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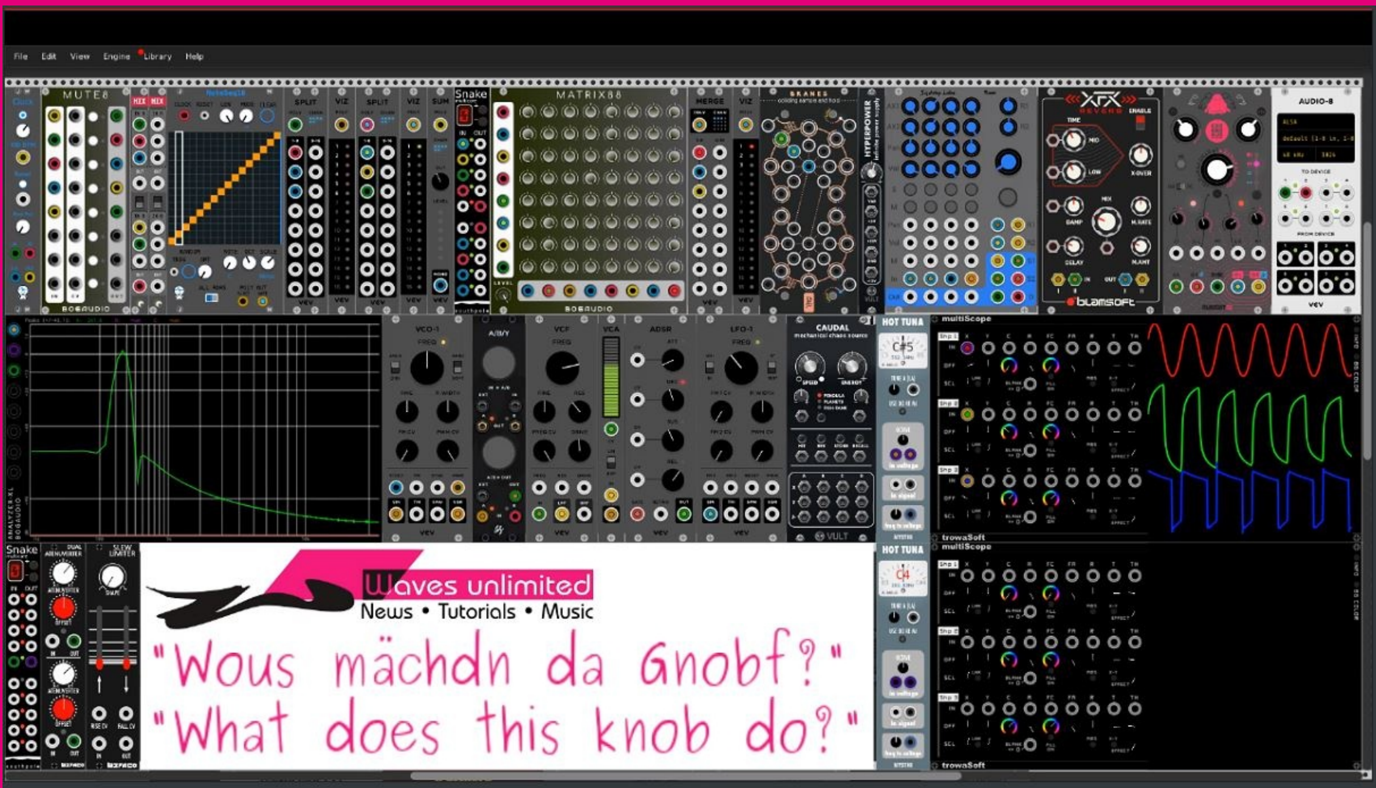
"Wous mächdn da Gnobf?"
"What does this knob do?"

Season 2: The next Generation

Rack V1.x

Episode 1: Setup, Oszillatoren/Oscillators 1



Eine nähere Betrachtung von VCV-Rack Modulen

A closer look at VCV-Rack Modules

Hello world and welcome to "The next Generation" of "What does this knob do?"

Why "next generation", will probably ask some. Quite simply because there was an "original series" of VCV-Rack 0.6.x with 13 episodes and because with the release of Rack version 1 has changed so much that it does not make sense to me - as originally planned - to publish updates but to start again with a completely new version. Of course I do not intend to reinvent the wheel, I will not re-discuss modules that I have already presented and that have not been changed in V1 and only refer to the episode. Incidentally, I have also summarized the previously published episodes as PDF, so that you can read them unhurriedly. You can download this e-book with links to the corresponding sections in the videos via my GitHub page.

In the new edition, which I will again produce in German (Franconian) and English, an accompanying PDF will be published for each video (actually you are reading it now), so that you can create your own reference work. In it you will not only find links to the modules, but also to the segments in the video. And I discuss similar modules from different manufacturers together, e.g. Versions of the Even VCO, Supersaw etc.

What is this about? The title "What does this knob do" reflects my thoughts when I'm sitting in front of a new module. Module? Ok, from the beginning.

In the broadest sense, this is about music, especially synthesizers. Whoever gets off here, I recommend googling for the term and to deal with the basics. For everyone else, it's all about the VCV-Rack virtual modular synthesizer system. I do not want to go into all the details of this powerful creative tool, just a few key facts.

• VCV Rack is free and open source.
• There are well over 1000 modules and most are free.
• VCV Rack runs on Windows, Mac and Linux.
• VCV Rack supports polyphony.
• VCV Rack can send and receive both audio and MIDI data.
• And there is an incredibly great community that constantly communicates through Facebook or forum.

I can not say how grateful I am to Andrew Belt and the many module developers who make it all possible. THANK YOU THANK YOU THANK YOU!!!

Of course, the variety of modules also brings a few questions. Basically, of course, anyone who deals with the matter knows what a VCO is. On closer examination of the various oscillators, however, almost all have some peculiarities that are not immediately apparent. And since the most exciting thing about module systems is the misappropriation of modules, it's extremely important to know what the individual components of a module do, to use them for things they were not really designed for.
I have often sat in front of it and asked myself, "What does this knob do?". That's why I've started to create a VCV rack work environment that allows me to compare and explore modules. I will describe my subjective impressions as simply as possible. I also work wherever I can, with measurement methods and graphical representation, as this makes many things easier to understand.

