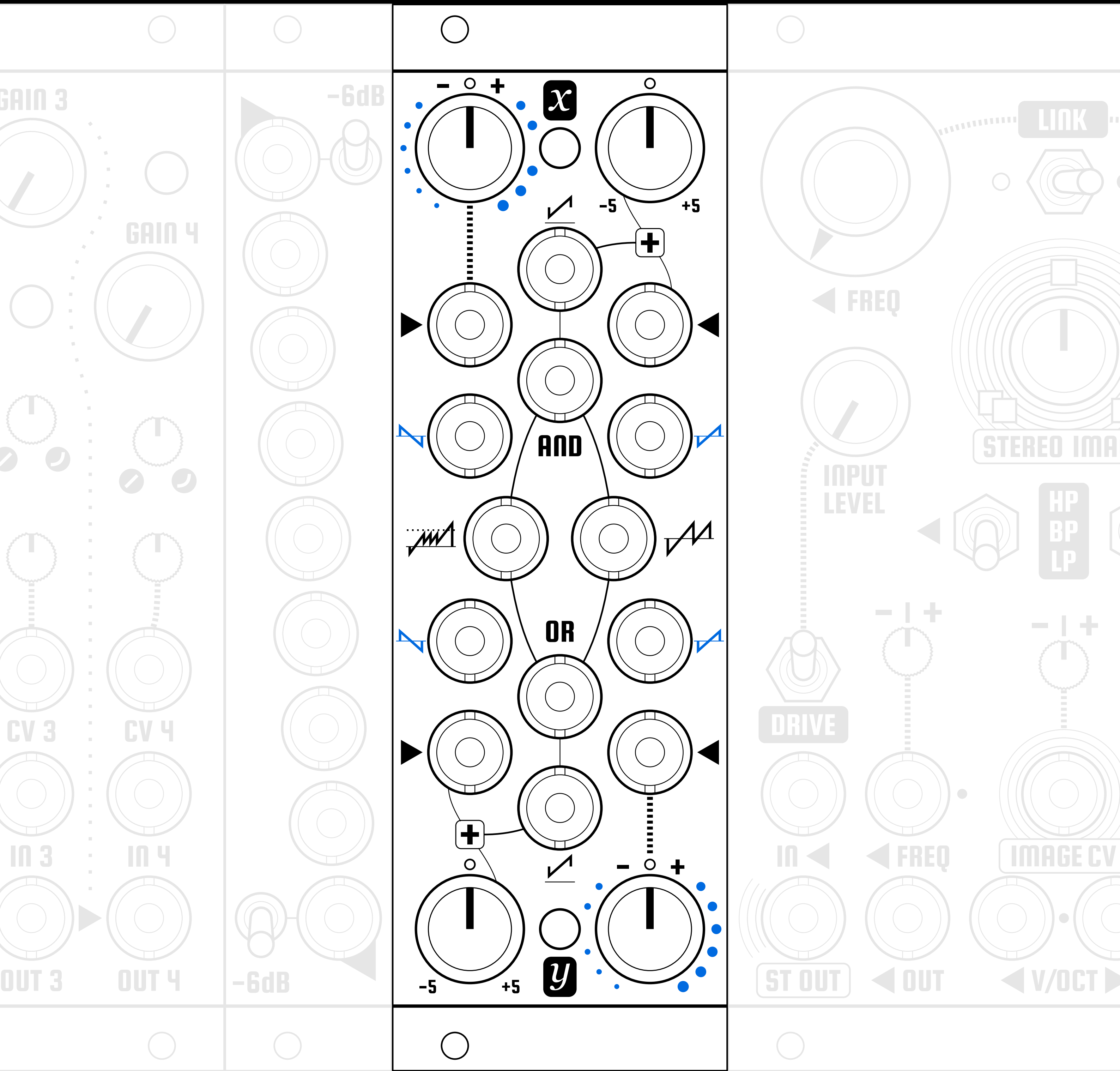
SIGNOS

Dual signal transmutator



User manual

olivella modular

Introduction

Olivella Modular SIGNOS is a dual channel utility and waveshaper module for processing both CV and audio signals.

Both x and y channels feature a classic/unipolar VCA with separate normal and inverted outputs, a polarizer/four-quadrant multiplier/bipolar VCA, a -5V to +5V manual offset voltage that gets summed with their respective channel's bipolar VCA outputs and a red/green LED indicator for this output. The offset voltage can be used on its own if no main input signal is present.

x and y sums of their bipolar VCAs output + offset (x **+ offset** and y **+ offset**) are then feeded to the logic and waveshaper circuits: an **AND** analog logic gate that outputs the minimum of x **+ offset** and y **+ offset**; an **OR** analog logic gate that outputs the maximum of x **+ offset** and y **+ offset**; a MOD waveshaper that represents the mathematical modulo operation as an analog CV modulator and waveshaper, with both x **+ offset** and y **+ offset** affecting different parts of this circuit; and a SHIFT waveshaper that was originally designed to pitch-shift sawtooth waves up an octave, but that can also do interesting wave-mangling to all kinds of signals.

All of the above are just the module's building blocks, only the tip of the iceberg of what SIGNOS can do. It naturally lends itself to feedback patching techniques within itself and/or other modules, complex waveshaping, external signal processing and more, which we will cover later in this manual. The limits of what SIGNOS can do are completely up to you.

Features

- Two channels
- One main input and one modulation input per channel
- Classic/unipolar VCA with normal and inverted outputs per channel
- Polarizer/four-quadrant multiplier/bipolar VCA per channel
- Variable -5V to +5V manual offset per channel
- LED signal indicator per channel
- Two analog logic gates
- MOD and SHIFT waveshapers
- Can process both CV and audio signals
- Fully analog operation

Installation

- Check that your Eurorack synthesizer is **powered off**.
- Connect the 10 pin side of the power cable to the 2x5 pin power header on the back of the module, **making sure that the red stripe on the cable is connected to -12V** (as shown on the back of the module).
- Connect the 16 pin side of the power cable to a free 2x8 pin power header on your Eurorack power supply, again **making sure that the red stripe on the cable is connected to -12V on your power supply**.
- Mount the module in your Eurorack case.
- Power it on!

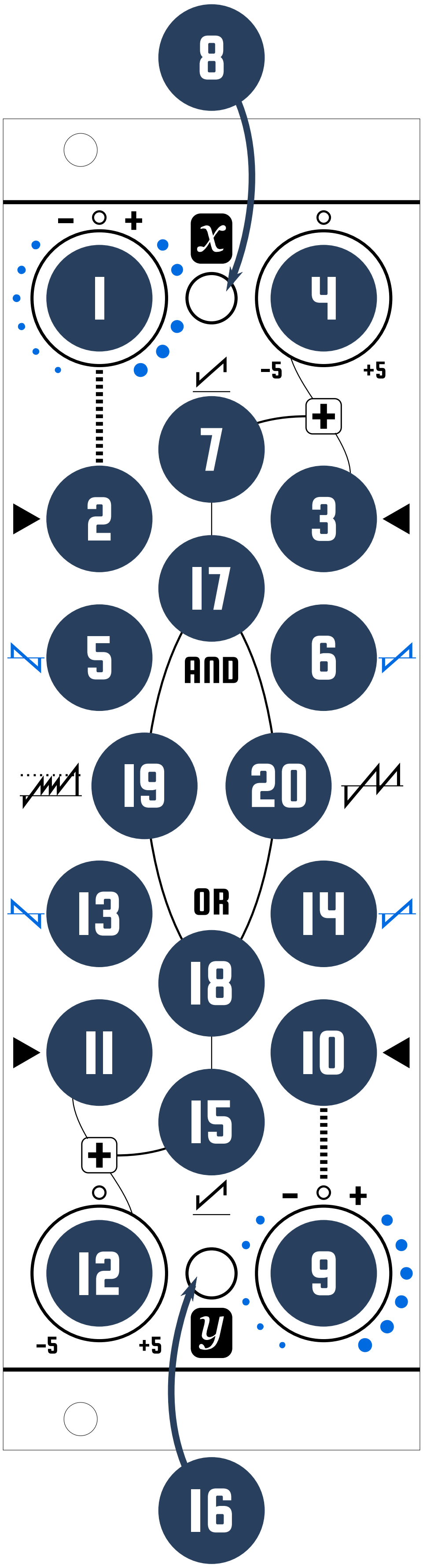
In the rare case that the power cable gets installed backwards (because you may be using a different power cable than the one provided with SIGNOS or for other reasons) **the module will not get damaged** because it features reverse polarity protection, but it won't work plugged the wrong way around.

