the oscillators will adhere to the chromatic scale. Both the technical and listening approach will require that you have an accurate control-voltage source controlling the oscillator in question. For ease of explaining, we will assume the user has a MIDI or USB device hooked up to The Ekdahl Polygamist.

Some of you may not care about playing stuff according to the chromatic scale, or want to do experimental scales, which is nice.

When adjusting the scale, we do **not** care about any specific pitch, rather that the pitches are *spaced* correctly (one octave = 12 notes). If you try to also readjust to get - say - a perfect 'c' at this time, you're gonna get all kinds of headaches and it's probably not gonna work or be overwhelmingly boring.

#### Preparations - Tilt Oscillator:

Turn down all modulation knobs to zero and remove all patch cables. Set *Octave* to '3' and *Detune* to its middle position. Set the *Pulse width* and *Tilt*-knob to the mid settings and turn the *Sync* to off. On *VCA2*, turn the *Amplitude Modulation* and *In 1 Level* knobs to zero, the *In 2 Level* to maximum and set the *Initial amplitude* to its middle

position. If you are using the listening approach, plug in your amplifier to VCA2 Out. If you are using a digital multi-meter, set it to frequency measurement and hook it up directly to the *Tilt Oscillator's Square Out*.

Make sure MIDI-TO-CV converter 1 is set to respond to the same *MIDI Channel* that your device is sending on and flip the *Send CV 1* to switch to *Osc 1 / Master Gate*. NOTE: make sure that the *MIDI Channel* of the other MIDI-TO-CV Converter is **NOT** set to the same channel as the first as it may impede the calibration procedure. Continue by following the procedures below.

#### Preparations - Pitch Multiplying Oscillator:

Turn down all modulation knobs to zero and remove all patch cables. Set *Octave* to '3' and *Detune* to its middle position. Set all of the *Sub pitch #[x] Fundamental \* n* knobs to zero. On VCA2, turn the *Amplitude Modulation* and *In 2 Level* knobs to zero, the *In 1 Level* to maximum and set the *Initial amplitude* to its middle position. If you are using the listening approach, plug in your amplifier to VCA2 Out. If you are using a digital multi-meter, set it to frequency measurement and hook it up directly to the *Pitch Multiplying Oscillator's All Out*.

Make sure MIDI-TO-CV converter 2 is set to respond to the same *MIDI Channel* that your device is sending on and flip the *Send CV 2* to switch to *Osc 2*. NOTE: make sure that the *MIDI Channel* of the other MIDI-TO-CV Converter is **NOT** set to the same channel as the first as it may impede the calibration procedure.

The two holes affiliated with these calibration procedures are marked *VCO 1 - V/Oct* and *VCO 2 - V/Oct*.

#### Listening approach:

We begin with coarse tuning; play a note on your MIDI/USB device, listen, and play the note exactly one octave above or below the first. Readjust the trim potentiometer until you hear exactly one octaves difference. Now, do the same procedure but instead of playing two notes on octave apart, make them 4 octaves apart. Do not use notes that are extremely high or low as the oscillators might have deviancies at the extreme ends that will throw off your calibration.

Once you have gotten it to scale as accurately as you can using your ears, you could try and make it even more accurate by tuning the oscillator to a certain pitch using the *tune* knob at a certain key. Now either measure it with a tuner or reference it to the beat frequency of an already tuned instrument, play another note on (on both instruments if you are using a reference instrument) and see if

it's still in tune. If not, try and adjust the scaling slightly. Now, remember that this will affect BOTH the first and the second note you played so you will again have to re-tune the oscillator to the basic pitch, and do the whole thing again. This step shouldn't be necessary but *could* yield better results.

#### Multi-meter approach:

Begin with coarse tuning; play a note on your MIDI/USB device, note the frequency reading, and play the note exactly one octave the first. Adjust the trimmer so that the two frequency readings are exactly double/half of each other. Now do the same procedure but play two notes that are 4 octaves apart, for this range the frequency will actually be 16 times higher or lower than the other. Example; if the first note is 50hZ, the same note one octave up should be 100hZ, two octaves up 200hZ, three octaves 400hZ and four octaves 800hZ.