Again, in the first episode, I introduce my work environment or the modules I use. Whenever possible I always try to keep this constellation, including the wiring. Over time, you will see all available modules, as I present them in groups according to their function, starting with oscillators or VCOs. For many modules there are also other great tutorials by experienced users who also show tips and tricks and also provide patches. Of course, I can not list all of them here, but I have to mention a few, since otherwise I would have been hopelessly lost in the early days:

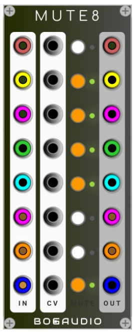
Nigel Sixsmith (The Art of Sound - Talking Rackheads), Omri Cohen, Andrew Mercer (Buckydurddle), Leonardo Laguna Ruiz (Vult Modules), Greg Brouelette (Modular Curiosity), Hagen Ueberfuhr (theklirrfactor), Artem Leonov (VCV-Rack Ideas) ...

You can find links to important websites under the video, also to modules that you can not download via the Plugin Manager. Basic information on installing and using VCV-Rack can be found on the official website. Do you have questions, wishes, suggestions? I am glad about every comment.

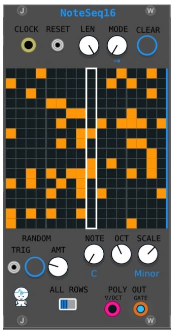
My setup

I've installed VCV-Rack on Windows 10 and on the same machine in a Linux Ubuntu Studio partition. I will work here mainly under Linux, but in principle the platform for the function of the modules should play no role.

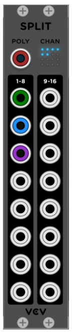
Starting from the top left, we first have the **Simple Clock** from **JW-Modules**. Not only does it provide an extremely large range (15-3840 bpm), it also offers different divisions of the original beat count (through 4, 8, 16, 32), making me flexible enough for a variety of tasks. Currently my speed is 480 bpm.



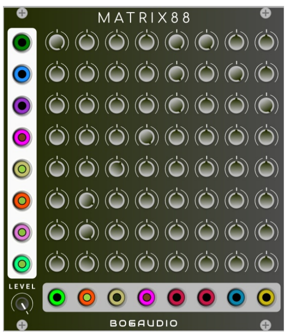
However, the various clock signals go first in **Mute8** from **Bogaudio** and then in **QuantalAudio's Unity Mix**, so I can mute or mix the unneeded clock pulses. Since Mute8 has CV inputs, I can also activate the mute with it.



The "melody" I generate with the **JW-Modules NoteSeq16**, which is up to 16-voice polyphonic, has a very easy-to-use random function and a built-in quantizer. Currently I use the polyphony with 3 channels and the scale C minor. The polyphonic V/Oct signal I send to **Split** of **VCV** to split it into its 3 channels and **Sum**, also from **VCV** to generate from the 3 channels a mono signal.

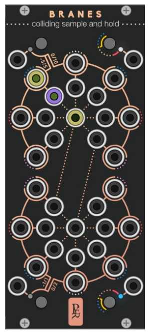


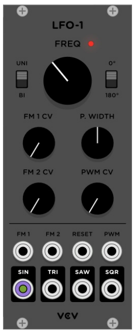
I also split the polyphonic gate signal into its 3 channels by means of a Split module.



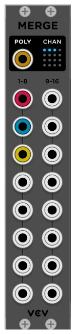
Each channel of the two Split modules goes into one input of the **Bogaudio Matrix88** module and can be mixed there with the potentiometers with other input signals and assigned to outputs. In addition, each channel from Split goes to an input of **Snake** from **Southpole**, which is a wireless multicore.

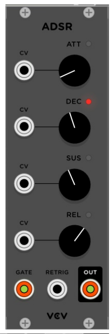
All Snake modules with the same number are connected together, so that the input signals can be tapped everywhere. I hereby send signals to the test module or from the test module to the matrix or the modulation path.



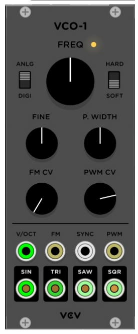


Another input from Matrix88 is occupied by **Branes** from **Geodesics**, which I use as Sample & Hold to add an **LFO** signal in sync with the clock.

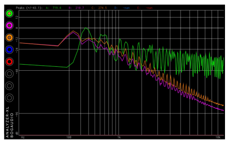




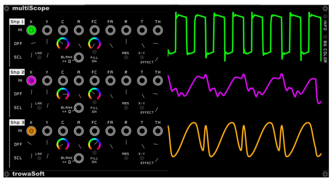
An output of Matrix88 is for a gate signal to the **ADSR** envelope generator of **VCV**. And I combine 3 more outputs in a **Merge** module of VCV and can generate a polyphonic signal from these.

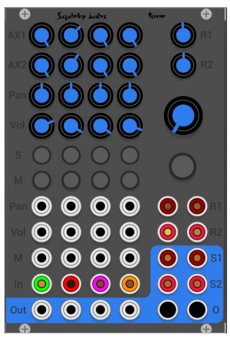


Another output from Matrix88 goes to my reference oscillator **VCO-1** from **VCV**. All oscillators are compared with this, because I define this as the default. Because of the better distinction I call this signal path 1 and the test module as signal path 2. Both signal paths receive the same signal from the sequencer. Signal path 2 via another output from Matrix88 through Snake.



Both signal paths are picked up directly at the module and graphically compared. The frequency response is displayed using the **Bogaudio XL Analyzer,** the frequency in numbers using **Nysthi's Hot Tuna**, and the waveforms using the **trowaSoft multiScope**.

