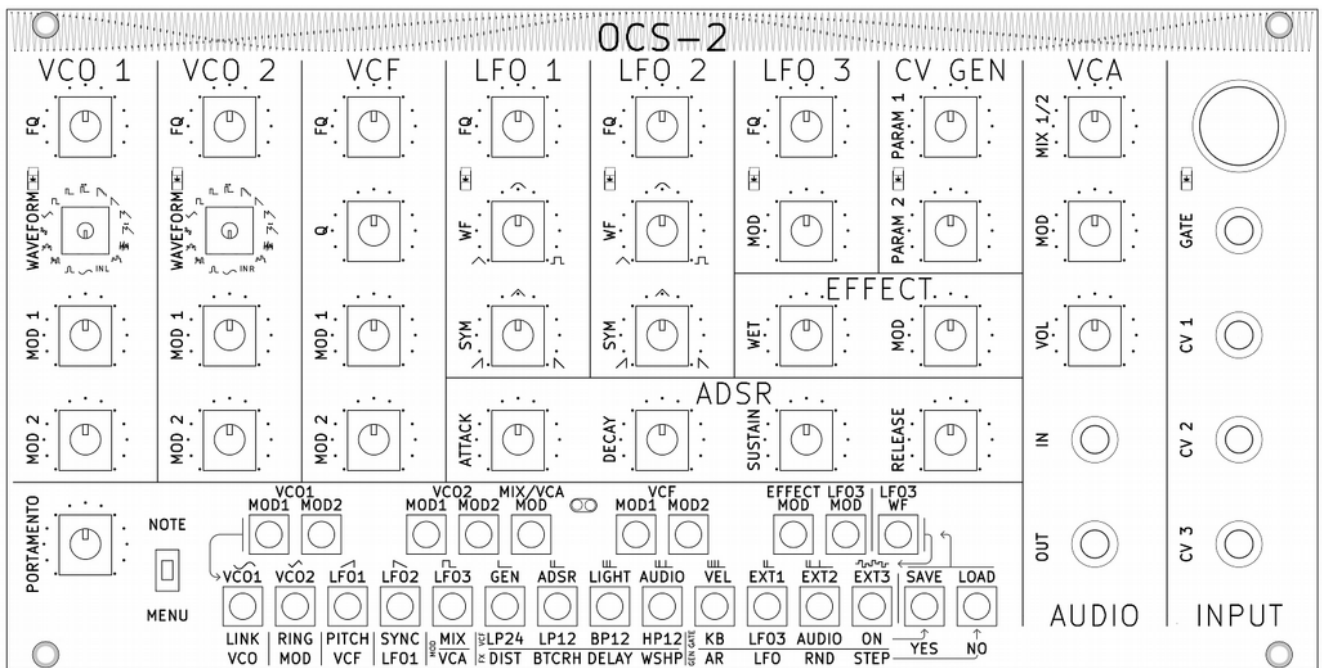
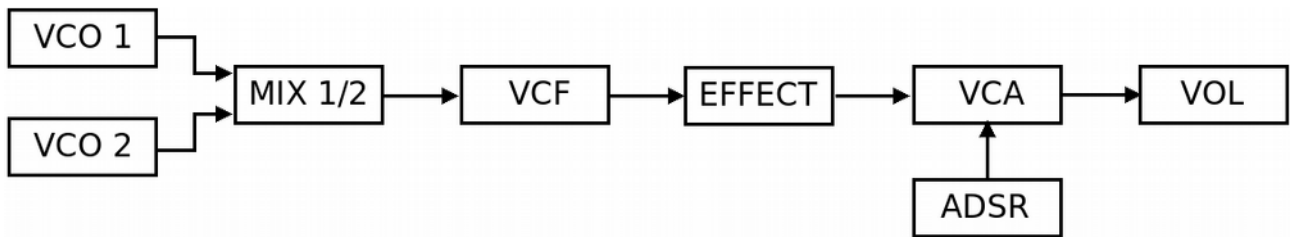


OCS-2 User Documentation

nozoid.com



Feature



This is the audio path wired inside the synthesizer.

- The VCOs are oscillators that generate tone
- The MIX allows to combine these 2 sound sources into 1
- The VCF is a filter dedicated to attenuate or amplify different harmonics of the signal
- The EFFECT processor alters the signal in specific ways
- The VCA changes the amplitude of this signal
- The ADSR creates a time evolution in order to control the sound amplitude
- The VOL potentiometer adjusts the final amplitude of the sound

Other modules are dedicated to create modulation (CV) in order to add parameter variations in the audio chain.

