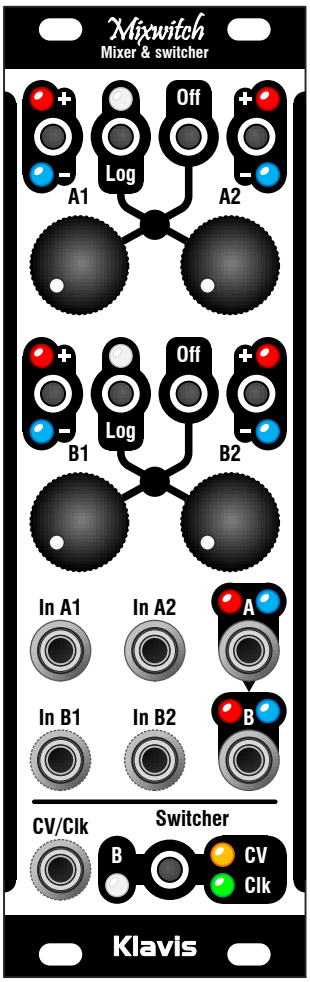
Mixwitch Mixer & Switcher

Voltage & clock-controlled analog switch with mixer

Introduction

Focused versatility seems an oxymoron when describing the features that led us to design the Mixwitch. With only a pinch of mixing, inverting and controlled switching, we brew up a plethora of combinations and uses. This is voltage processing magic!



Features at a glance

- Dual 2 to 1 mixers, normalized into 4 to 1
  - Click-less mute per mixer
  - Click-less polarity inversion per input with LED indication
  - Modulation vs. audio mode selection (lin/log) per mixer, with change of potentiometer curve response and LED indication.
  - Two LEDs on each output showing the amplitude and polarity of the output signal
  - Unconnected inputs present a fixed voltage to ease offset creation
  - Full range DC-coupled analog signal path
- Switch /Selector
  - Switch among 4 inputs, only 2, or disabled
  - Select an input sequentially with a clock/trigger
  - Select an input randomly with a clock/trigger
  - Select an input in relation to a control voltage
  - CV and clock control are audio rate capable
- Settings retained over the power cycle
- High-quality potentiometers with metal shaft
- Skiff-friendly & compact module

Installation and security

Purpose

This module is meant for installation in a Eurorack-compliant chassis.
It adheres to Eurorack Doepfer mechanical and electrical specifications.

Do not attempt using this module in other mechanical or electrical contexts.

Installation

Before the installation, disconnect the mains power supply from your modular system. Some power supplies are not safely isolated; there is a risk of injury!

See in the specifications if this module requires 5V from the supply rails. If 5V is needed and your rack is not providing 5V, do not attempt connection!

Check that the current consumption requirements of this module, when added to your installed set of modules do not exceed the available current from your supply. This is done by adding up the current draw of all modules (mA) separately for each of 5V, 12V and -12V rails. If any of these 3 sums exceeds the available current of your supply for that voltage, do not connect the module to your system; you need a stronger power supply.

The provided supply flat cable can only be inserted in the appropriate orientation at the back of the module, so there is no risk of error on that end. However, you should pay attention to the orientation of the cable in the socket of the supply PCB inside your chassis. Cheap sockets without shrouding may allow you to plug in the connector the wrong way!

The red stripe on the cable should match a stripe printed on the supply board. The stripe also indicates the -12V side. In case there is no stripe, a -12V marking is a safe indication of the orientation.

Double check that the connectors are fully inserted and correctly oriented before switching on the power supply. In case of an anomaly, switch off the power supply immediately and check everything again.

Birth of the product

The Mixwitch design comes from a frustration with attenuvertors (bipolar attenuators-inverters) whose off (neutral) position is difficult to retrieve, especially in live situations.

We went for a digitally-controlled analog path where polarity inversion would be at the touch of a button. So, the usefulness of attenuating/inverting can be realized by turning the pot down, swiftly pressing the inversion button and reopening the level. The zero level is where you expect it, with the pot full down.

Once we had a clean polarity control, we easily added a mute function offering the benefit of pre-adjusted pot settings ready to be activated at will.