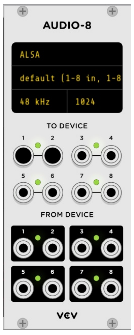




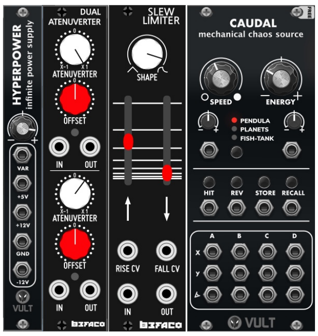
In addition, the output signal of both signal paths is passed once unchanged to the **Squinky Labs** Mixer **Form** and once to the **A/B/Y** switch of **AS Modules**, so that each can also be routed through the Filter

VCF of VCV.

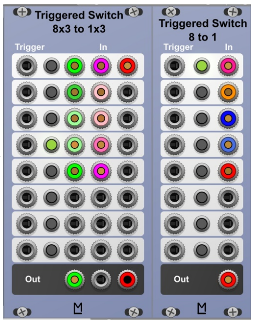
The **LPF** (Low Pass Filter) output of the **VCF** is connected to the input of the **VCA-1** of **VCV**, which in turn is modulated by the ADSR, creating a slightly percussive sound. The output of the VCA goes into another channel of the mixer.



The mixer is connected to the VCV **Audio-8** module and thus to my system speakers. The two aux ways of the mixer I use for the reverb module **XFX Reverb** of **Blamsoft** and the delay module **Chronoblob2** of **Alright Devices**.



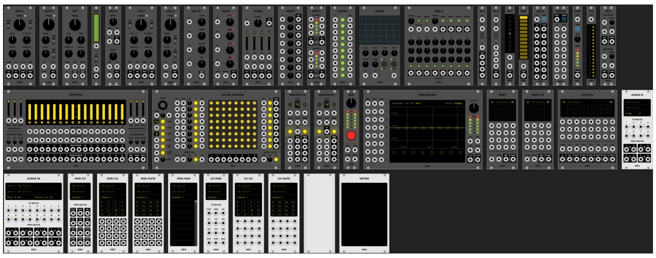
Other modules include **Vult's Hyperpower**, which provides flexible voltages, the **Dual Atenuverter** from **Befaco**, which I use to amplify, attenuate and use for offsetting signals, **Befaco's Slew Limiter** for sliding soft transitions, **Vult's Caudal** for randomly generated voltages and different variants of the **Triggered Switch** from **ML Modules** for switching.



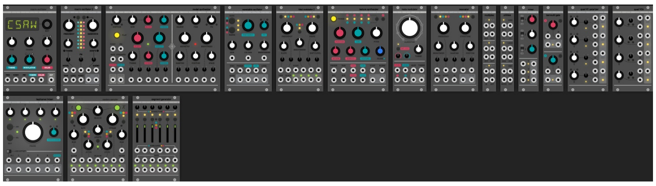
This listing is not exhaustive, because with some oscillators I will certainly use other modules.

Modules from VCV and their versions

Numerous developers determine the variety in VCV-Rack, but some modules are also provided by VCV itself. Earlier, when they talked about **Fundamental** and **Core** modules, they are now jointly managed under **VCV**. Here you will find all the modules that are automatically installed during the installation of Rack, but also all purchased VCV **Premium Modules.** If you also want to support VCV financially, you should de-



finitely look at it and get it. Also the modules of **Audible Instruments,** which are VCV versions

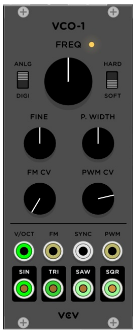


of Euro-Rack Modules of the company **Mutable Instruments** and the **Befaco** modules, which

also correspond to hardware modules, as well as the module **E-Series Cloud Generator** and the previously not yet available for V1 **Grayscale** modules are offered by VCV itself. Because VCV-Rack is open source, some modules come with versions from different developers. In this first episode, I introduce all these modules.

Fundamental & Functional

As already mentioned, I use the **VCO-1** from **VCV** as a reference module, because for me it represents a standard against which other modules have to compete and, of course, because the **Fundamental** modules are part of the basic configuration of VCV-Rack.



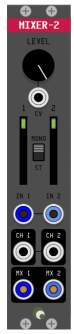
I will always refer to this standard in my consideration, so I define this here first of all on the basis of the VCO-1. It has a pitch of +/- 4 octaves, and can be tuned steplessly with the **Freq** control. For **fine tuning** of +/- 3 semitone steps, an extra knob is available. The four s**tandard waveforms sine**, **triangle**, **sawtooth** and **square** can be used simultaneously and each have their own output jack. To compare the same waveform with different modules, I connected all outputs to the **Triggered Switch 8x3 to 1x3** from **ML Modules**. This allows me to change the waveform of up to 3 modules at the same time with one click. The square wave can be changed in the **pulse width** by a rotary knob and this can also be controlled by CV, the same applies to the **frequency modulation**. There is an input for **external synchronization** and you can choose between hard and soft sync, as well as between analog and digital waveform.

The **Functional VCO** by **Squinky Labs** is a 1: 1 implementation of the VCO-1 and was created as a CPU more economical version. Meanwhile, however, the VCO-1 is also very economical, so that there is hardly any difference in this regard. But it is different in the **frequency response**. Here, the VCO1 shows a lot more overtones, even with the sine wave. In **analog mode**, the differences are marginal, but the **digital mode** shows huge differences. The purple curve is the functional VCO and shows a clean frequency response exclusively from the base frequency, as it should be with a sine wave. The green curve is as always the VCO1 and here you can clearly see overtones that should not be there. Thus, the frequency response is almost like a triangular wave, as you can see very well here in the analyzer. Squinky Labs has gone to great lengths to reduce **aliasing**, and the result is clearly visible across all waveforms. You can hear the aliasing especially in high pitches.

The **VCO-2** - here the red curve - differs in details from the VCO-1, but shows the same frequency response. It has no 4 individual outputs for the waveforms, but only one output and the **waveform** can be adjusted **steplessly** via the knob Wave or CV or. Be controlled. Nevertheless, all standard waveforms are possible, but also **mixed forms**. The modules also support 16-voice **polyphony**.

As I said before, the VCO-1 will be with us all the time, both in the frequency analysis and in the oscilloscope it can always be recognized by the green curve.