VCO 1 and 2

Available waveforms are a mix of classic ones: sinus, triangle, saw, square, pulse, PWM, noise – and less common ones: $(\sin + 1)^2$, double saw, squared ramp, digital noise – and even some that haven't been named yet.

- 2 modulation potentiometers allow to modulate VCOs frequency with the CV connected via the digital connection matrix.
- All waveforms are band-limited to remove digital synthesis artefacts.
- VCO 1 and 2 frequencies can be adjusted separately, or linked together. In this case VCO 2 frequency potentiometer tunes between 0-1 octave against VCO 1 frequency.
- A ring modulator option mixes the signal of the 2 VCOs.
- PWM is controlled via LFO1 or LFO2 depending on the VCO.
- Noise color can be adjusted using the VCO frequency control.
- The 16th waveform is the audio in: Left for VCO1, right for VCO2.

VCF

The VCF is a custom version of the Moog filter. It mimics its most important features:

- 24dB low pass / resonant frequency response
- high resonance creating auto-oscillations
- no amplitude increase with high Q

This filter has some specific features :

- No distortion of the signal at low Q, allowing a clear pass-through.
- 4 frequency responses are available : the classic Low Pass 24dB/Octave is the default configuration, but there is also a Low Pass 12dB/Octave, a Band Pass 12dB/Octave, or a High Pass 12dB/Octave.

2 LFOs with variable waveform

These two LFOs offer a unique feature : you can adjust the shape of the CV using potentiometers instead of switches. This allows to continuously change from a rising saw, to a triangle and then to a slope down. Or stop halfway between sinus and square.

The waveform (WF) potentiometer controls the shape of the transition. It changes from a straight ramp (like in triangle or saw), to a sudden change of value (like in a square), passing through a sinusoid shape.

The other potentiometer (SYM) adjusts the symmetry of the output, i.e the ratio between rise/fall times. It passes from a rising saw to a triangle and then a falling saw.

Frequency range of these LFOs is huge : the period can go from 45 seconds to 1/40 second. When this LFO is synchronized with a GATE signal (from keyboard, or midi), the LFO phase is reset at the beginning of every note.

LFO3 : VCLFO with selectable waveform

The 3rd LFO is completely different as it is wired to the gate and can trigger notes.

In addition to classic waveforms (sinus, triangle, square, pulse), it provides waveforms dedicated for simple rhythmic generation : [1 0], [1 0 0 0], [1 1 0 0], [1 1 1 0], [1 1 0 1 0], [1 1 1 1 0], [1 1 0], [1 1 0 0 1 0 0 0].

It also provides a random generator, because... well, it's nice.

LFO 3 frequency range is the same than LFO 1 and 2, BUT it's a VCLFO : LFO3 frequency can be controlled by another CV, via the "mod" potentiometer.

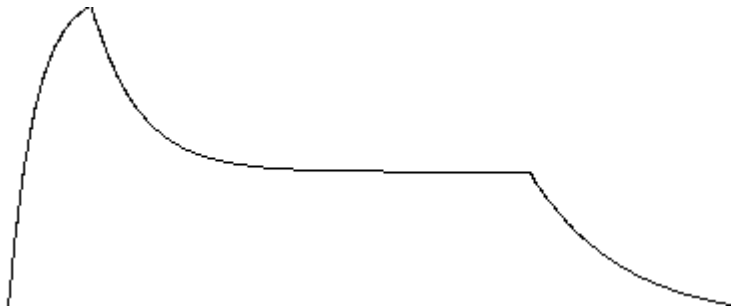
The LFO 3 automatically synchronize on the MIDI clock when one is received. In this mode, the "mod" fader did not use the modulation CV, it change the LFO frequency inside a LFO loop in order to stay synchronize to the MIDI clock.

This is LFO3 waveforms :



ADSR

This is a standard analog ADSR :



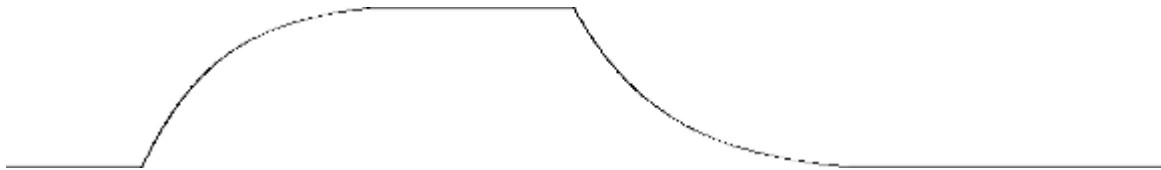
Attack, Decay, Sustain and Release can all be adjusted with potentiometers.