Details

- Fully DC-coupled
- All inputs allow DC to audio-rate signals
- Input impedance: 100 kΩ
- Output impedance: 510 Ω

- Width: 8 HP
- Depth: 40 mm
- +12V: 110mA
- -12V: 110mA
- Reverse polarity protection

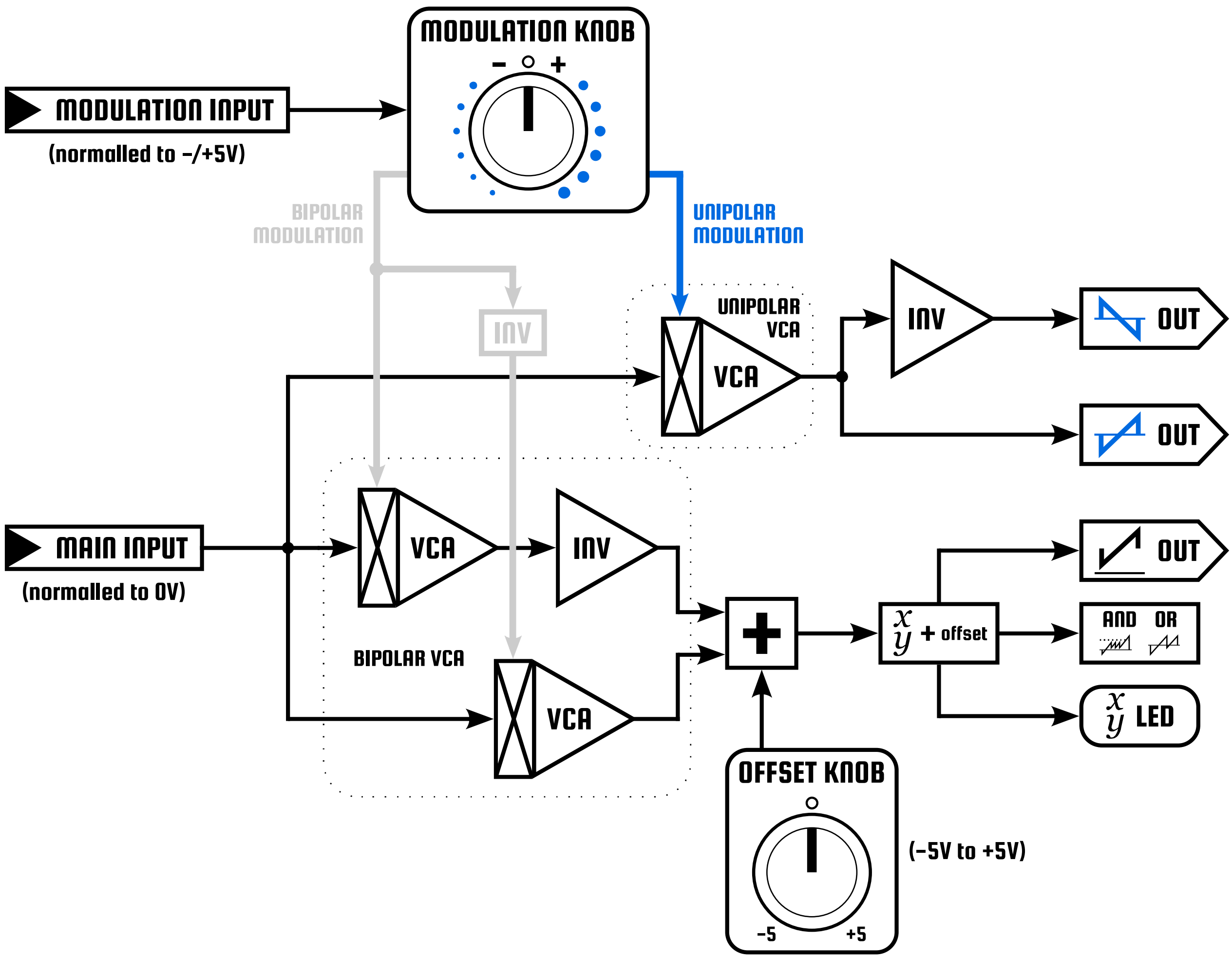
Panel overview



1. X modulation knob
2. X modulation input
3. X main input
4. X offset knob
5. X unipolar VCA out
6. X inverted unipolar VCA out
7. X bipolar VCA out
8. X bipolar VCA LED indicator
9. Y modulation knob
10. Y modulation input
11. Y main input
12. Y offset knob
13. Y unipolar VCA out
14. Y inverted unipolar VCA out
15. Y bipolar VCA out
16. Y bipolar VCA LED indicator
17. Analog AND gate out
18. Analog OR gate out
19. MOD waveshaper out
20. SHIFT waveshaper out

Inputs and VCAs

Block diagram (one channel)



SIGNOS has **four inputs** (two per channel) marked with black triangles ▶ pointing at their respective jacks. All of them are DC-coupled, meaning that they accept both audio and CV signals.

There are two types of inputs: **main inputs** and **modulation inputs**.

Main inputs

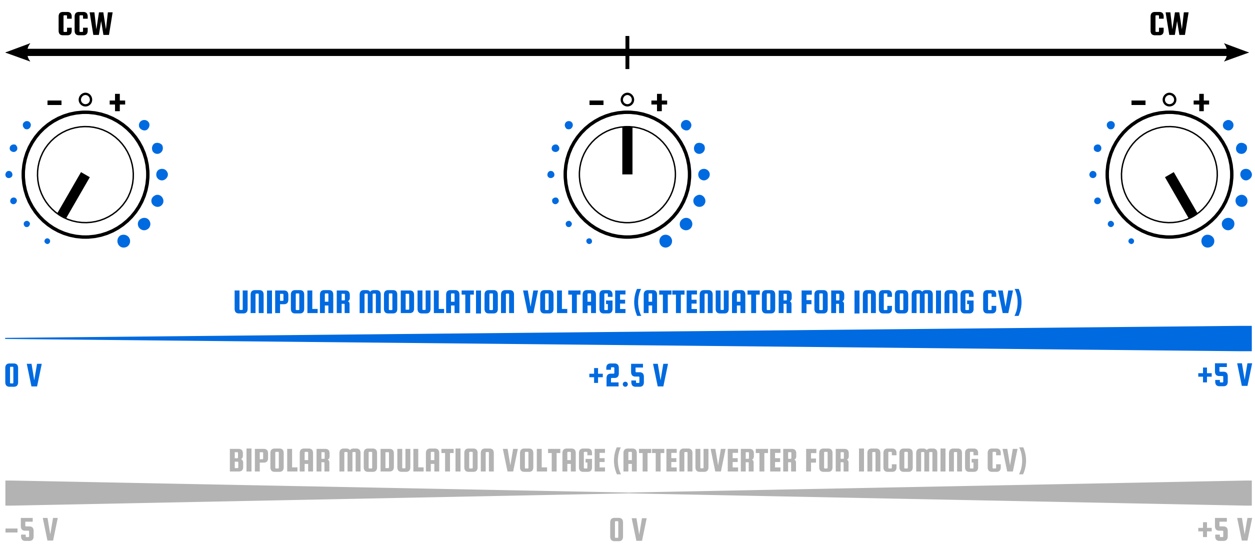
These **receive the signals that will actually get proccesed** by SIGNOS.

When unpatched, they're normalled (internally connected) to 0V. The main inputs are unattenuated and go straight to their respective channel's unipolar and bipolar VCAs (which are controlled by the modulation knobs and modulation inputs, more on that later). After this step, they get summed with their respective channel's voltage offset resulting in the signals x **+ offset** and y **+ offset**, which are then visually represented by their channel's LEDs, sent to the logic and waveshaper circuits and to the outputs.