EvenVCO & Co.

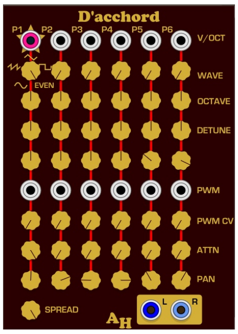


From the beginning, the **EvenVCO** from **Befaco** was one of the most popular oscillators in the VCV-Rack. To compare this and its variants, I have changed my setup something or extended. With the **8to1 Triggered Switch** from **ML Modules**, I select between the 3 oscillators to be compared and with a second Triggered Switch I select the waveforms of the EvenVCO. **D'acchord** by Amalgamated Harmonics has a low output volume, so I use the **Mixer 2** from **QuantalAudio** to pick it up so that it is congruent with the other two modules, as you can see in the analyzer. **Green** is my **reference oscillator**, **purple** the **EvenVCO**, **orange** the **EV3** of **Squinky Labs** and **blue D'acchord**, where both channels can be seen. The oscilloscope shows that a sinewave was selected for all oscillators. In the analyzer, we all see the clean frequency response of a sine wave, and in comparison, the overtone-rich version of the VCO-1.

At first glance, the **EvenVCO** looks pretty unspectacular. Its **range** goes from 32 'to 1/16', which corresponds to C0 to C9 and this is set via the large **Octave** knob. The categorization in foot are a tribute to classical church organs, so the tone C in octave 0 would be generated with a 32 'long whistle. The preset pitch 1 'thus corresponds to a C5 with 523.25 Hz. About the **Tune** control, depending on the octave still a fine tuning in the range of +/- 7 semitone steps possible. There are 2 **V/Oct inputs**, resulting in e.g. Transpositions are very simple. **FM** and **Hardsync** can be controlled by CV, but there is also no internal setting option. So far, the EvenVCO is more spartan. Also, the pulse width of the **square wave** can be controlled by CV and there is also the **PWM** controller. Other waveforms are **triangle**, **sawtooth**, **sine**, and **even**. The latter waveform is the peculiarity and the namesake of the oscillator, a waveform in which the even overtones are emphasized. This sounds rounder than a pulse wave, but sharper than a triangle wave. What makes the EvenVCO a classic is simply its sound. It sounds warm and analog, in the oscilloscope we also see that the waveforms are not perfect, just like an analog oscillator should be. Thanks to Martin

Lueders of ML Modules, the EvenVCO is now **polyphonic**.

Variants of the **EvenVCO** are **D'acchord** from **Amalgamated Harmonics** and the EV3 from Squinky Labs. In principle, D'acchord is **6 EvenVCOs** with stereo output. It has **6 input jacks** for each 1 V/Oct signal, with the first jack **polyphonic** and distributes the signal to all channels. The **Wave** parameter selects the desired waveform between sine, sawtooth, triangle, rectangle, and even. The **Octave** control determines the octave in the range +/- 3. **Detune** unfortunately only has a circumference of +/- 1 semitone, which means that no internal chords are possible. **PW** is, as usual, the pulse width of the square wave, which can also be controlled by **PWM** via CV. The amount of this modulation is set with **PWM CV**. Each "voice" has its own volume control, **ATTN**, and via **PAN**, these can be distributed via the stereo field. **Spread** affects the distribution of all "voices" relative to the center of the stereo field.



As the name implies, **Squinky Lab's EV3** offers **three EvenVCOs** in one module. These can act as separate units or as overall sound, and **chords** are also possible here, because next to the **Octave** slider, which goes from 0-9, there is a slider for **semitones**, which even indicates the **interval** to the root note for VCOs 2 and 3. I'm excited! **Fine** is the usual +/- 1 semitone slider for beats and **Mod** determines the amount of FM modulation and is therefore connected to the FM input. **PW** is connected for manually setting the pulse width of the square wave and **PWM** for the control via CV and therefore also with the corresponding input socket. The waveform is selected by **clicking** on the corresponding icon. There are 5 waveforms known from the Even VCO plus the ability to **mute** any oscillator. Oscillator 2 and 3 can be synchronized with Oscillator 1. Just set the slider to **sync**. Each oscillator has its own input. If underlying inputs are not assigned, they will receive the same signal as the input above. This allows an input signal to be output in **multiple voices** and each voice mixed separately. In addition to the three individual outputs, there is also a **total output**. The ratio of the three oscillators is set by means of the three small black knobs. These must therefore be turned on before you get a signal at the sum output.

Let us now come to the sound comparison. Since this is always subjective, I use once again to visualize the analyzer Bogaudio in the XL version. Here we see that there are **hardly any differences in sound** between the modules, except for the triangular wave. Oddly, D'acchord's frequency image looks more like a sawtooth wave, and the view of the scope confirms this. We hear and see a sawtooth that is 1 octave higher than the other waveforms. I therefore assume that this is a bug.

Which is the better oscillator? I will not answer this question because they sound the same if only one oscillator is used.

The **EvenVCO** by **Befaco** is the **uncomplicated classic** that can process 2 input signals simultaneously, which can be used simultaneously with 5 different waveforms.

D'acchord is **not quite mature**, capable of processing 6 input signals simultaneously, which are output as a stereo signal. Each of them can have different characteristics, as well as being out of tune with each other and distributed in the stereo spectrum. As a result, wide and fat floating sounds are possible.

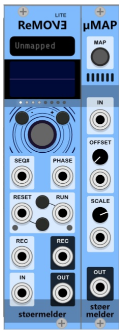
The **EV3** is the efficient **universal module**, and not just for CPU consumption. It can process 3 input signals simultaneously and output them either separately or as a total. In addition, it offers a variety of modulation options and can generate chords and this with only one input signal.

No matter which version you choose, the Even VCO and its descendants are a must have!

Frames & Waves

I did not expect the **Keyframer/Mixer** from **Audible Instruments**, which corresponds to **Multiple Instruments Frames**, to be in the oscillators. In **episode 13**, I considered his assignment as a **VCA** and had to look at his abilities as an LFO in a later episode. At the time he was not yet listed as a VCO, now it is him and that has, of course, made me curious. And I only look at this today, for the VCA properties I refer to the episode and LFOs come later.