**TIP:** some multi-meters can only measure frequencies when the voltages involved are rather high, to boost the output of the oscillator you can run its output through the Preamp / Inverter.

### 3.2 Tilt Offset calibration

The purpose of this calibration procedure is to make sure that the *Tilt* waveform of the *Tilt Oscillator* is as close as possible to a true triangle waveform when the *Tilt* knob is set to its middle position.

The hole affiliated with this calibration procedure is marked *VCO 1 - Tilt Offset*.

#### Preparations:

Turn down all modulation knobs to zero and remove all patch cables. Set *Octave* to '3' and *Tune* to its middle position. Set the Pulse-width and *Tilt* to the mid settings and turn the *Sync* to off.

#### Listening approach:

On *VCA1*, turn the *Amplitude Modulation* and *In 1 Level* knobs to zero, the *In 2 Level* to maximum and set the Initial amplitude to its middle position. Plug in your amplifier to *VCA1 Out*.

Because of the analog nature of the oscillator, the middle position of the *Tilt* knob may not correspond exactly to the middle triangle position (meaning, where both the up and down slope of the waveform are 45 degrees). We need to start by finding this position which can be done by carefully twisting the knob back and fort until the sound is as mellow as possible (as little "buzz" as possible). Once you believe you have achieved this point, change the calibration setting

until you hear less and less "buzz". Once you have gotten as clean of a sound as you can, you may go back to twisting the *Tilt* knob back and forth and see if the most mellow position have changed, if it has, do the calibration again - if not, you're done.

Oscilloscope approach:

Hook up your probes to the *Tilt Oscillator's Tilt Out*.

Because of the analog nature of the oscillator, the middle position of the *Tilt* knob may not correspond exactly to the middle triangle position (meaning, where both the up and down slope of the waveform are 45 degrees). We need to start by finding this position which can be done by carefully turning the *Tilt* knob until the up and down slope are of equal length. Please note that the top notch of the triangle ends will most probably not meet perfectly, this is where the *Tilt offset* calibration point comes in - change the calibration setting until the top of the triangle points meets up.

### 3.3 Pitch Multiplying Oscillator Offset calibration

The purpose of this calibration is to minimize errors when scaling up the sub-pitches from the fundamental, any errors here will result in a "buzzing" sound.

The hole affiliated with this calibration procedure is marked *VCO 2 - Offset*.

Preparations:

Follow the preparations as given in section 3.1 for the *Pitch Multiplying Oscillator*.

Listening approach:

Start with all *Sub Pitch #[x] Fundamental \* n* knobs set to zero, turn up the *Sub Pitch #1 Fundamental \* n* knob so that it's about 4 octaves higher than the fundamental. Now plug in a patch cable from *Sub Pitch #1 Out* and put the other end in *VCA1 In 1* so that you are only listening this particular output.

Now change the calibration setting until the sound gets to its mellowest - the calibration might change how the *sub-pitch* tracks the fundamental so you might have to adjust the sub-pitches *Sub Pitch #1 Fundamental \* n* knob during this procedure.

The mellowest setting on the first sub-pitch *might* not correspond exactly to the mellowest setting of all of the other sub-pitches. Therefore it may be useful to do this same procedure with the other sub-pitches so that you can get a good average.

#### Oscilloscope approach:

Start with all *Sub Pitch #[x] Fundamental \* n* knobs set to zero, turn up the *Sub Pitch #1 Fundamental \* n* knob so that it's about 4 octaves higher than the fundamental. Now plug in a patch cable from *Sub Pitch #1 Out* and connect your probe to the other end so that you are only seeing the first sub-pitches waveform.

You will probably notice a "tail" on the waveform, now change the calibration setting until the tail has become as small as possible - the calibration might change how the sub-pitch tracks the fundamental so you might have to adjust the sub-pitch's scale knob during this procedure.

The best setting on the first sub-pitch *might* not correspond exactly to the best setting of all of the other sub-pitches. Therefore it may be useful to do this same procedure with the other sub-pitches so that you can get a good average.