Modulation inputs and modulation knobs

These **control the modulation applied to the VCAs** both unipolar and bipolar and, therefore, the **amplitude** of the main input's signals.
When their respective modulation inputs are unpatched, the modulation knobs are normalled to -/+ 5V for the bipolar VCAs and from 0 to 5V for the unipolar VCAs. As such, **the modulation knobs act in two different ways in parallel**:

- At fully CCW, they apply -5V to the bipolar VCAs and 0V to the unipolar VCAs.
- At noon, they apply 0V to the bipolar VCAs and around +2.5V to the unipolar VCAs.
- At fully CW, they apply +5V to both bipolar and unipolar VCAs.



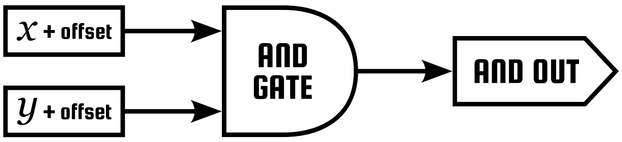
To distinguish this dual behavior more clearly, the controls and outputs related to the unipolar VCAs are graphically represented with a light blue color: the dots growing in size around the modulation knobs pinpoint their attenuation-only side, and the unipolar VCAs normal and inverted output's symbol color show the influence the modulation knob's unipolar action have on them.

When their respective modulation inputs are patched, the modulation knobs act as **attenuverters (gain of -1 to 0 to 1)** for the CV going into the bipolar VCAs and as **attenuators (gain of 0 to 1)** for the CV going into the unipolar VCAs.

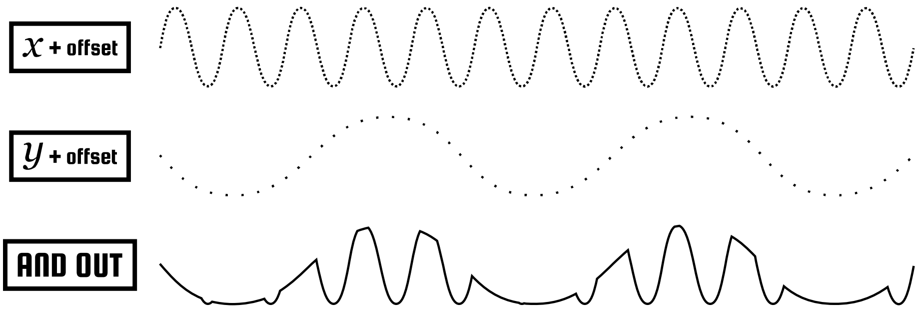
This means that the two types of VCAs effectively have different amplification curves, except when their respective modulation knobs are set fully CW and both have a gain of 1 (+5V going into unipolar and bipolar VCAs alike).

Analog logic

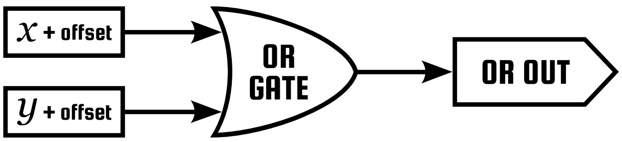
AND gate (analog minimum / boolean AND)



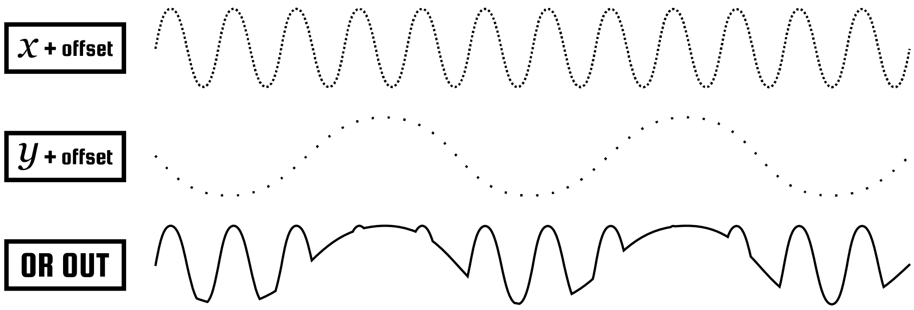
This circuit always outputs the **lesser value** between x **+ offset** and y **+ offset** .
When using binary signals (either high or low) like gates or triggers, this output will be high **only when both signals** are high.



OR gate (analog maximum / boolean OR)



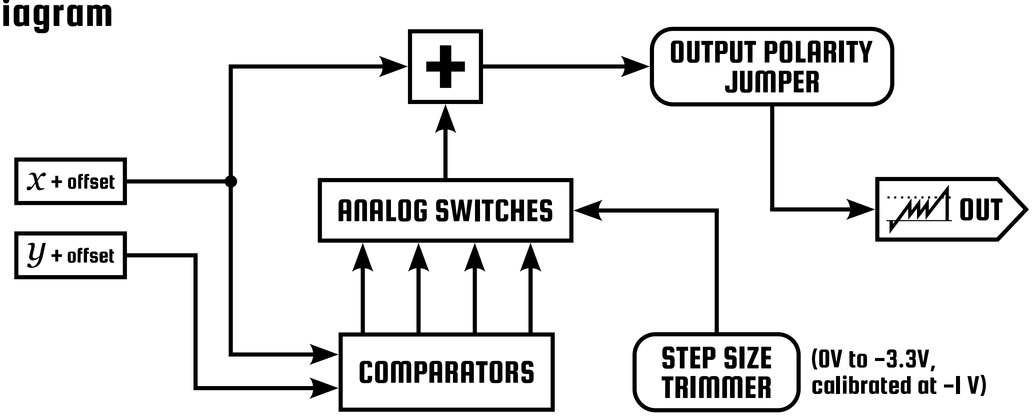
This circuit always outputs the **greater value** between x **+ offset** and y **+ offset** .
When using binary signals (either high or low) like gates or triggers, this output will be high **whenever either of the signals** are high.



x and y offset voltage's variations will influence the comparison level between signals for both **AND** & **OR**.

MOD waveshaper

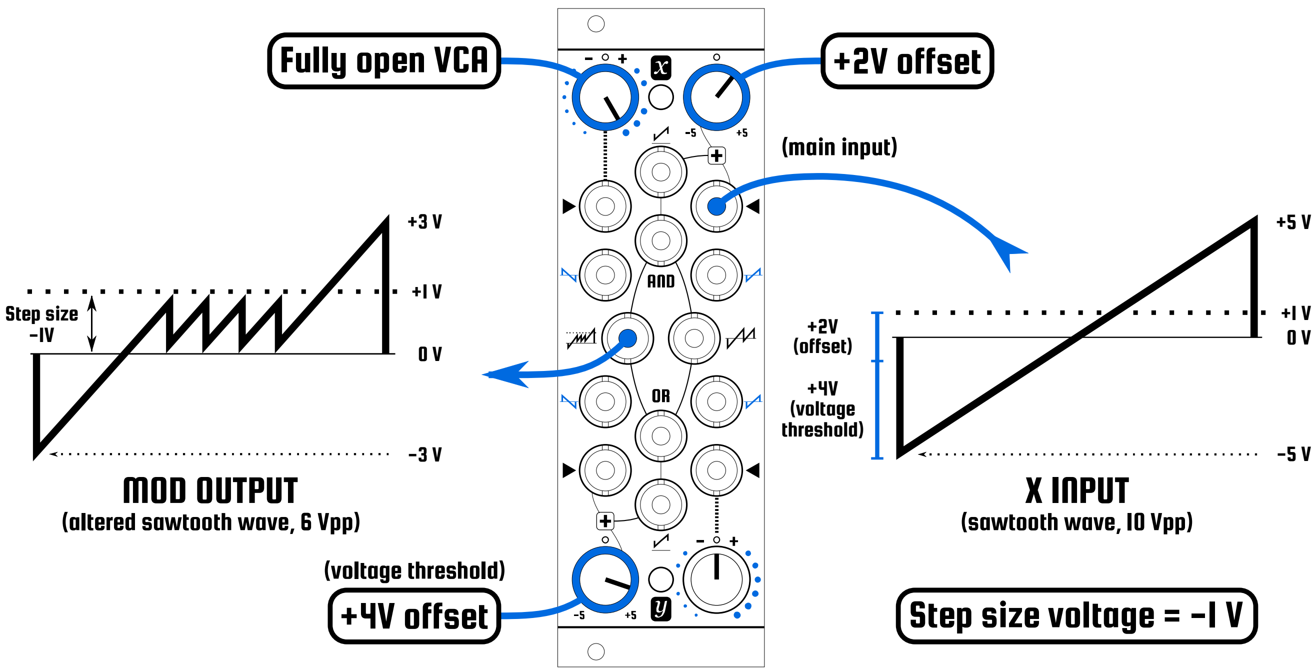
Block diagram



This circuit tries to **reproduce the mathematical modulo operation** using analog switches, comparators and mixers interacting in a quirky way.