In general, you can of course use any LFO as a VCO by increasing the frequency accordingly. In the **context menu**, we can select the operation as **LFO** and it is immediately noticeable that the large **Frame Slider** is colored, as if you have already saved frames. This is because a control voltage is already applied here, because this controller defines the basic speed or frequency of the LFO. If I move this from left to right, the color and the speed change, so the frequency of the waveform increases. The **Frame input** with the attenuator **Modulation** also affects the frequency, so here also a V/Oct signal for pitch change can be introduced. With the slider **+ 10V offset**, the **All** Input gets a signal of 10 volts, alternatively, of course, at the inputs also an external voltage can be introduced and a combination is also possible. The voltage introduced here affects the signals of the **4 channels** and is not a CV for the 4 channel controllers.
These now each have different functions. The controller for **channel 1** controls the **waveform**, it reads interpolated from a wavetable. The **channel 2** knob controls the difference in **wavetable position** between each channel. In the middle position, all channels have the same waveform. When rotated, each channel receives a different wavetable waveform. The controller for **channel 3** controls the **phase or frequency offset** between the individual channels. In the middle position, all channels are phase and frequency synchronous. Turned clockwise to get a phase shift between the channels, counterclockwise a frequency shift.
Finally, the controller for **channel 4** controls a kind of **phase modulation** or transition between the channels. In the middle position all channels are independent. Turned clockwise, each channel is increasingly modulated by the next channel, turned counterclockwise, each channel is increasingly modulated by the previous channel.
Each channel has its own output, so basically we have **4 different oscillators** available. However, there is also the **Mix** output, where the signal of all free outputs is applied. If the individual outputs are not assigned, then there is a total signal of all channels. In this mode you can not save frames, therefore the output **FR STEP** has no function.

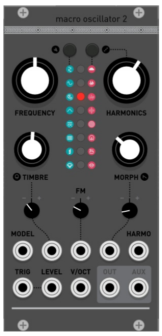


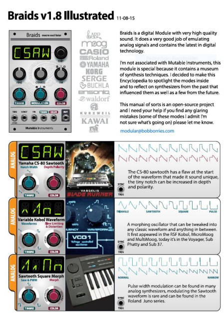
As an oscillator, **Frames** is definitely very **experimental**, but also interesting. Thanks to **Remove** and **MicroMap** from **stoermelder**, some wishes that I would have had come true, because of course I missed the possibility to control the channel controllers via CV. These possibilities enhance this unusual oscillator enormously.

Braids & Plaits

The **Audible Instruments Macro Oscillator** and its **Southpole** counterpart **CornrowsX**, both versions of **Braids** from **Mutable Instruments**, were introduced in **Episode 5**, so I refer to that. In the meantime **Mutable Instruments** has released **Plaits** and **Audible Instruments** the **Macro Oscillator 2**.

Of course, Plaits or the Macro Oscillator 2 does not have the diverse resources of Braids, I mean the **Braids Illustrated Cheat Sheet** and the meanwhile **33 videos by Omri Cohen.** For **Plaits,** there is only one video of **VCV Rack Ideas** called "**Mutable Instruments Plaits in VCV Rack - 15 Tips & Tricks**", which I highly recommend. Of course that also means





that I can not refer to other material and therefore I need to go into more detail here.

Braids has **45 synthesis models** whose names are shown on the display. **Plaits** completely eliminates the display and provides only **16 synthesis models**. What at first looks like a slim, turns out to be an **extension of the possibilities** when looking closely. Because effectively **Braids** has only 6 different synthesis models, since each one has **several variants.** While Braids has basically provided changeable presets, **Plaits** actually has **several synthesis models** on board and these can be modulated with 4 parameters each. The synthesis models are selected by a **click** in one of the black circles above the row with green and red circles, which also have a **symbol of the synthesis form**, but are too small for my taste. Fortunately, VCV Rack has the **Zoom** function, or you can go directly to the **Context menu**, which is invoked as usual by **right-clicking** and select the model from the list. Here we also see that this module has a **Low CPU Function** and a **Low Pass Gate**, whose processing is activated here. The four parameter knobs are **Frequency**, **Harmonics**, **Timbre** and **Morph**. Except for Frequency, which adjusts the pitch in the range of 8 octaves, the function of the knobs **depends on the chosen synthesis model**, so here too I hope for a quick overview a la Braids Illustrated. At the moment you have to make do with the official **Quickstart** by **Mutable Instruments**. Below I give a brief **overview** of the synthesis models and the function of the controllers.

In general, **Timbre** is used to set the timbre between dark / diffuse and light / dense. **Morph** varies the sound and **Harmonics** controls the frequency distribution or balance between the different parts of the sound. Important for the understanding is at this point also that the module has **2 outputs** and the output **AUX** is another variant of the sound and this too depends on the model.

In the "**Pair of Classic Waveforms**" model, a virtual-analog synthesis of classical waveforms, HARMONICS regulates the detuning between the two waves, TIMBRE a variable square wave - from short impulse to full waveform to hardsync formants. MORPH creates a variable saw tooth, from the triangle to the braid CSAW (the Yamaha CS80 sawtooth). The output AUX outputs a sum signal consisting of two hardsync'ed waveforms whose shape is controlled by MORPH and detuned by HARMONICS.

The **Waveshaping Oscillator** generates an asymmetric triangle, which is processed by a waveshaper and a wavefolder. HARMONICS defines the waveform of the waveshaper. TIMBRE determines the intensity of the wavefolder, MORPH its asymmetry. At AUX, a variant with a different wavefolder curve can be tapped.

Two Operator FM means two sine wave oscillators mutually modulate each others phase. HARMONICS detunes the frequencies, here also inharmonic intervals are possible. TIMBRE defines the modulation index, in principle the timbre or the amount of overtones. MORPH generates feedback, either to the right of the center, as operator 2 modulates its own phase or to the left of the center by modulating the phase of operator 1. AUX is a sub-oscillator.