The next step was to bring something extra, useful and creative. There are plenty of analog switches controlled by a clock; but arbitrarily selecting an input with a voltage is less common. Having both control capabilities combined with our specific mixer features created a unique fusion: welcome to the Mixwitch !

Module description

Mixers

The mixing section is made of a pair of two-input mixers. Each of mixers A & B works the same.

Each potentiometer controls the gain from zero to max. At maximum setting, the signal is amplified slightly above x2.

Inputs

When an input is left unconnected, it defaults to a voltage. This allows easily offsetting the signal brought at the other input of the mixer. You can create offsets up to plus/minus 10V.

Outputs

Outputs A and B are each summing the inputs 1 and 2 from their respective mixer. When no jack is inserted in the mixer A output, its signal is added to the signal of output B, creating a 4 to 1 mixer. Red and blue LEDs at each output indicate the strength and polarity of the outgoing signal.

Buttons

- The +/- button and LEDs control the input signal polarity inversion.
- The Log button and its LED apply to both inputs of a mixer. It also changes the curve of the potentiometers from linear to logarithmic and reduces the overall gain by 6dB to avoid audio clipping.
  Linear is typically used to combine control voltages while log is fit for audio signals.
  Log can nevertheless be used for control voltages easing the setting of subtle levels.
- The Off button applies to both inputs of a mixer. When a mixer is muted, its polarity LEDs are off.

Switcher

With the Switcher section active, the module behaves as an analog selector switch with adjustable gain and polarity settings. The switcher can work on all four inputs or only two from mixer B.

By default, the Switcher is disabled; all 3 Switcher LEDs are off.

The Switcher acts on the mixer inputs so that only one amongst them is active at once.
When setting the switcher for mixer B only, mixer A is available for normal mixing duties.

The CV/Clk jack allows the input selection to be realized in two different ways:

- by a voltage imposing which input is ON, or
- by a clock that calls each input sequentially in a loop (or randomly)

Using a CV goes beyond the typical operation of a sequential switch since inputs can be arbitrarily activated according to the CV level.

The Switcher push button sets its operation mode.
Each press brings the next mode in turn:

Switcher mode	**LEDs on**			**Details**
	CV	**Clk**	**B**	
Off				Switcher is disabled - Mixers operate normally
CV, 4 channel	•			Selects one of four inputs or none according to a voltage. 0 to 4V = none, A1, A2, B1, B2
Clock, 4 channel		•		Clock/trigger calls each input sequentially in a loop.
Clock, 4 channel, random		blink		Clock/trigger calls four inputs randomly; never calls the same input twice in a row
CV, 2 channel (B)	•		•	Selects one of 2 inputs of mixer B or none according to a voltage. 0 to 2V = none, B1, B2 Mixer A is unaffected
Clock, 2 channel (B)		•	•	Each clock pulse will alternatively select input B1 or B2 of mixer B. Mixer A is unaffected

- When the Switcher is active, it is still possible to mute the mixers.
  The steps calling a muted input are not skipped; they are simply not playing out.
- When changing mode, muted mixers are enabled.

Applications

1. Control signal mixer

Besides processing two modulation signals, one input can be left open which brings a permanent voltage that can be added or subtracted to/from the other input's signal.

The on/off function allows preparing a precise setting (e.g. a transposing modulation) to be activated as needed.

2. Audio mixer

When the Log LED is on, the mixer reconfigures itself for audio purposes.

Adding two audio sources at their nominal level won't clip the output since the gain is reduced by 6dB automatically. This way you benefit from the entire potentiometer travel for precise level setting.

Leaving the mixer out A jack unconnected makes a 4 to 1 mixer at output B.

3. Four step sequencer/randomizer

With the switcher in Clock mode and all mixer inputs left unconnected, bringing a cyclic square/pulse to the Clk input makes a 4 step sequencer.

For more fun, you can also use the random clocked mode.

Out B could go to an oscillator V.Oct input while your clocking signal can be used as a gate/trigger for an envelope generator. The four mixer pots set the melody.

4. Simple sub-octave generator

With the switcher in Clock B-only mode, an audio signal at the clock input will make the two inputs of the B-mixer alternate with every audio cycle.

Using the B pots sets the amplitude and polarity of the generated sub-octave.