Basically, it takes **x + offset** as its **main input** and **y + offset** as a **voltage threshold**. When the main input reaches the threshold level, another voltage called "**Modulo step size**" (set by the trimmer on the back of the module) is added or substracted. Then, if **x + offset** reaches/rises by the voltage threshold amount again, the **step size** voltage is added or substracted again **up to four times**, from now on called "**steps**". After the last step, no more processing takes place and the circuit simply tracks the main signal changes. Additionally, the "**Modulo output polarity**" jumper on the back allows you to invert (or not) the MOD output signal.

The circuit's behavior is roughly pictured by the symbol next to the MOD output: the straight line represents **0V**, the dotted line illustrates the **voltage threshold level** at which the step size voltage is added or substracted, and the altered sawtooth wave portrays the **resulting waveform** of the following base patch:



Let's break down what is going on:

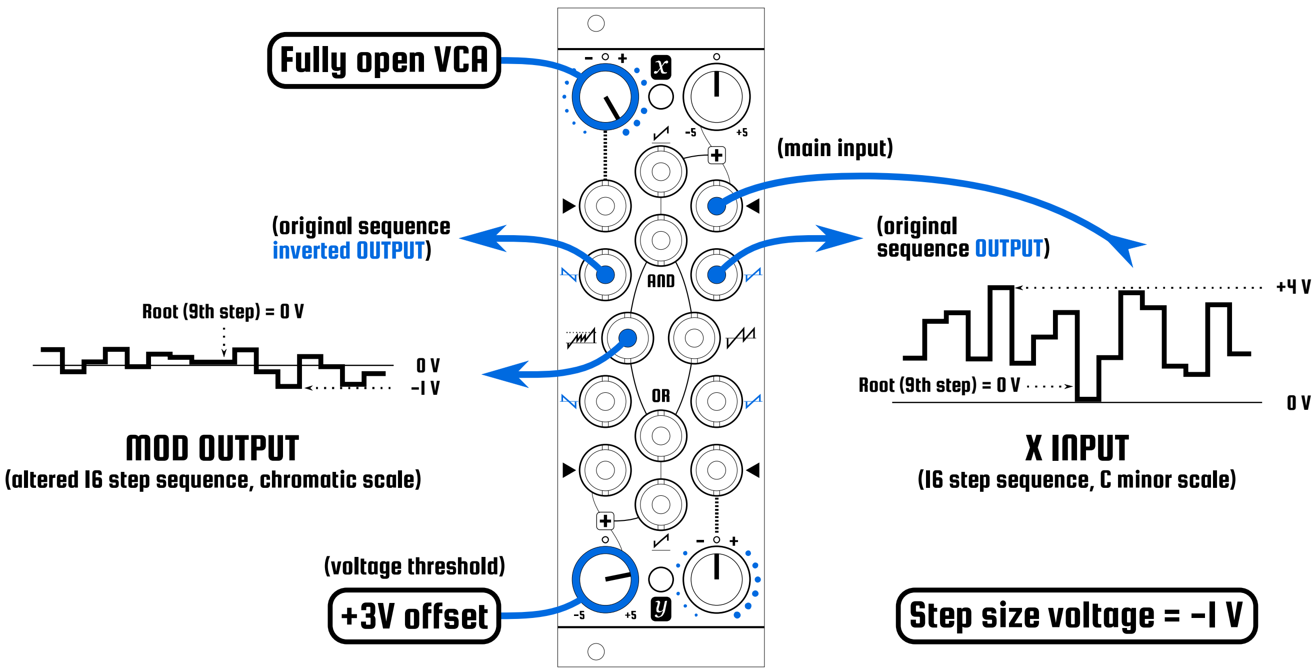
The 𝒳 channel has as its input a sawtooth wave with an amplitude of **-/+5V** coming through a fully open VCA. This waveform gets summed with the **+2V** coming from the 𝒳 offset knob, resulting in the **main input** of MOD (**𝒳 + offset**).
On the 𝒴 channel, the only signal is the **+4V** coming from the 𝒴 offset knob, producing the **voltage threshold** of MOD (**𝒴 + offset**).

Both offsets effectively mix together (**+2V + 4V = +6V**) and, starting from the bottom of the waveform (**-5V**) they set the **actual voltage threshold** level (**+1V**) at which the **step size** voltage kicks in and **substracts -1V** from the signal, making it fall back to **0V**. As the sawtooth wave continues to rise, this process repeats three more times (**four steps in total**) and then the signal keeps rising unaffected until the end of its cycle.

As we'll see in later examples, different input signals and patch settings will drastically change the final result, from voltage-controlled waveshaping to bit-reduction/fuzz and distortion.

To be clear, in this example the voltage threshold level and the step size voltage appear to be the same thing because they share the 1V level dotted line by coincidence, but **they are very different and separate parts of this circuit** and in other patch examples their voltage levels will differ from one another.

Sequence / DC manipulation:



Here we have a 16 step sequence (**0 to +4V**, C minor scale, root = **0V**) as the 𝒳 channel's main input, therefore acting as the **main input** of MOD (**𝒳 + offset**).
On the 𝒴 channel, the only signal is the **+3V** coming from the 𝒴 offset knob, producing the **voltage threshold** of MOD (**𝒴 + offset**).

The key thing to understand here is that **moving the *y* offset knob CCW restricts the range of the altered sequence** coming out of MOD, even going into the negative realm as shown. This gives a bassier counterpoint to the original sequence while **keeping its root note steady** (**9th step = 0V**) and **maintaining its tuning within the 12 notes of the chromatic scale** for more variance and/or dissonance, if you wish.
As a bonus, you get **two copies of the original sequence**, one of them inverted.

The mechanism by which this occurs is similar to that of the first example:
When a certain sequence step reaches the **voltage threshold** set by ***y* + offset**, the **step size voltage** (**-1V**) kicks in and substracts a voltage that, in this case, is **inversely proportional of said threshold level**: the higher ***y* + offset** is, the lesser of an effect this would have on the step sequence and viceversa.

Take into account that for this patch to work as intended, the **Modulo output polarity jumper** in the back of the module must be set to **positive (+)** and the **Modulo step size trimmer** must be set at **EXACTLY -1V** as it comes when we calibrate each unit before shipping.

Modulo step size – calibration procedure:

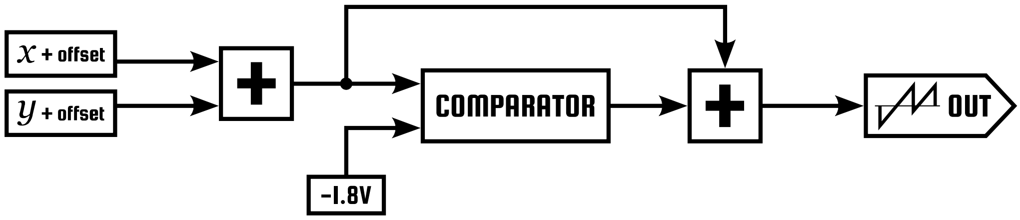
First of all, beware that you will be doing this with your system turned ON, so be careful to not touch or poke into anything other that the labeled probing points on the back of the module.