The **Granular Formant Oscillator** is a simulation of formants and filtered waveforms by multiplication, addition and synchronization of segments of sine waves. HARMONICS determines the frequency ratio between formant 1 and 2, TIMBRE their frequency and morph their width and shape. AUX has a filtered waveform - a replica of the Z*** models of Braids. In this case HARMONICS controls the filter type (Peak, LP, BP, HP).

The **Harmonic Oscillator** is an additive mixture of harmoniously connected sine waves. HARMONICS specifies the number of fluctuations within the amplitudes of the spectrum, TIMBRE which overtones should be emphasized and MORPH the form of the fluctuation between the amplitudes - from flat and wide to pointed and narrow. AUX offers a variant that contains only the overtones of the drawbars of a Hammond organ.

The **Wavetable Oscillator** contains four banks of 8x8 waveforms accessed via row and column, with or without interpolation. With HARMONICS you take the bank selection. Turned to the left the 4 interpolated banks, turned right the same 4 banks, in reverse order, without interpolation. TIMBRE is the row index. Within a row, the waves are sorted by spectral brightness. MORPH is the column index and the AUX output is a low-fi signal.

Chords plays four-tone chords with either a VA or wavetable oscillator. HARMONICS defines the chord type, TIMBRE is responsible for chord progression and transposition, MORPH defines the waveform. On the left side of the middle, you can choose raw waveforms that are known from string machines. To the right of the middle a small wavetable is scanned. AUX is the root of the chord.

Vowel and Speech Synthesis is a collection of speech synthesis algorithms. HARMONICS fades between formant filtering, SAM and LPC vowels, and then goes through several banks of LPC words. With TIMBRE the species is selected, from Daleks to Chipmunks. MORPH is used for phoneme or word part selection. A word is triggered with a pulse in the trigger input, the intonation is controlled with the FM attenuator and the speech speed with the MORPH attenuator. In this case, the attenuators operate without a dedicated input signal. Once a voltage is applied, these Attenuverter work again as usual. AUX is the signal of unfiltered vocal cords.

The following "red" models are primarily for **noises and percussive sounds**.

The **Granular Cloud** is a swarm of 8 sawtooth waves with an envelope. HARMONICS defines the intensity of a random pitch change. TIMBRE sets the density of the grain signal, MORPH its duration and overlap. On AUX, a variant with sine wave oscillators can be tapped.

Filtered Noise produces white noise with variable clock frequency, which is processed by a resonant filter. HARMONICS determines the type of filter, from left LP to middle BP to right HP. TIMBRE is the clock frequency and MORPH the filter resonance. AUX has a variant with two bandpass filters whose separation is controlled by HARMONICS.

Particle Noise sends noise particles through networks of allpass or bandpass filters. HARMONICS specifies the intensity of a random frequency change, TIMBRE the particle density and MORPH the filter type. In the left area allpass filter with reverb, right bandpass filter with resonance. AUX provides a raw noise signal.

We know the terms **Inharmonic String Modeling** and **Modal Resonator Bank** from **Rings**, in VCV-Rack **Resonator** from **Audible Instruments** and **Annuli** from **Southpole**. So it's about stirring a vibration. This usually requires a trigger signal, but in plaits this can also be done internally with noise particles. The functions of the controllers are the same for both models. HARMONICS determines the degree of harmony or material. TIMBRE defines the timbre of excitation by the trigger and the density of the noise particles. MORPH affects decay time and energy absorption. AUX is the raw excitation signal, either the trigger or the noise particles.

With the **Analog Bass Drum Model** HARMONICS corresponds to the attack time, TIMBRE of the timbre, MORPH of the decay time and with AUX another classic bass drum sound can be tapped.

In the **Analog Snare Drum Model**, harmonics control the balance between the harmonic and noise components, while TIMBRE determines the balance between different drum modes, such as bass. Flat or Rimshot. MORPH is also the decay time here and at AUX another alternative version can be tapped.

In the **Analog Hi-Hat Model** HARMONICS determines the balance between the metallic sound and the filtered noise. TIMBRE is the cutoff of the internal high-pass filter, MORPH is again the decay time and AUX is a variant of the sound based on ring-modulated square waves.

For the last 5 models, the internal lowpass gate is disabled, as each has its own decay envelope and filter. In general, however, this is active on all models when a signal is present at the Trigger Input and can be changed by activating the "**Edit LPG response / decay**" option in the context menu. Then it is possible with the slider Timbre to set the ratio between pure VCA and VCFA, ie VCA + Filter. On the far left, the VCFA has 100%, to the far right of the VCA. The Morph slider adjusts the LPG's lag time and the Decay time of the internal envelope. The four yellow LEDs, which indicate the value of the parameters in Plaits, we search in the Macro Oscillator 2 in vain.

The **synthesis model** can also be changed by **CV**. As soon as a control voltage is inserted into the corresponding socket, 2 LEDs light up, the permanently lit always indicates the currently selected model, the flashing one the average value reached at 0 volts. This can still be selected manually. In addition, if there is a trigger signal, the model will only be changed if this is triggered.

Timbre, Frequency, Morph and Harmonics also have their own **CV inputs**, with only the first 3 of them having an attenuator. These attenuators influence the internal decay envelope without input but with trigger signal. With a signal in the trigger input this is triggered, also the physical and percussive models and the value of the model CV input is thereby sampled and held. In addition, the internal low-pass gate is excited, unless there is a signal in the level input.

A signal at the **Level Input** opens the internal lowpass gate to control its amplitude and tone together. It also sets an accent on physical and percussive models.

Controlling as many parameters as possible with just a few controls is the specialty of Mutable Instruments / Audible Instruments and with Plaits / Macro Oscillator 2 this has been further enhanced. "**If this condition exists, the control fulfills this function!**" This could be a general formula with which one can describe this module. Anyone who does not read manuals will probably never exhaust all possibilities, at least I would never have thought of turning on knobs whose input jacks are empty.

So I recommend this time not only to **experiment**, but also theoretically to deal with the possibilities.