To avoid DC offset on the resulting audio signal, one mixer channel could be set to positive and the other to negative with their amplitude setting duplicated on the two pots.

5. Complex sub-octaves generator

As a variation from the above example, the switcher is here in 4-channel clock mode.

The audio signal at the clock input calls each of the 4 input in turn. Depending on the pot settings, you can create an audio signal one and/or two octave lower than the control signal.

6. Simple granular synthesis

The initial setup is the same as the complex sub-octaves generator hereabove and requires a VCO whose various waveforms are simultaneously available.

The idea is to bring these waveforms from the controlling oscillator to the mixer inputs. The clocking wave can also be part of the mix.

With every new cycle a different waveform will play in turn creating a repeated sequence of 4 waveshapes that can be mixed at will. A given wave can be connected to more than one mixer input to appear more than once in the sequence, possibly with a different polarity.

7. Multiple-segment waveshaper

The switcher should be in 4-channel CV control mode.

With the switcher being able to point to an input according to a voltage, we will use an audio waveform to cycle through all inputs during each wave cycle. The typical CV shape for this purpose is sawtooth.

A) With the 4 mixer inputs left open, the resulting shape at the mixer-B out will be made of flat steps adjustable in level and polarity.

With the levels arranged regularly in proportion to the CV control voltage, this provides the typical bit-crushing wave shaping; other settings allow more creative waves.

B) A richer variation is to bring some wave(s) from the controlling oscillator to one or more mixer inputs. The polarity switches can change the resulting sound drastically.
As the ramp of the sawtooth goes, each mixer input will provide its wave snippet for a fraction of time.
Since the switcher is in "no selection" when the control voltage is zero, it might be useful to offset the controlling CV such as to define the range of channels covered, and whether "no selection" should be part of the sawtooth sweep.

8. Phase-controlled wave-stitcher

The switcher is set to CV B-only, and a PWM signal coming from an audio oscillator is used as control wave. In order to avoid the "no selection" state, the PWM is first processed through mixer A to add a positive offset if necessary.

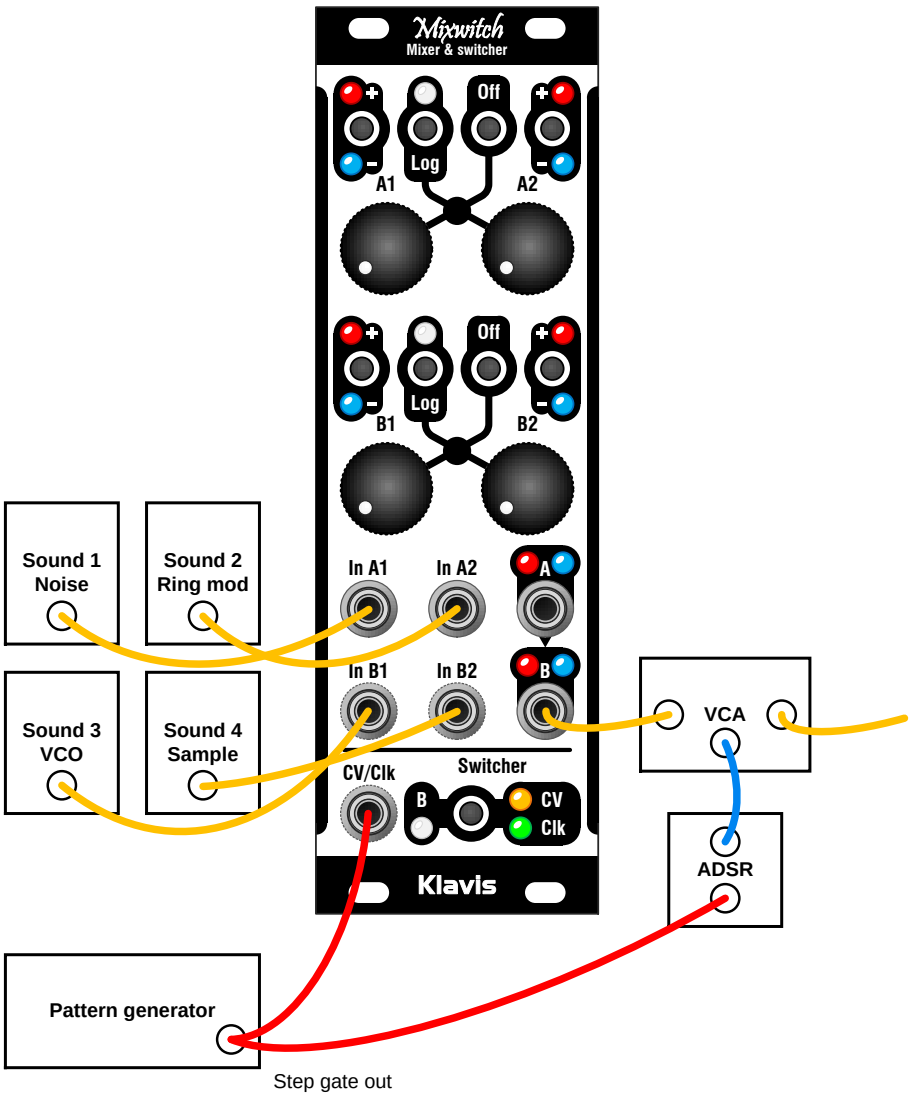
One or two audio waves from the controlling oscillator are brought to the mixer B inputs (e.g. sine, saw, triangle, complex wave). Now, adjusting the pulse-width of the oscillator manually or with a modulation will change the proportion of the waves stitched and consequently the shape of the resulting wave at mixer B output.