Custom CV Generator module

This module aim is to create modulation CV, just like a LFO. However the CV Generator is dedicated to more complex evolution. Moreover, you can use 4 different algorithm:

- AR : Attack Release envelop generator

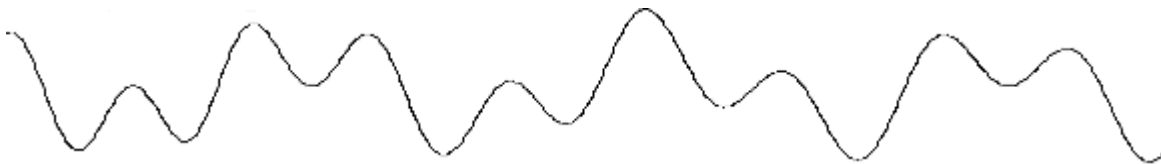
The modulation is a standard analog type Attack-Release generator.



PARAM 1: Attack time / PARAM 2 : Release time.

- LFO : Dual LFO

The modulation is the sum of 2 sinusoidal LFOs.



PARAM 1 : LFO frequency 1 / PARAM 2 : LFO frequency 2.

- RND : Random generator

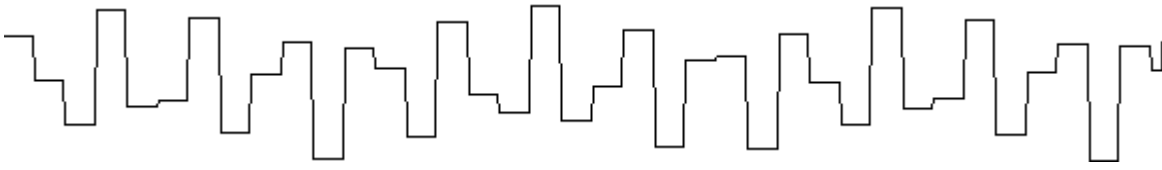
A random value, updated periodically is filtered using a low pass filter.



PARAM 1 : frequency of the random value generator / PARAM 2 : cutoff frequency the filter.

- STEP : a Step Oscillator.

This module generates strange rhythmical patterns that can mutate.



PARAM 1 : step frequency / PARAM 2 : steps evolution speed.

VCA

The VCA amplifies the VCF audio output thanks to the ADSR signal.

The MIX potentiometer allows to adjust the amplitude of VCO1 regarding VCO2 feed to the VCF. (unless if the ring-modulator option is enabled, the MIX potentiometer mixes between VCO1 and the ring-modulator).

Depending of the MOD MIX/VCA option, The VCA modulation potentiometer can modulate either the MIX factor, or the amplitude of the audio signal.

A master volume is also available.

Audio effect

You can choose one of the four available audio effects :

- Distortion

WET : distortion amount. MOD : WET modulation.

- Bit crush

WET : bit crush amount. MOD : WET modulation.

- Delay

WET : level of audio sent to the delay line. It mixes between the VCA out and the delay line out.

At 0%, the delay does not have any effect.

At 50%, the delay line input is a mix between the VCF out and the delay line out.

At 100%, no external sound is sent into the delay line. Only the delay line out is sent to the delay line in.

MOD : delay time, ranging from almost 0 to more than 900ms.

Unlike the other effects, the delay is after the VCA in the audio chain.

- Waveshaper

WET : Waveshaper amount. MOD : WET modulation.

Keyboard

When toggle is on NOTE, this is a 2 octaves keyboard controlling the frequencies of the VCOs. It also controls the frequency of the VCF if "PITCH VCF" option is ON. The portamento filters the frequency change of the keyboard.

When toggle is on MENU, the keyboard is used to patch the matrix and to edit all options.

Digital patching matrix

Connection between modules are made via a digital matrix. You will not be short of cables anymore, and you can even save your patch! The Matrix allows to connect any CV to any modulation potentiometer.