Tides & Cycles

Tides from **Mutable Instruments** is now also available in the second version. The name has remained the same with Mutable Instruments, in VCV Rack the module is called **Tidal Modulator 2** by **Audible Instruments**. The VCV Rack

variants of the predecessor model from **Aepelzens Parasites**, **Audible Instruments**, **Southpole** and **Southpole Parasites** were introduced in **episodes 3 and 5**. In Rack

V1, the parasite variants are not (yet) available. The new version of Tides has more controls and sockets compared to its predecessor. But this still had the alternative firmware **Sheep / Lambs** and there were the parasites Modes **Two Drunks** and **Two Bumps**, so I filled the whole episode 3 with this module. Therefore, it is of course very exciting to explore the possibilities of the successor.

Let's start once again with the inputs and outputs. The 6 input sockets of the upper row are all **CV input sockets** and the lines show which parameter they belong to. From left to right are **Slope**, **Frequency**, **V/Oct, Smoothness**, **Shape** and **Shift/Level.** Of course the **V/Oct** input is also connected to the **Frequency** parameter, but of course follows the usual scaling.

The Trigger / Gate Input is only marked as **Trig**, however, the selected Envelope Mode determines how a signal is processed here.

In **AD mode**, a trigger resets the envelope to 0V and initiates an attack / decay cycle. Regardless of how short the trigger is, the attack / decay cycle is always completed.

In **Cycle mode**, a trigger resets the oscillator so that it starts a new ascending phase.

In **AR mode**, the rising edge of the gate causes the envelope to rise from its current value to +

8V, and the falling edge of the gate causes the envelope to drop from its current value to 0V - just like an ADSR envelope with a decay time of zero and maximum sustain level.

The **Clock input** is for the generation of tempo or frequency controlled signals. When this input is busy, the **FREQUENCY** knob controls the ratio between the frequency of the signal sent to that input and the frequency of the signals generated by Tides.

For the **outputs**, there are four modes, which are selected by the black round button on the top right.

In the initialized state, the associated **LED is off**. This mode is called **Different Shape**. The four outputs produce four different waveforms that pass through Tides' entire signal processing chain. SHIFT / LEVEL acts like an attenuator on the main signal. The waveforms are all dependent on the other controls, but you can say that output 1 is the main signal, output 2 is a raw asymmetric triangle, output 3 is a pulse at the end of the attack phase, and output 4 is a pulse at the end of the release phase.

A click on the button activates the **green LED** and thus the mode **Different Amplitudes**. In this mode, the SHIFT / LEVEL knob is used to select the output to which the signal is sent, with the crossfading between adjacent outputs being smooth. So it is possible to route the signal from Tides to different destinations.

Click again to activate the **yellow LED** and the **Different Times** mode. In this mode, the SHIFT / LEVEL knob shifts the vertex of the waveform over time. This effect is achieved by applying a different SLOPE setting for each output (in AD or AR mode) or by applying a phase shift between each output (in cyclic mode).

Another click finally activates the **red LED** and the mode **Different Frequencies**. In this mode, the SHIFT / LEVEL knob adjusts the frequency ratio between the outputs. In the middle position, all outputs are set to the same frequency. Turn clockwise to increase the frequency of outputs 2, 3, 4. Turning counterclockwise decreases their frequency. At low frequencies, this produces polyrhythmic LFOs. With a low SLOPE value one can produce signals whose edges are sharp enough to drive other modules. At audio frequencies, this creates chords.

Let's jump to the **top left**. Here again we have a black round button, next to it an LED and **three colored circles**. A sure sign that we can choose something here. Here it is the frequency range, more precisely the frequency of the **Frequency** Regulator in the middle position.

In the initialized state, the **yellow LED** lights up, this is the **2 Hz** range intended for rhythms and modulations, e.g. also for the operation as LFO.

With a click on the button, the **LED** changes to **red**, which corresponds to a center frequency of **130.8 Hz** and thus to the audio range. In this setting, Tides works as an Oscillator, which of course we will deepen soon.

But first back to the **green LED**, which we activate again by clicking and thus a very low-frequency mode of **1/8 Hz**, which is predestined for slow movements and oscillations.

Another black round button with LED and colored circles screams for attention in the **middle of the module**. Here, the type of **envelope** is selected.

Again, in the initialized state, the **yellow LED** lights up, which means we have a **cyclic bipolar oscillation** here. Cyclic says very clearly that we do not need a trigger for this, so in principle also optimal for operation as an oscillator.

Red LED means u**nipolar Attack-Release Envelope**, which is an envelope that is triggered and goes into the release phase after reaching its highest point.

Similar is the **green mode**, except that here an **Attack-Decay Envelope** is generated. If you've seen episode 14 about envelope generators, you know that the difference is that during the decay phase, the key is still pressed and the drop in amplitude is voltage controlled, while the release is triggered by releasing the keys and the time to reach the value 0 volts.

And all these choices can now be combined with each other and be influenced by the parameters of controllers and CV inputs.

The **FREQUENCY** control is of course responsible for the pitch, its circumference is +/- 4 octaves around the center frequency, which is selected with the button above. When one of the Envelope Modes is selected, its speed increases in a clockwise direction and decreases ccw.

SHAPE fluently defines the shape of the envelope. In the middle linear, left exponential, right logarithmic.

SLOPE sets the ratio between the durations of the rising and falling segments of the envelopes. Classic envelope generators have separate attack and decay controls. In Tides you first set how fast the whole envelope is completed (with FREQUENCY), then you set how much time is spent for the decay or release relative to the attack (with SLOPE).

SMOOTHNESS is responsible for the waveform transformation. Counterclockwise, a 2-pole low-pass filter is used to smooth the edges of the waveform. Clockwise, a wavefolder inserts kinks and jolts into the shape of the waveform.

SHIFT/LEVEL controls the polarization of the outputs and their displacement. Depending on the output mode, this controller adjusts either the amplitude and polarity of the first output or the amplitude / time / frequency shift between each of the four outputs.

With a **clock signal** or a clean and pure oscillator signal at the Clock input, Tides follows the frequency of that clock / oscillator and multiplies it by a ratio set with the FREQUENCY knob. A 1: 1 ratio is used when this knob is in the center position.