9. Voltage controlled transposer

With the Switcher in 2 or 4 channel CV control, a voltage from any source can provide precise transpose voltages defined by the mixer potentiometers. Interestingly, the transposition steps do not necessarily need to increase as the control voltage does. The "no selection" feature offers a "no transpose" option.

10. Drum randomizer

This works in combination with some rhythm pattern generator. Using a single VCA and envelope generator allows creating a set of 4 different sounds.
The selector is put in clocked random mode and fed with the gate/trigg signal that comes with each step.



11. Digital inverter / signal amplifier

Using one of the mixers, one input set to negative polarity receives the signal, while the other, left unconnected, is adjusted to compensate that the signal goes in the negative range.
The red LED confirms that you have a positive signal at the output.

12. Voltage window comparator

The goal is to get a result (switching or gating) only when a signal is within a specific voltage range that you define arbitrarily.

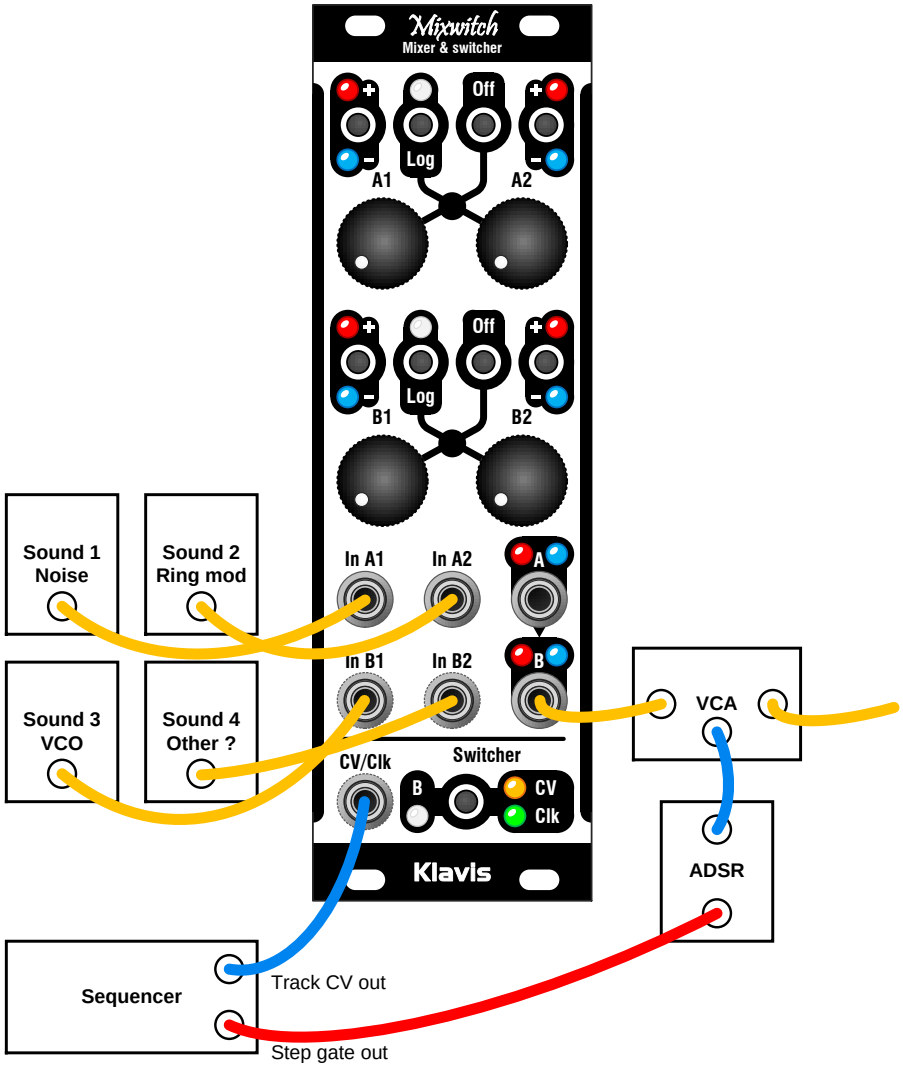
Patch output A to the switcher CV in and set the switcher to B-only CV control.