CVs are :

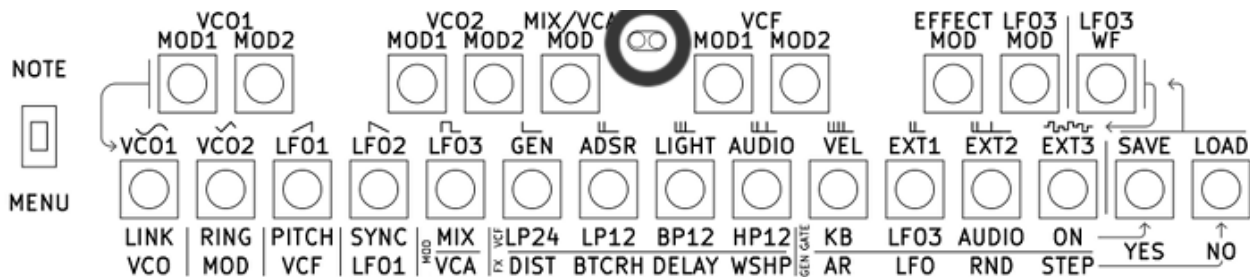
- VCO 1 out
- VCO 2 out
- LFO 1
- LFO 2
- LFO 3
- ADSR
- CV GENERATOR
- LIGHT sensor
- AUDIO IN envelope
- MIDI NOTE ON velocity
- EXTERNAL CV 1 (or MIDI pitch Bend)
- EXTERNAL CV 2 (or MIDI Modulation Wheel (CC 1 + CC 33))
- EXTERNAL CV 3 (or MIDI CC 2 (+CC 34))

Modulation potentiometers are :

- VCO 1 MOD 1 and 2
- VCO 2 MOD 1 and 2
- VCF MOD 1 and 2
- VCA/MIX MOD
- LFO 3 MOD
- EFFECT MOD

Light Sensor

The light sensor is located near the keyboard :



Use the shade of your hand to control the sound! The light sensor generates a Control Voltage that can be routed to any modulation potentiometer thanks to the patching matrix.

Audio In

Audio in (stereo – line level) is plugged on the 16th waveform of the VCOs, it allows to input any audio source in the synthesizer audio path using a 3.5mm stereo jack plug. The audio signal can be used as any other waveform.

It can also be used to generate a CV thanks to an an envelope follower.

When AUDIO option is selected as GATE mode, a gate is triggered when the audio left signal is above a threshold.

External CV

3 analog inputs (-6v/6V) and an external GATE IN (0/5V) are available using 3.5 mono jacks, compatible with most modular setups.