If the trigger input remains free, an AD or AR envelope is generated at each pulse of the clock, the oscillations of which are in phase with the clock. Again, the FREQUENCY control multiplies or divides the clock signals.

It is also possible to feed a signal into both inputs **CLOCK** and **TRIG**. In this case, Tides must receive a trigger on the trigger input to generate an envelope, but adjusts the envelope duration to match the external clock frequency.
Tempo-synchronized LFOs, the generation of just-intonation chords or overtones, as well as time division / multiplication / phase shifting are possible with this function.

And finally, we also come to the audio capabilities of Tides, so its **use as an oscillator**, that's what it's actually in this episode.

Because we perceive the different frequency ranges differently, Tides adjusts its behavior when the frequency range selector is set to the **audio**.

- The **SHAPE** control offers different waveforms that differ significantly in sound.
- The **SLOPE** controller uses a linear curve (instead of Exponential) for smooth pulse width modulation effects.
- To avoid aliasing, the range of the **SHAPE** and **SMOOTHNESS** controls is limited when generating high-frequency tones.
- In the **red** output mode, a different set of frequency ratios corresponding to the musical intervals is selected for each output.
- Another algorithm that favors pitch accuracy and lack of jitter is used for the **Clock** input. This algorithm assumes that there is a periodic waveform at the clock input and does not guarantee that the phase of Tides signal will match the phase of the external clock.

Conversely, when the frequency range selector is set to the lower or middle frequency setting, Tides follows precisely that phase of the clock and can follow irregular (but repetitive) rhythmic patterns or clocks with shuffle / swing.

In order to put the whole thing into practice, I have now chosen the setting **red / yellow / red**, ie audio range with cyclic course and different frequencies at the 4 outputs. The 4 audio signals I bring together and thus have the possibility of a polyphonic sound.
This one is not that overwhelming, so I'm looking with the shape controller for a nice waveform.
The folded on the right side I like very well and with some LFO modulation it comes in motion.
With the Shift/Level control I influence the frequency of the 4 outputs.

With the shape control clockwise I add to the sound even more overtones.
Now the sound needs rhythm yet so a trigger in the input trigger.
The parameter Slope controls my Envelope, so I modulate this also by CV. Smoothness is still causing me too much noise, so I'm driving it back a bit and voila, we have a well grooving 80s synth line, which of course you can vary even further, e.g. with LFOs with different speeds and filters and and and. And of course together with the Macro Oscillator 2.

These modules are fun, they sound fantastic and are **extremely versatile**. But they are not easy to handle, you have to deal with it, but it's worth it.

Resonances & Clouds

I have already introduced **Resonator** from **Audible Instruments** and **Annuli** from **Southpole** in **episode 9** and refer to it.

I have also already introduced

the **E-Series Cloud Generator**, which corresponds to the **Synthesis Technology E340 Cloud Generator**, in **episode 7**. Meanwhile, however, this is **polyphonic**, which is a tremendous added value for this module. Otherwise nothing was changed, so I refer to the episode.

Reviews & Previews

And so we are already at the end of episode 1 of the new edition of "What does this knob do?". As mentioned in the beginning I present the oscillators in the order of their appearance and I hope to create a new episode every week. **Next time**, I will take a closer look at all **SuperSaw** oscillators and compare them. As always, you will find **links** to the most important websites and also to the **developers** of the modules introduced this time.

And not to forget, many thanks to **Andrew Belt** and all the module developers, without whom all this would not be possible. That's it from me, let it go well

Modules in this episode

A/B/Y (AS Modules) https://github.com/AScustomWorks/AS
ADSR (VCV) https://vcvrack.com/
Analyzer XL (Bogaudio) https://github.com/bogaudio/BogaudioM...
Annuli (Southpole) https://github.com/gbrandt1/southpole...
Audio-8 Modul (VCV)
Branes (Geodesics) https://github.com/MarcBoule/Geodesic...
Caudal (Vult) https://vult-dsp.com/
Chronoblob2 (Alright Devices) https://www.alrightdevices.com/
Cloud Generator (E-Series) https://vcvrack.com/ESeries.html
CornrowsX (Southpole)
Cycles (Aepelzens Parasites)
D'acchord (Amalgameted Harmonics) https://github.com/jhoar/AmalgamatedH...
Dual Atenuverter (Befaco) https://vcvrack.com/Befaco.html
EV3 (Squinky Labs) https://github.com/squinkylabs/Squink...
Even VCO (Befaco)
Form (Squinky Labs)
Functional VCO (Squinky Labs)
Hot Tuna (Nysthi) https://github.com/nysthi/nysthi/
Hyperpower (Vult)
Keyframer/Mixer (Audible Instruments) https://vcvrack.com/AudibleInstrument...
LFO-1 (VCV)
Macro Oscillator (Audible Instruments)
Macro Oscillator 2 (Audible Instruments)
Matrix88 (Bogaudio)
Merge (VCV)
Mixer 2 (QuantalAudio) https://github.com/sumpygump/quantal-...
multiScope (trowaSoft) https://github.com/j4s0n-c/trowaSoft-VCV
Mute8 (Bogaudio)
NoteSeq16 (JW-Modules) https://github.com/jeremywen/JW-Modules
Resonator (Audible Instruments)
Simple Clock (JW-Modules)
Slew Limiter (Befaco)
Snake (Southpole)
Splash/Lambs (Southpole/Southpole Parasites) https://github.com/gbrandt1/southpole...
Split (VCV)
Sum (VCV)
Tidal Modulator (Audible Instruments)
Tidal Modulator 2 (Audible Instruments)
Triggered Switch (ML Modules) https://github.com/martin-lueders/ML_...
TwoBumps/TwoDrunks (Aepelzens Parasites/Southpole Parasites)
Unity Mix (QuantalAudio)
VCA-1 (VCV)
VCF (VCV)
VCO-1 (VCV)
VCO-2 (VCV)
XFX Reverb (Blamsoft) https://blamsoft.com/vcv-rack/xfx-reverb