The signal to be compared is brought to input A1. Using the pot A1 for gain (= window spread) and pot A2 for offset, you can adjust the switcher CV to have output B1 selected only when the CV is higher than 1 Volt but lower than 2 Volts. Inverting can be needed in case your control signal is in the negative range.
You can set the B1 pot to create a simple gating when the control voltage is in range or to allow a signal brought to B1.
Optionally, input B2 can bring its own signal when the CV control is above 2V.

13. Drum selection in sequencing applications

The number of tracks in a sequencer is usually limited so that you cannot allocate a dedicated track to each and every sound you'd like to include.

The following patch allows you selecting up to 4 sounds from a single pattern track and its related CV track. The switcher is set to CV control. The pots are a dedicated percussion mixer.



14. Random clocking – Chance generator

The switcher is set to random-clock. A clock signal is brought to the Clock input. Adjusting a number of pots to "one" will determine the occurrence of the "ones".

When two channels at "one" play consecutively the result is a longer gate instead of two separate triggers. To avoid that, bring the clock signal to the mixer inputs you intend setting at "one".

15. Two-input logic AND / NAND gate

An AND function gives a one when the two source signals are simultaneously at one.

Set the switcher to CV B-only. One signal goes to the CV input, while to the other goes to the B input that is pointed when the CV control is "one". The B output only goes to one when the two signals are at one. If NAND is needed, you still have section A available to invert out B.

16. Two-input logic XOR gate – Digital ring-modulator

An XOR function combines two signals so that the output is at one only when a single of the two inputs is at one. This patch recreates a "digital ring-modulator" such as implemented in the ARP Odyssey and Korg MS-20 synthesizers.

Input A	0	0	1	1
Input B	0	1	0	1
Output	**0**	**1**	**1**	**0**

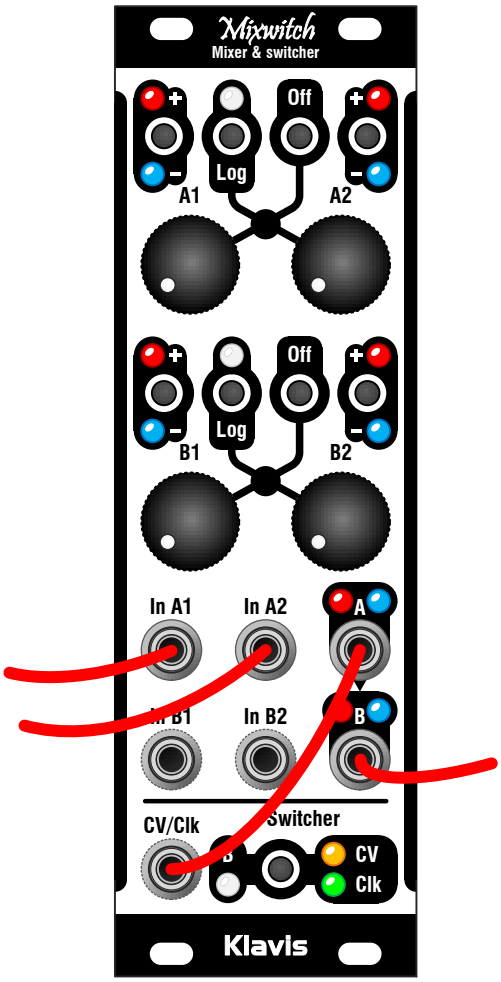
In the Mixwitch this is realized by using section A to mix the two signals at equal level, and section B to map the result of that addition.