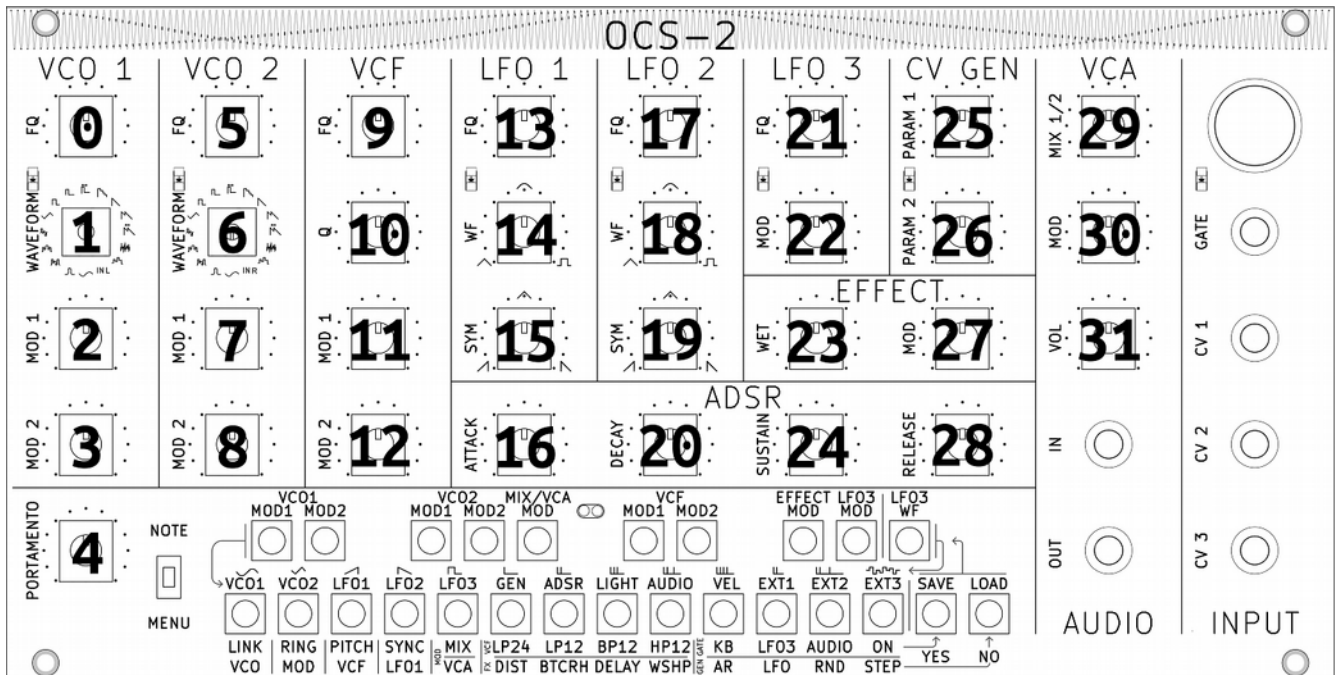
MIDI

You can also control your synthesizer with a MIDI cable : using a keyboard to play notes, or the pitch bend or modulation wheel to control the sound. Connect an external sequencer, a computer etc. The midi data used is :

- Note On / Note Off – channel 1. Note On velocity is accessible in the digital patching matrix so you can use it like any other control CV.
- Pitch bend, modulation wheel (CC1 – 7 bits / CC1 and CC33 – 14 bits) and after-touch (CC2 – 7 bits / CC2 and CC34 – 14 bits) – channel 1. When sending one of this data in midi, the CV IN 1, 2 or 3 are disconnected from the analog input and connected to this midi data.
- Program change from 1 to 10 – channel 1 : load one of the memory.
- Control Change (1CC – 7 bits / 2CC – 14 bits) – channel 2 : control all potentiometers in midi. Midi data is added to potentiometer value to control the corresponding parameter. For 14 bits MIDI, use CC N for MSB, and CC N+32 for LSB. Always send MSB after the LSB.

- **MIDI Clock :** As soon as MIDI syncro signal (F8) is received : the LFO3 synchronize on this signal. Few seconds after you stop sending the syncro, or unplug the cable, the LFO3 frequency goes back to a non synchro mode. During the synchro mode, the LFO FQ potentiometer change the frequency to 1/16, 1/8, 1/4, 1/2, 1, 2, 4 or 8 times the frequency of a MIDI note.

Here is a map of MIDI CC number :

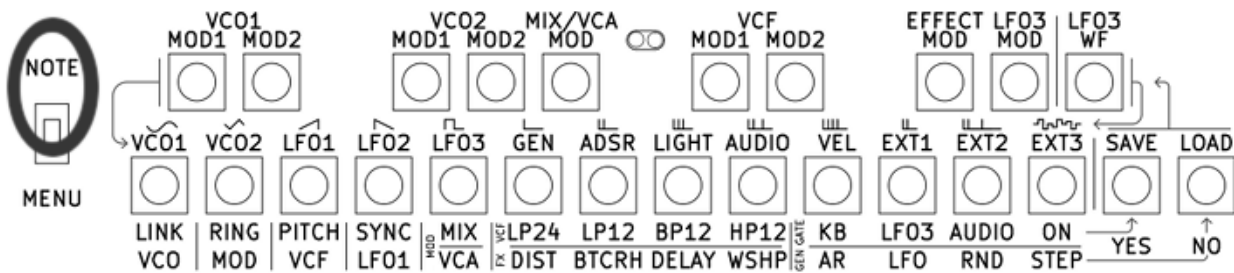


Keyboard

This is a 2 octaves keyboard. The portamento filter the frequency control of the keyboard. Thanks to a switch, the keyboard is also used to control the menu in order to edit all OCS options.

How to use the key as a midi keyboard?