You'll need a **multimeter** and a **small flat head screwdriver**.

- Put your multimeter on DC voltage mode (the V with straight lines).
- Test this two points at the same time: **one of the screws (labeled GND)** with your COM probe and the **circled test point below the Modulo step size trimmer** with the V probe. You should now be reading a voltage between 0V and +3.3V (or 0V to -3.3V if you placed the probes backwards, doesn't matter really).
- While probing those two points, **start adjusting the trimmer** until the multimeter reads exactly 1.000V for factory calibration. Feel free to experiment with different voltages to achieve different results!
- **Turn off your system** and put SIGNOS into your rack again.
- Done!

SHIFT waveshaper

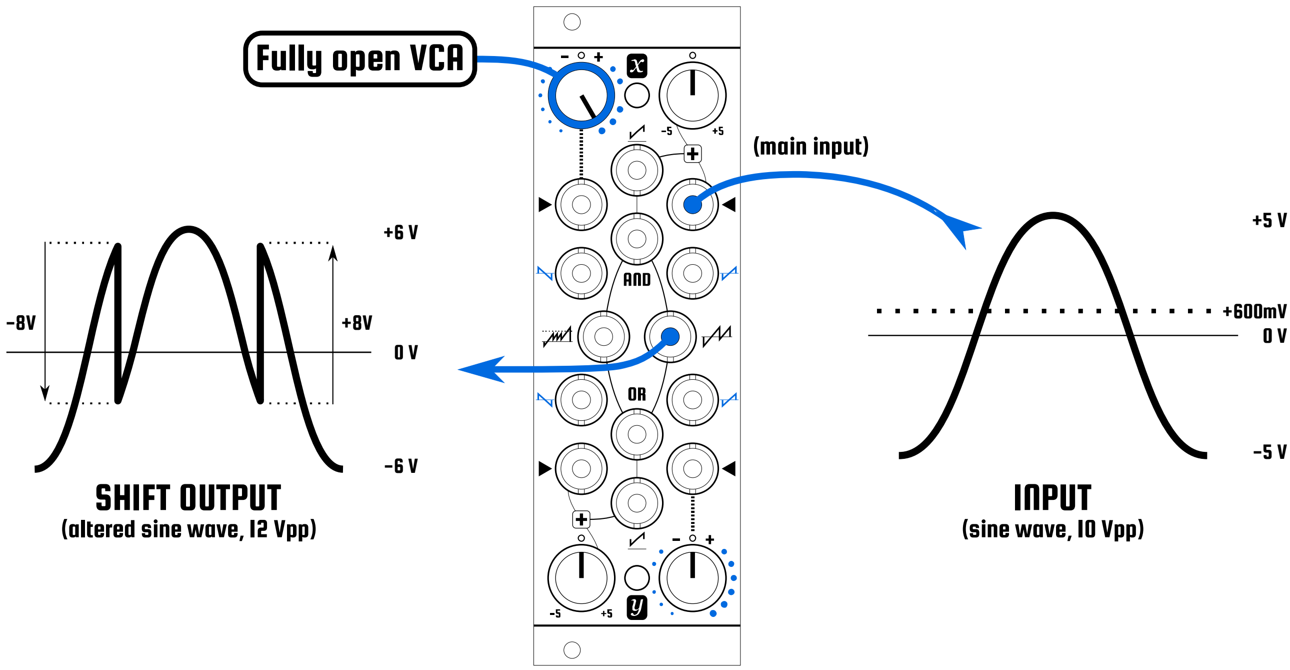
Block diagram



This simple circuit combines two mixers and a comparator to form a wave-shifter that, at first glance, doesn't look like much – however it **packs a lot of shaping capabilities** such as **sawtooth frequency-doubling**, complex waveshaping, **distortion**, self-oscillation and more, **especially using feedback** patching techniques as we'll see later.

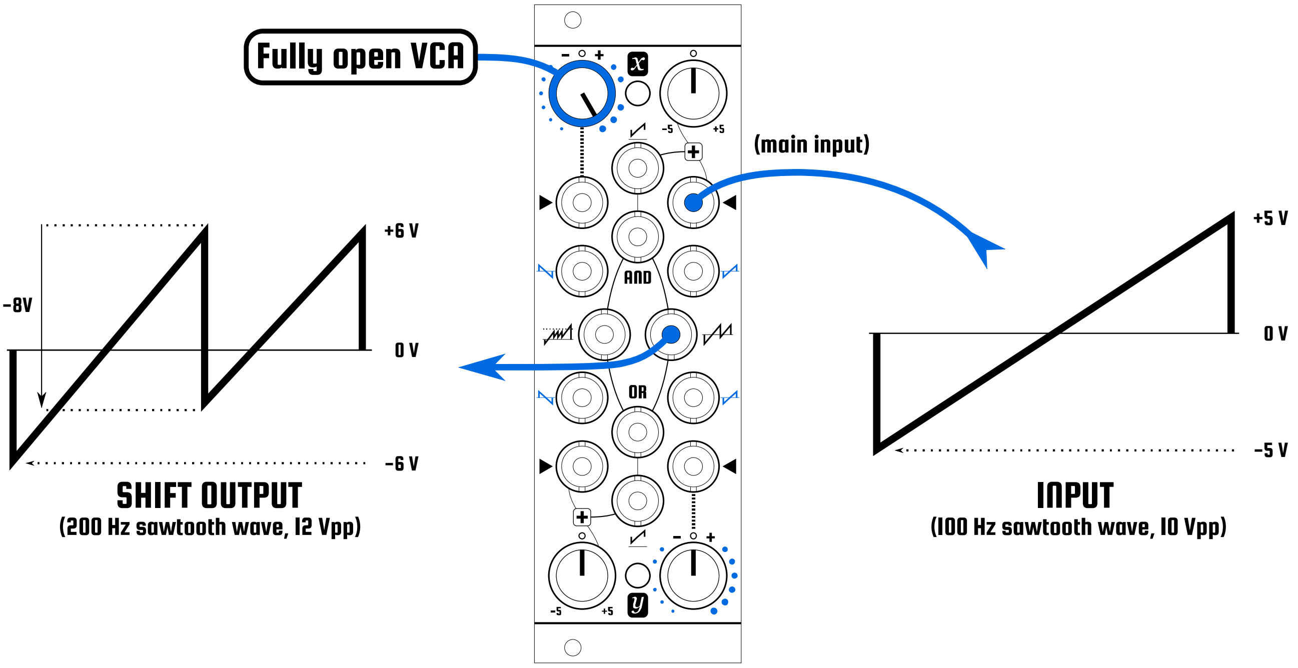
Basically, both x **+ offset** and y **+ offset** get summed together and then fed to both the comparator and the second summer, while the fixed -1.8V reference voltage cancels out the offset introduced by the comparator.

To better explain how SHIFT works, we'll assume that the input of the circuit it's a 10Vpp sine wave. If it **exceeds +600mV,** the comparator's output will change and **subtract 8V** to the signal seen at the SHIFT output, introducing a sharp discontinuity/fold to the waveform. The sine wave will then continue its cycle unaffected; when it **drops below +600mV** the comparator's output will change again, **adding 8V** to the signal seen at the SHIFT output, producing another discontinuity in the waveform.



The SHIFT circuit's behavior is roughly pictured by the symbol next to its output: the straight line represents **0V**, and the altered sawtooth wave portrays the **resulting waveform** of the following base patch:

Sawtooth frequency doubler:



The only input signal comes from the $\mathcal{X}$ channel, which has as its main input a sawtooth wave with a frequency of **100Hz**, and an amplitude of **10Vpp** that goes through a fully open VCA, representing the **main input** of SHIFT ($\mathcal{X}$ **+ offset**).