Output A is is controlling the switcher set to CV B-only mode.
Pot B1 is open to create a logic one level; pot B2 is left at zero.

Adjust (jointly) the levels of mixer A, such as:

- When there is no signal, Out A = zero, the switcher points to "no selection", so that Out B=0.
- When only one input A is at "one", the switcher will point to B1, providing the level set on pot B1.
- When both inputs are at one, the sum of their levels will make the switcher pointing to B2, whose pot is off, giving zero at the out B.

Hereabove we assume that the two input signals are of the same amplitude; if not, you have to adjust pots A1 and A 2 accordingly.



17. Saw to PWM with manual or CV control – Audio/LFO

Bring a sawtooth from a VCO to A1, and a modulation acting as PWM CV to A2. With no CV connected, the pot A2 is used for manual pulse width setting.

Output A goes to the switcher set to CV B-only. The two B-pots are set equal according to the amplitude of the output PW signal.

The signals in mixer A should be adjusted such as Out A is slightly above 1 volt when the PWM CV is at minimum. This results in a narrow pulse at out B.

From there, higher CV will push a longer portion of the sawtooth above 1 volt, extending the duration of the resulting pulse.

18. Hard clipping

Clipping is the effect of restricting the amplitude of a signal to a hard limit. For example, beyond a certain level, a triangle wave will be cut, creating a plateau instead of its peak. Its level would never go beyond that plateau whatever the incoming amplitude. Clipping is usually symmetrical which means that the wave is equally constrained on both polarities. Ideally the signal is unaffected when staying within the limits. The following patch follows all of these requirements.

For the Mixwitch to do a very precise hard-clipping, it is needed to make careful adjustments, ideally with a voltmeter.

Proceed in the following order:

- Start the Mixwitch in full mixer mode
- Adjust pot B2 to have 5.0V at out B; pots A1, A2, and B1 should be off
- Adjust pot A2 to have 1.5v at out A; pot A1 must be off
- Connect out A to input B1 and to the switcher CV in
- Set the switcher to CV B-only mode; B1 will be automatically selected
- Adjust pot B1 to get 2.5V at out B
- Bring a bipolar signal to A1 (usually an audio wave)
- Adjust A1 as needed
- To the exception of pot A1, don't change any setting on the Mixwitch
- The signal will be clipped between zero and 5 volts; its DC offset being at 2.5V

Specifications

Mechanical

Dimensions	mm	inches	Eurorack compliance
Height	128.40	5.06	3HE
Width	40.00	1.57	8HP
Depth behind panel (with supply cable inserted)	25.00	0.98	

Supply

The supply socket is protected against reverse insertion.

Supply rail	Current draw
+12V	22 mA
-12V	26 mA
+5V	13 mA

Input/output

All inputs and outputs can withstand signals between -12V and +12V without harm.

Jack	Effective voltage range received or generated
CV control input	0 to +4V, in 1V steps
Clock control input	1V min, rising edge detection
Mixer inputs	-11V to +11V
Mixer outputs	-10V to +10V

Signals

Parameter	Values
Mixer Frequency range	DC to beyond audio

Packing list

The box contains:

- Mixwitch module
- 4x M3 black mounting screws + washers
- Eurorack-compliant 16-pin supply cable
- Quick setup notice

Klavis products, including PCB and metalwork, are designed and manufactured in Europe.