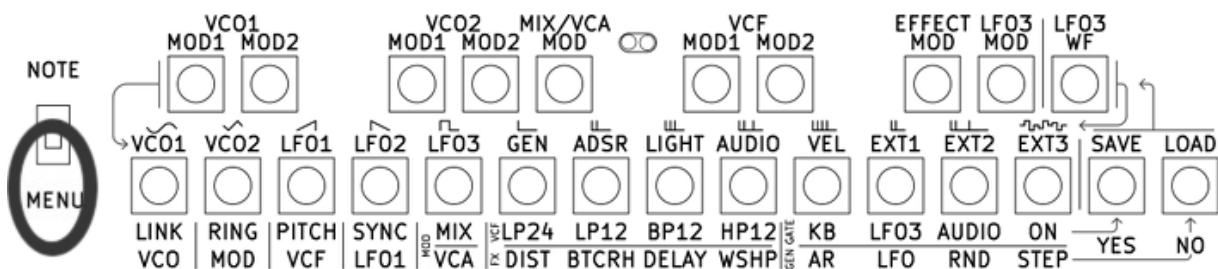
Switch the toggle to NOTE.



How to use the menu?

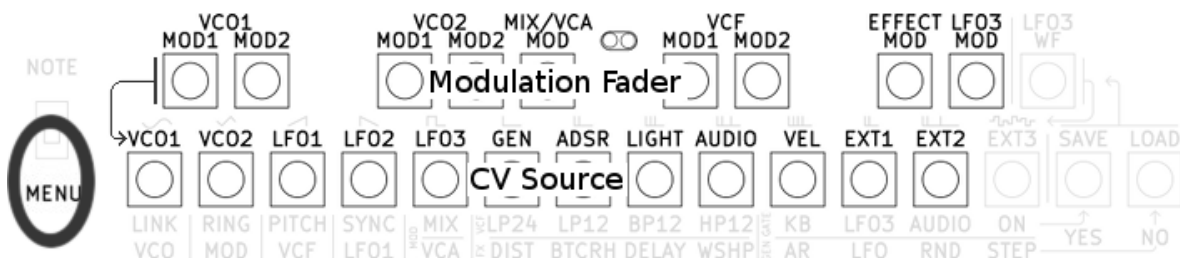
Switch the toggle to MENU.

All options are available using 2 keys combination.



How to change the patching matrix?

- Hold the modulation potentiometer key to assign
- Press the modulation source key



For example, to use LFO3 as VCO 1 modulation 1, you have to press on the same time this 2 key :



How to know what modulation source is assign to a modulation fader?

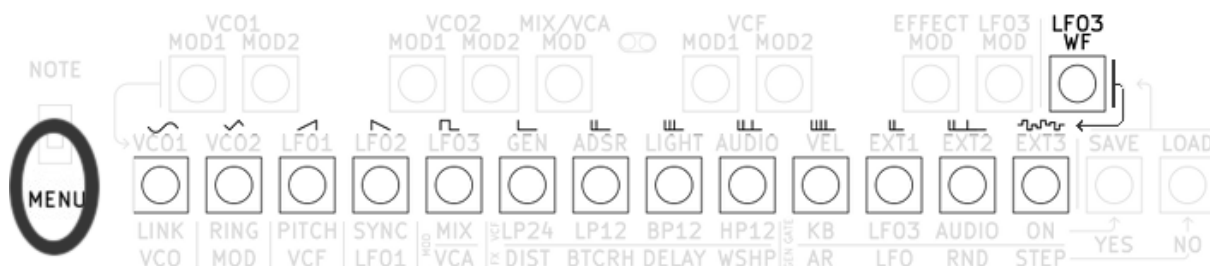
When holding a modulation fader, the 7 led show the current assignation.

- LED VCO 1 -> VCO 1
- LED VCO 2 -> VCO 2
- LED LFO 1 -> LFO 1
- LED LFO 2 -> LFO 2
- LED LFO 3 -> LFO 3
- LED CV GEN -> CV Generator (AR, LFO, RND, NL)
- LED GATE -> ADSR
- all LED except VCO 1 -> Light Sensor
- all LED except VCO 2 -> Audio envelop
- all LED except LFO 1 -> MIDI Note On velocity
- all LED except LFO 2 -> EXT 1 (External CV 1)
- all LED except LFO 3 -> EXT 2 (External CV 2)
- all LED except CV GEN -> EXT 3 (External CV 3)

How to change LFO3 Wave Form?

Press simultaneously the 2 key :

LFO3 WF and the WF key to select



How to link/unlink the VCO frequency?

Press simultaneously the 2 key :

LINK VCO and YES or LINK VCO and NO



When linked, the VCO2 frequency follow the VCO1 frequency.

How to enable/disable the Ring Modulator?

Press simultaneously the 2 key :

RING MOD and YES or RING MOD and NO



When the ring modulator is enable, the VCO2 signal is replace with the ring modulator signal.

How to enable/disable the Filter keyboard tracking?