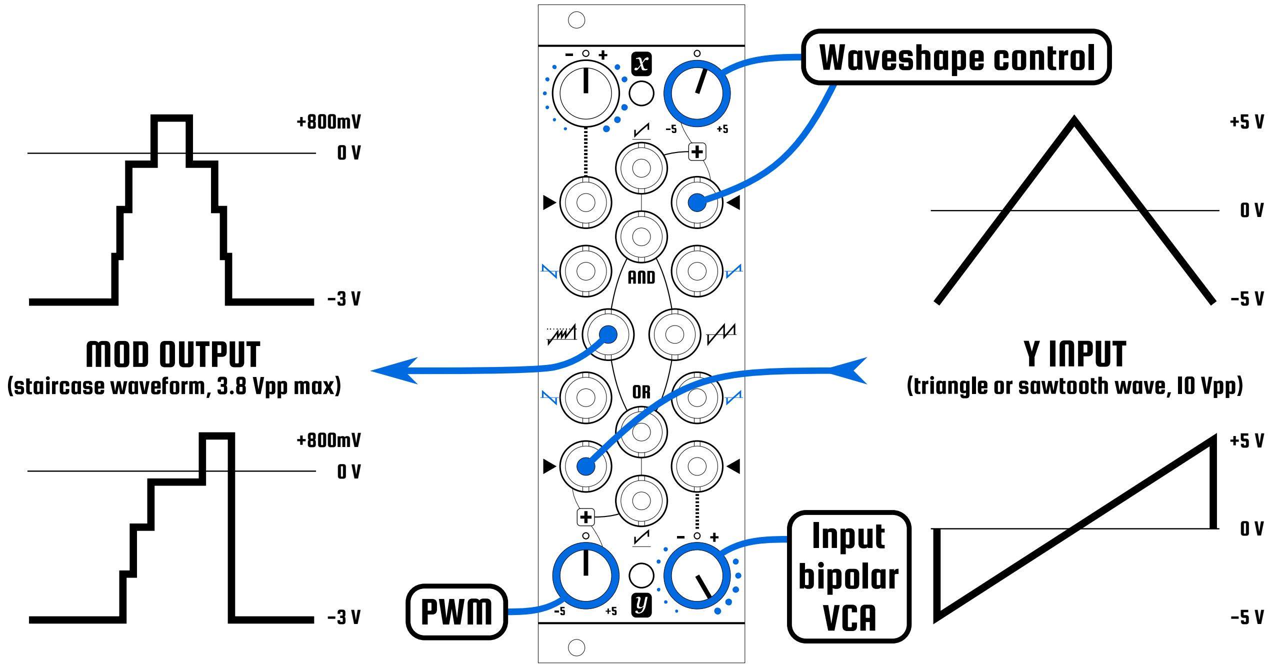
As the main input **rises above +600mV** the waveform at the SHIFT output, which is rising faster in voltage than the original and is now peaking at +6V, **gets dramatically shifted down by -8V**. After that, the signal keeps rising unaffected until the end of its cycle.
This discontinuity effectively **doubles up the frequency** of the SHIFT output from 100Hz to 200Hz.

The SHIFT output waveform can be modulated by the $\mathcal{Y}$ channel's offset and inputs, effectively mixing with the main input of SHIFT at the first summer ($\mathcal{X}$ **+ offset** + $\mathcal{Y}$ **+ offset**) as previously shown. This means that unlike in the MOD waveshaper, **both channels can act as the main and/or the modulation input of the SHIFT circuit indistinctly**.

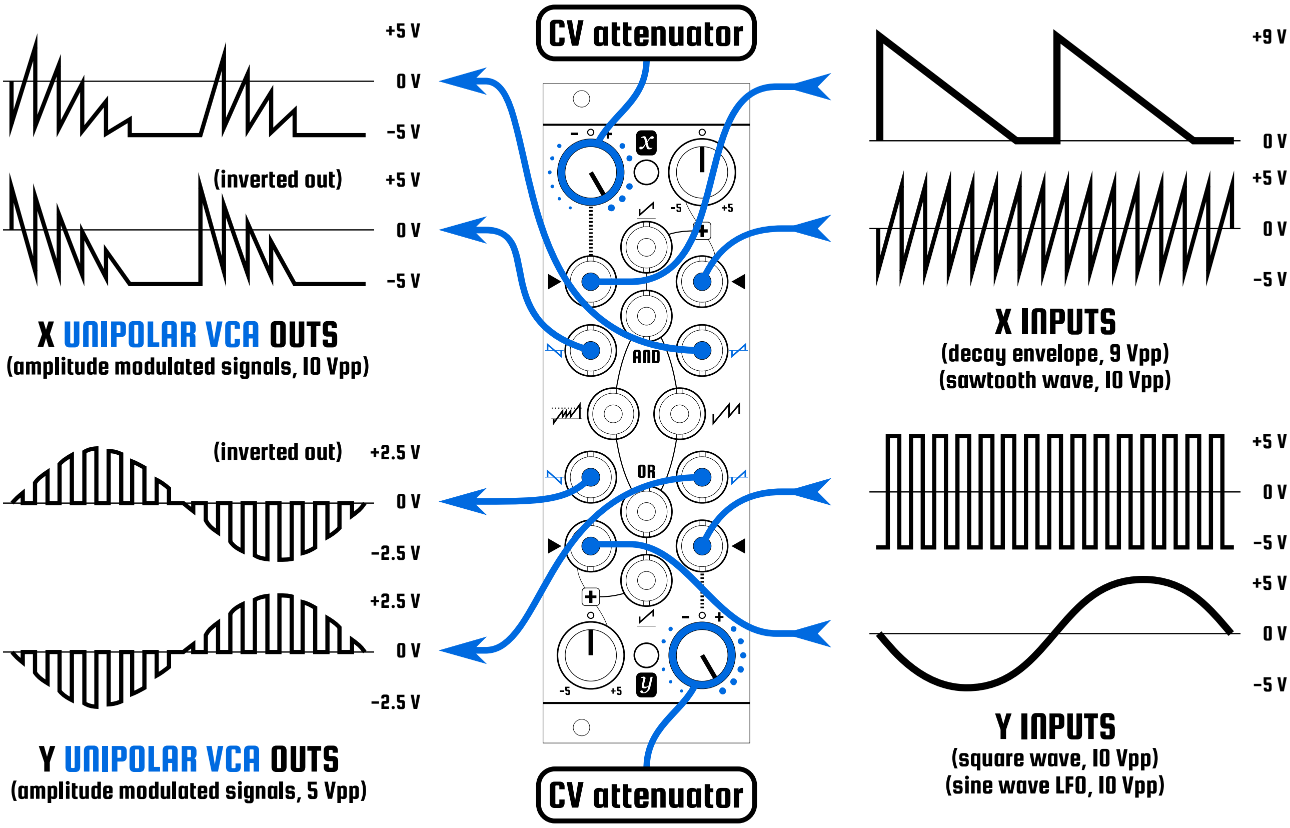
For example, sending an LFO or random voltage into the $\mathcal{Y}$ channel's main input will bias the output waveform along with the LFO's cycling movement, producing a supersaw-like effect.

More patch examples!