### 3.4 Pitch Multiplying Oscillator Sine shape calibrations

The objective of this calibration procedure is to make the fundamental and sub pitch outputs of the *Pitch Multiplying Oscillator* resemble sine-waves as closely as possible.

#### Preparations:

Again follow the preparations procedure in section 3.1

#### Listening approach:

While listening to the oscillator output, start by adjusting *VCO 2 Fundamental Sine Shape* until you hear a minimum of "buzz". Continue by turning up all three sub pitches to about two octaves of the fundamental frequency. Now plug in a cable from *Sub Pitch #1 Out* to *VCA 2 In 1*, adjust the *VCO 2 SP #1 Sine shape* calibration until you hear a minimum of "buzz". Do this same procedure for sub pitch #2 and #3.

#### Oscilloscope approach:

Look at the waveform presented and adjust the *VCO 2 Fundamental Sine shape* calibration until you get a waveform that resembles a good sine-wave as much as possible. Continue with plugging your probe to *Sub Pitch #1 Out* and adjusting the *VCO 2 SP #1 Sine shape* calibration to it's optimal setting. Do the same procedure for sub pitch #2 and #3.

### 3.5 VCF V/Oct

The objective of this calibration is to make the *Low Pass Filter* resonant peak frequency be able to be controlled at exactly one octave per volt. The purpose of this is so that the resonant peak of the filter can be used as a sine-wave oscillator in its own right.

#### Preparations - Tilt Oscillator:

Turn down all modulation knobs to zero and remove all patch cables. Turn *Feedback Pole* to '2', Set *Octave* to '3' and *Detune* to its middle position. Set the *Pulse width* and *Tilt* to the mid settings and turn the *Sync* to off. On VCA2, turn the *Amplitude Modulation* and *In 1 Level* knobs to zero, the *In 2 Level* to maximum and set the *Initial amplitude* to its middle position. If you are using the listening approach, plug in your amplifier to VCA2 *Out*. If you are using a digital multi-meter, set it to frequency measurement and hook it up directly to the *Tilt Oscillator's Tilt Out*.

### 3.6 Ribbon calibration

The ribbon has two calibration settings, *Ribbon Null* and *Ribbon high scale*. The *Null*-calibration makes sure that the high and the low ribbon position gives an equal voltage when set to the same scale. The *Scale*-calibration sets the minimum ribbon scaling to one octave.

#### Preparations:

Turn all *Quantize [..]*-switches and *Send ribbon [..]*-switches off and set the ribbon *scaling*-knobs to minimum.

If you are using the listening approach (recommended), connect a cable from VCA1 *Out* to your listening device and turn up VCA1 *Initial amplitude* until you hear a steady signal. Turn LFO2 to about 10Hz (blinks ~10 times a second) and turn off all modulation and the sync of VCO1. Now connect a cable from the *Voltage Controlled Switch's Switch Out* to VCO1 *Pitch CV*. If you have done this correctly, VCO1 should change pitch as you play the ribbon, if you put down two fingers on the ribbon, the VCO should alternate in between the two pitches. Please note that the synthesizer might alternate in between two different notes even if only one finger is depressed - this means you really need to calibrate :)

#### Listening approach:

Depress the position-ribbon at the leftmost position with one finger (or even your finger nail as you want to depress as small of an area as possible in order to avoid errors) and use a screwdriver to change the *Null*-calibration until you only hear one note being played. It is much easier to hear any fluctuating errors if you set VCO1 to a very high pitch.

Now set *VCO1* to a moderate pitch, turn on both *Quantize [..]*-switches associated with the ribbon. The green keyboard layout on the front panel indicates how the ribbon should respond once set to one octaves range. Play the lowest note then play the highest note - they should be one octave apart, if not you need to change the *Scale high position*-calibration.

#### Multi-meter approach:

Connect a cable to the *Ribbon High Position CV Out* and connect the other end to your multi-meter. Depress the leftmost position on the position-ribbon and change the *Offset Null*-calibration until you read 0V.