Press simultaneously the 2 key :

PITCH VCF and YES or PITCH VCF and NO



When the filter keyboard tracking is enable, the cut-off frequency of the VCF follow the keyboard pitch.

How to enable/disable the LFO 1 synchronization?

press simultaneously the 2 key :

LFO1 SYNC and YES or LFO1 SYNC and NO

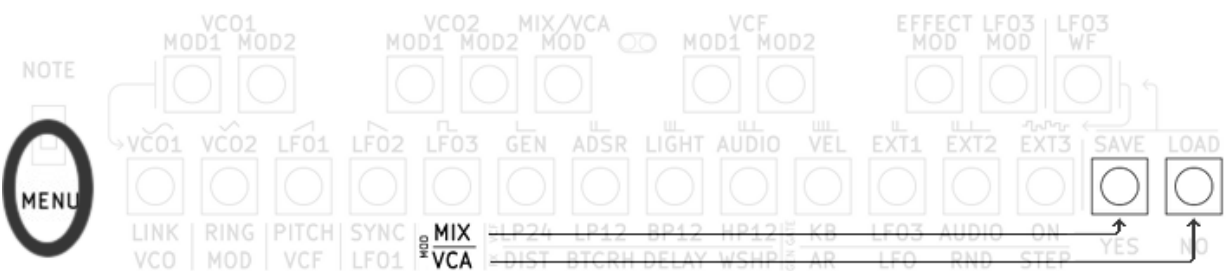


When this option is enable, The LFO1 phase is reset at every GATE signal.

How to change the MIX/VCA modulation?

press simultaneously the 2 key :

MOD MIX/VCA and YES (for MIX) or NO (for VCA).



How to know what is the current status of the various options?

When holding the option « LINK VCO », « RING MOD », « PITH VCF », « SYNC VCO1 » or « MOD MIX/VCA », the 2 led « VCO 1 » and « VCO 2 » indicate if the option is enable or disable : « VCO 1 » for YES, « VCO 2 » for NO.

How to change the filter mode?

Press simultaneously one of the key :

LP24 (Low Pass 24dB/Octave), LP12 (Low Pass 12dB/Octave), BP12 (Band Pass 12dB/Octave), HP12 (High Pass 12dB/Octave)

and SELECT



When holding one of the VCF option key, the 2 VCO leds indicate current VCF option :

- « VCO 1 » OFF and « VCO 2 » OFF : LP24
- « VCO 1 » OFF and « VCO 2 » ON : LP12
- « VCO 1 » ON and « VCO 2 » OFF : BP12
- « VCO 1 » ON and « VCO 2 » ON : HP12

How to change the audio effect?

Press simultaneously one of the key :

DIST (distortion), BTCRH (bitcrush), DELAY (delay), WSHP (waveshape)
and SELECT



When holding one of the FX option key, 4 leds indicate the current EFFECT :

- « LFO 1 » for DISTO
- « LFO 2 » for BITCRUSH
- « LFO 3 » for DELAY
- « CV GEN » for WAVESHAPE

How to change the GATE source?

Press simultaneously one of the key :

KB (keyboard), LFO3, AUDIO, ON
and SELECT



When holding one of the GATE option key, the 2 VCO leds indicate the current GATE Source:

- « VCO 1 » OFF and « VCO 2 » OFF : KEYBOARD
- « VCO 1 » OFF and « VCO 2 » ON : LFO3
- « VCO 1 » ON and « VCO 2 » OFF : AUDIO Envelope
- « VCO 1 » ON and « VCO 2 » ON : ON

How to change the CV Generator algorithm?

Press simultaneously one of the key :

AR (Attack release), LFO (dual LFO), RND (random), NL (Non Linear) and SELECT



When holding one of the GEN option key, 4 leds indicate the current CV GENERATOR module used :

- « LFO 1 » for ATTACK / RELEASE
- « LFO 2 » for Dual LFO
- « LFO 3 » for RANDOM
- « CV GEN » for NON LINEAR

How to Load / save configuration?

Press simultaneously one of the LOAD or SAVE key and one key from the top row



I don't have sound, what is the problem?