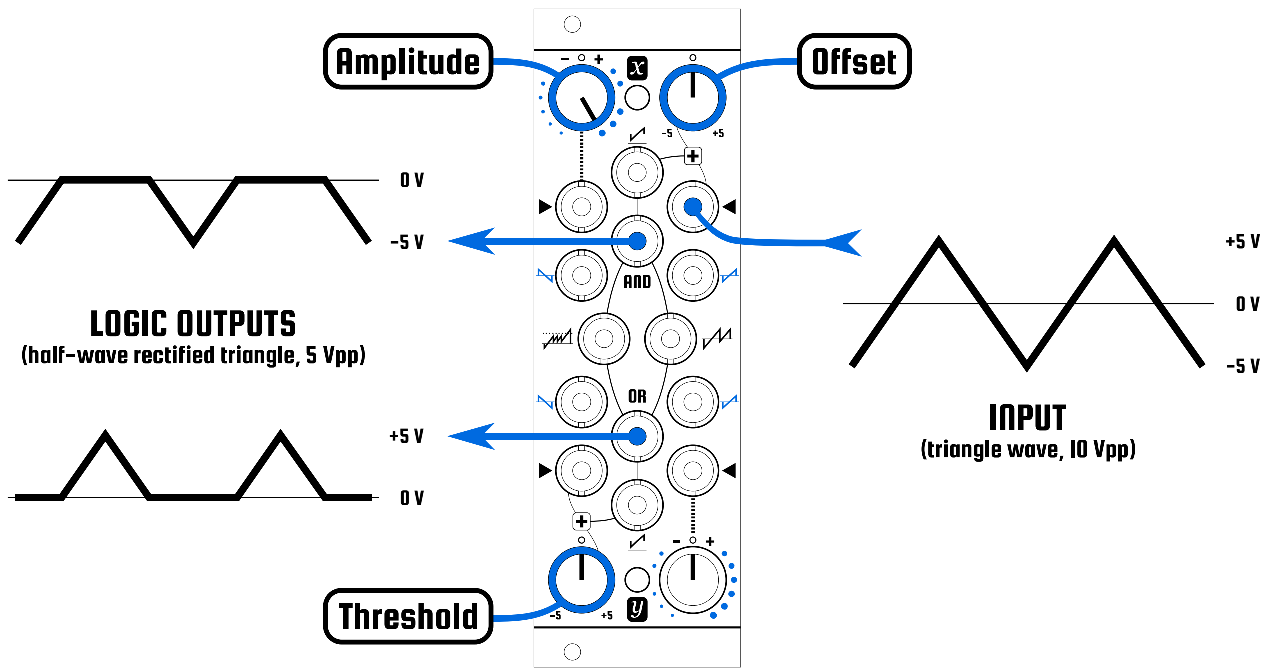
Staircase waveshaper:



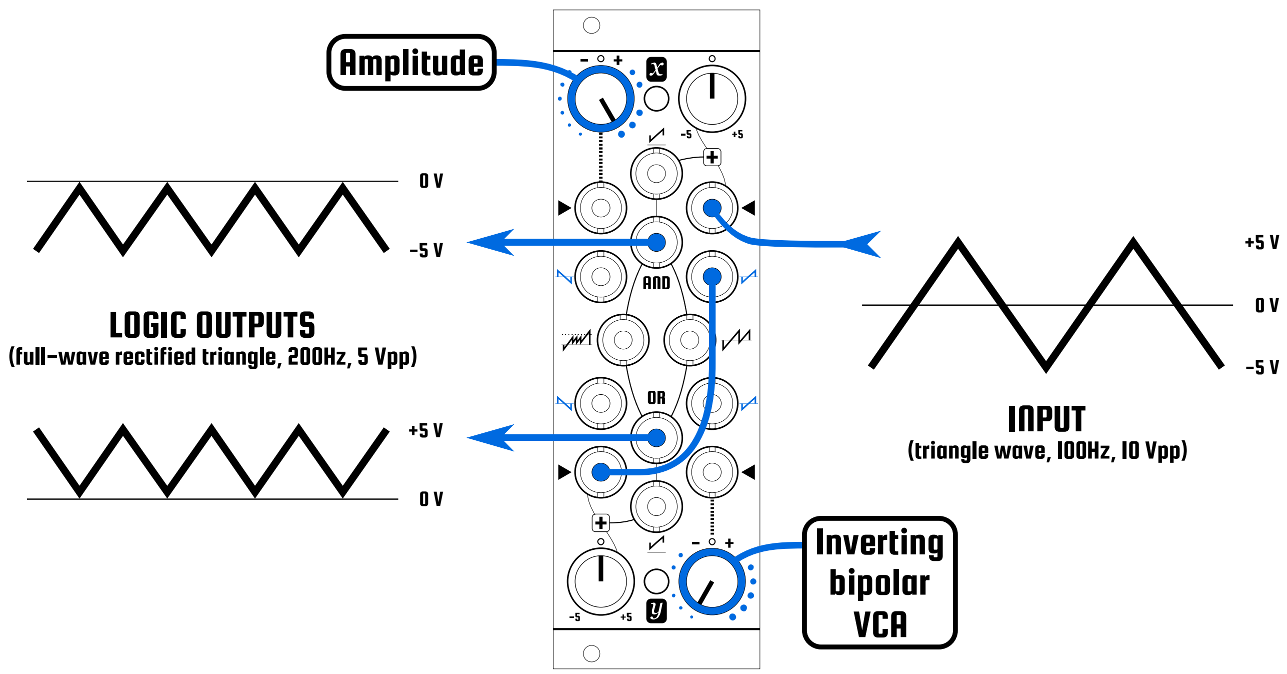
Dual linear VCA with normal and inverted outputs:



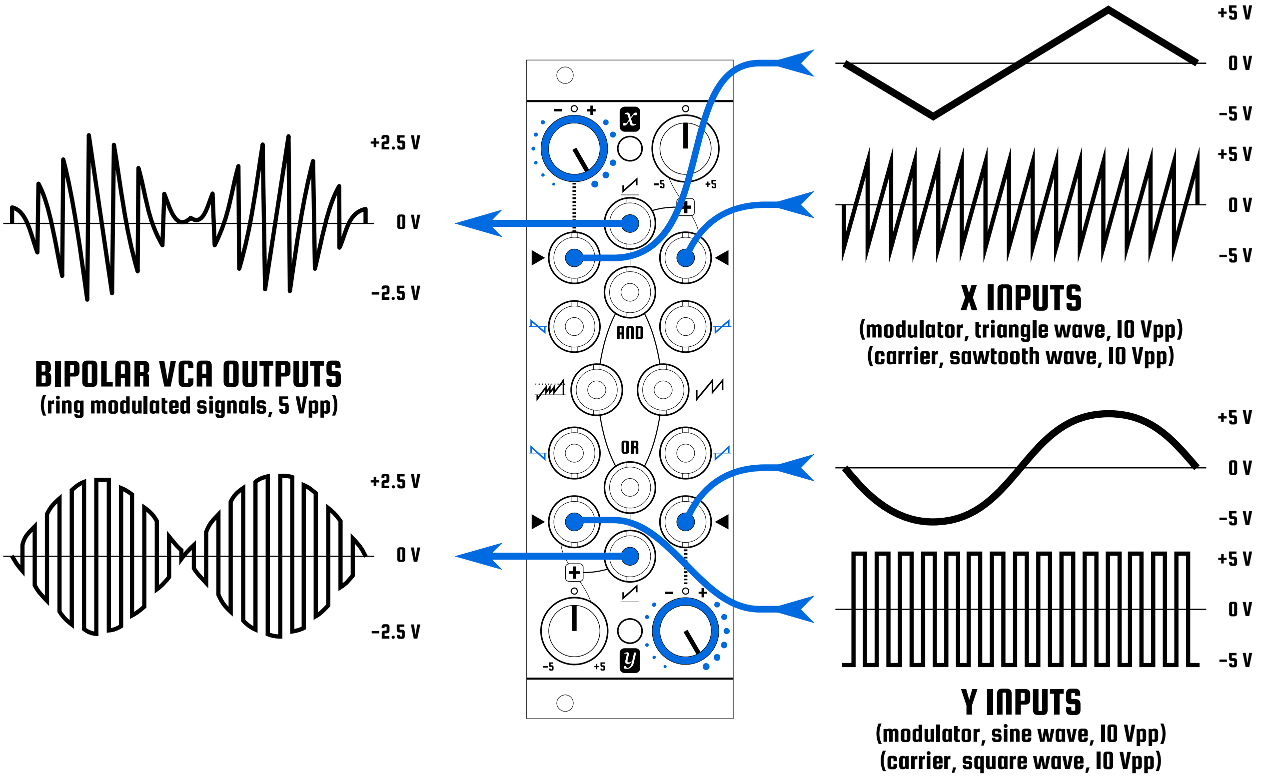
Half-wave rectification (with variable offset and threshold):