Now turn on both *Quantize [..]*-switches associated with the ribbon. The green keyboard layout on the front panel indicates how the ribbon should respond once set to one octaves range. Play the highest note and change *Scale high position*-calibration until you read 1.0V.

## 4. Firmware update procedure

To update the firmware in the Ekdahl Polygamist, you need to boot it in a special mode.

To do this you need to turn the synth off, unplug the power cord and unscrew the front panel. At the bottom right corner of the main circuit board there are two pins that need to be shorted using a header, this header should when unused be resting on one of those pins. Move the header so that it sits over both pins. Replace the front panel without screwing it down, plug in the power cord and a USB cable to your computer and start the synth.

Start the bootloader update software, this should automatically detect that the synthesizer is in update mode and tell you that it's ready to update. Load the firmware file using the "import firmware"-command, then press the "Erase/Program/Verify" button. The software will tell you whether it worked or if there was any problems.

Once the synthesizer is updated, unplug all cables, lift the front panel and place the header back in the original position over one of the two pins on the main board. Screw back the front panel and you're done.

## 5. Specifications

All the values given in this specification sheet are **approximate** and could vary substantially due to the analog nature of the Ekdahl Polygamists circuitry.

Name	Voltage	Range
General CV input maximum values	+/- 12V	
<b>VCO1</b>		0.1Hz - 20kHz
- Octave switch		6 octaves
- Detune		+/- 1 octave
- Tilt out	+/- 5V	
- Pulse out	+/- 5V	
<b>VCO2</b>		5Hz - 20kHz
- Octave switch		6 octaves
- Detune		+/- 1 octave
- Sub pitch X fundamental * n		Fundamental * 20
- Sub pitch X out	+/- 5V - 0V	
- Fundamental + Subs Out (All)	+/- 5V	
<b>ADSR</b>		
Attack / Decay / Release		1mS - infinity
Gate In	+2.5V - +12V	
Out	0V - +10V	
<b>LFO1</b>		
Speed		5 minutes - 600 Hertz
Delay		0 - 30 seconds
Gate In	+2.5V - +12V	
Triangle Out	+/- 5V	
Square out	+/- 5V	
<b>LFO2</b>		
Speed		1.5 hours - 300 Hertz
Triangle out	+/- 5V	
Square out	+/- 5V	
<b>LFO3</b>		
Speed		12 minutes - 1200 Hertz
<b>Noise</b>		
Noise Out	+/- 5V	
<b>Sample-And-Hold</b>		
Source	+/- 10V	
Sample trig.	+2.5V - +12V	
S&H Out	+/- 10V	

<b>Low pass filter</b>		
Cutoff		1Hz - 20kHz
Resonance		0 - overdrive
External In	+/- 5V	
Out	+/- 5V	
<b>VCA1</b>		DC - 1MHz
Amplitude mod.	+/- 10V	DC - 1kHz
In1 / In2	+/- 10V	
Out	+/- 10V	
<b>VCA2</b>		DC - 1MHz
Amplitude mod.	+/- 10V	DC - 20kHz
In1 / In2	+/- 10V	
Out	+/- 10V	
<b>Multiples</b>	+/- 12V	
<b>Mixer</b>		
In1 / In2 / Out	+/- 10V	
<b>Preamp</b>		
Gain		10
In / Out	+/- 10V	
<b>MIDI-TO-CV Converters</b>		
CV X Out	+/- 5V	10 Octaves
Gate X Out	0 - 10V	
Velocity X Out	0 - +5V	
<b>Voltage controlled switch</b>		
In / Out	+/- 10V	
Switch select <i>LOW</i>	0 - +2.75V	
Switch select <i>HIGH</i>	+3.25V - +12V	
<b>Quantizer</b>		
In / Out	+/- 10V	
<b>Ribbon controller</b>		
Position scaling		6 Octaves
Ribbon CV Out	0 - +6V	
Ribbon Gate Out	0 - +12V	
Ribbon pressure out	0 - +10V	

<b>Master Gate In</b>	0 - 10V	
<b>Master CV In</b>	+/- 10V	