- The VOL fader is too low.
- The VCO frequency is too low.
- The VCO Waveform selector is on "IN Left" or "IN Right", and no external signal is connected.
- The VCF cutoff frequency is too low/high (depending on the filter type).
- The ADSR sustain is too low.
- The ADSR attack is too high (you need a long GATE in order to have a sound).
- The keyboard is on MENU mode (no GATE signal is generated).
- The GATE mode is on AUDIO and the external audio is not above the threshold (no GATE signal is generated).
- The GATE mode is on LFO, but the LFO3 is too slow
- The VCA/MIX MOD fader is configured as VCA modulation, and the modulation signal and fader are too high.
- The Delay audio effect WET fader is too high (no sound is feed to the delay).

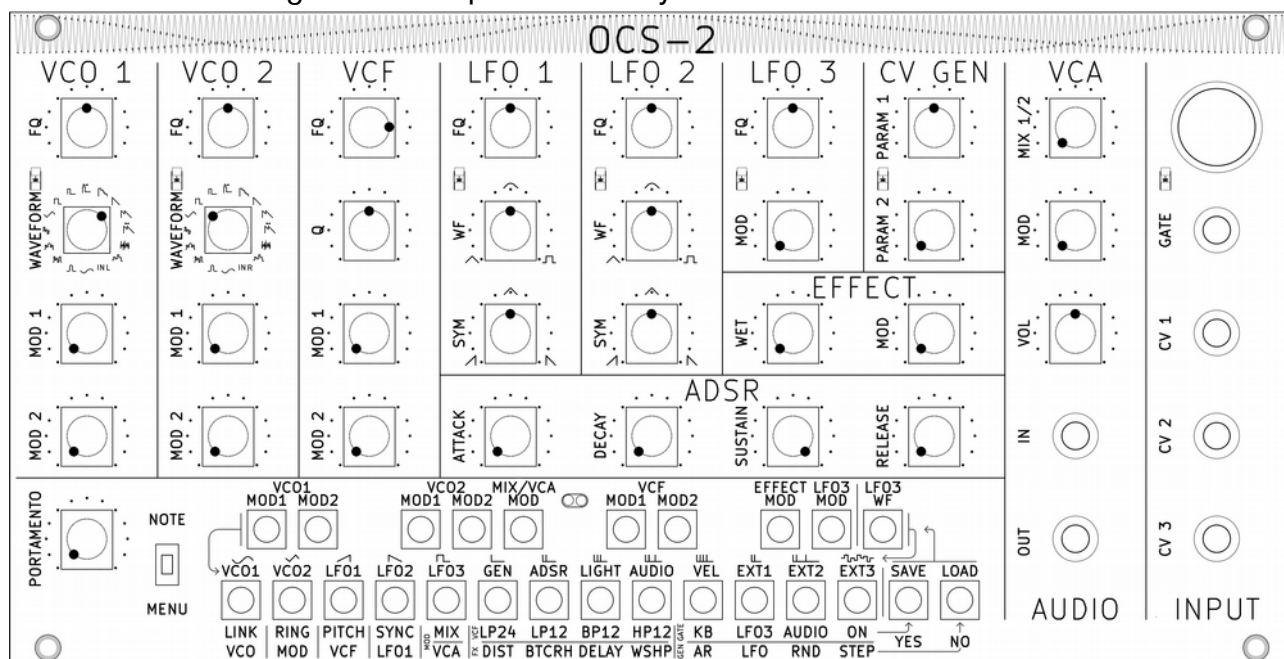
Resetting your synth

If you want to perform a factory reset of your synth, you should press the "load" switch when switching the synth on. This will erase all memory and current option.

No modulation patch

There is no way to unplug a modulation : you can only replace it with an other one. In order to have a basic "patch", you need to turn the modulation faders to zero.

Here is a fader configuration that produce a very basic sound :



Protect your synthesizer

This synthesizer need the same protection as most electronic device : Do not put in water, excessive cold or heat. Do not give it to the dog etc.

Put only 9 or 12V DC power supply with the correct plug and polarity (ground should be outside the plug).

During transportation, do not let heavy weight on faders or on the front face. Ideally, put the front face sit in a flat and rigid surface. Or put it in a robust box.

Extra care

The wood have been waxed. With time, the wax layer can fade away. You can apply a new wax layer every 5 or 10 years in order to keep the wood well protected and shinny.

Update and customize the code

The code of this synthesizer is open source, under GPL version 3 license. It mean that you can use the code, modify it as long as your modifications stay under GPL v3.

See the GNU General Public License for more details.

Few options have been design for easy configuration.

The code is available here :

<https://github.com/ch-nry/ocs>

You can download it to your computer, read the INFO.txt and change the conf.h file.