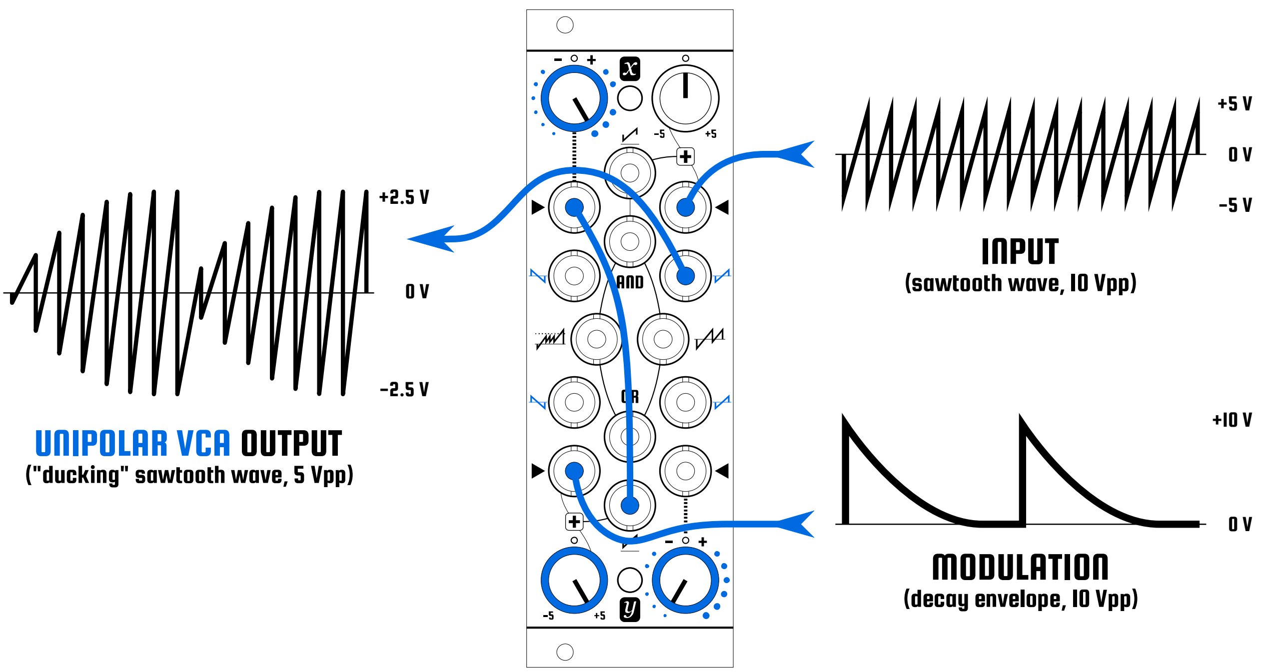
Full-wave rectification:



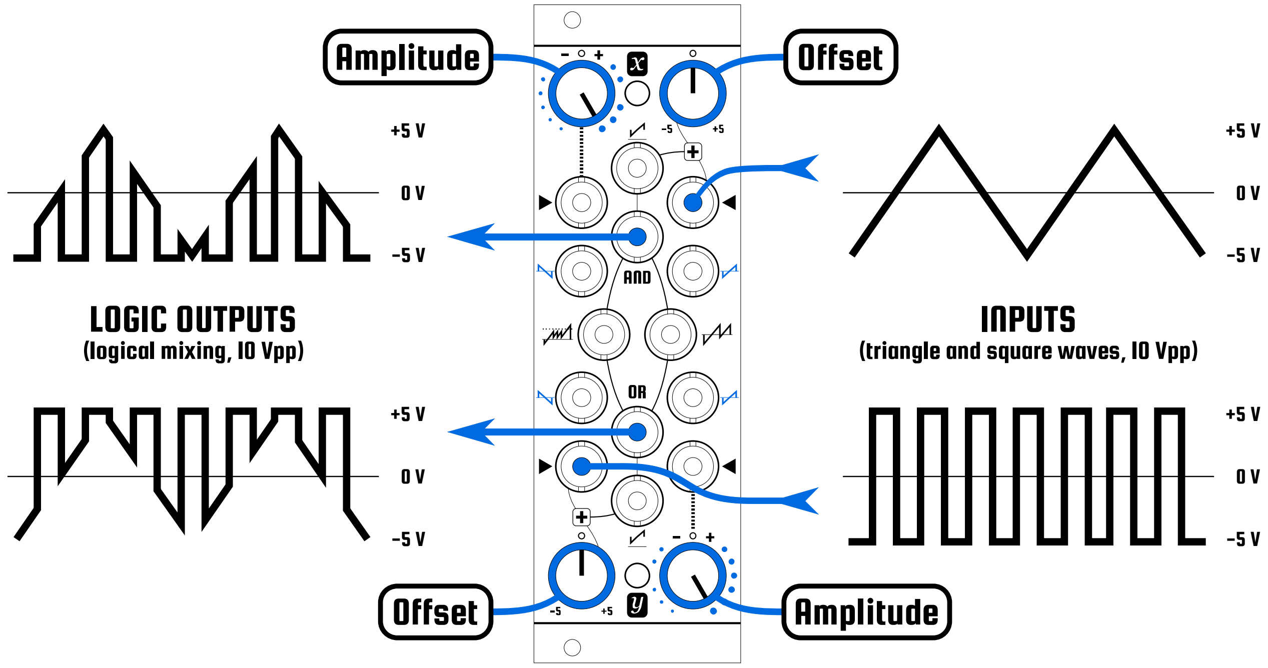
Two independent ring modulators:



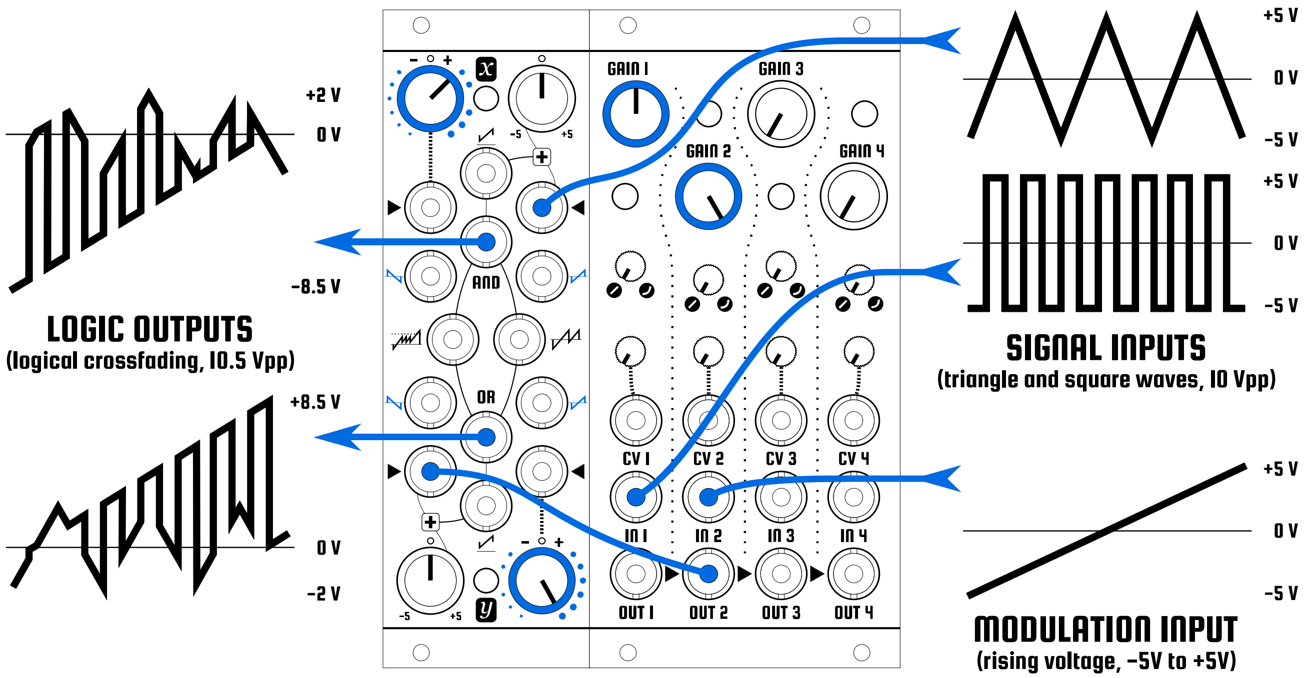
Ducking / "sidechaining":



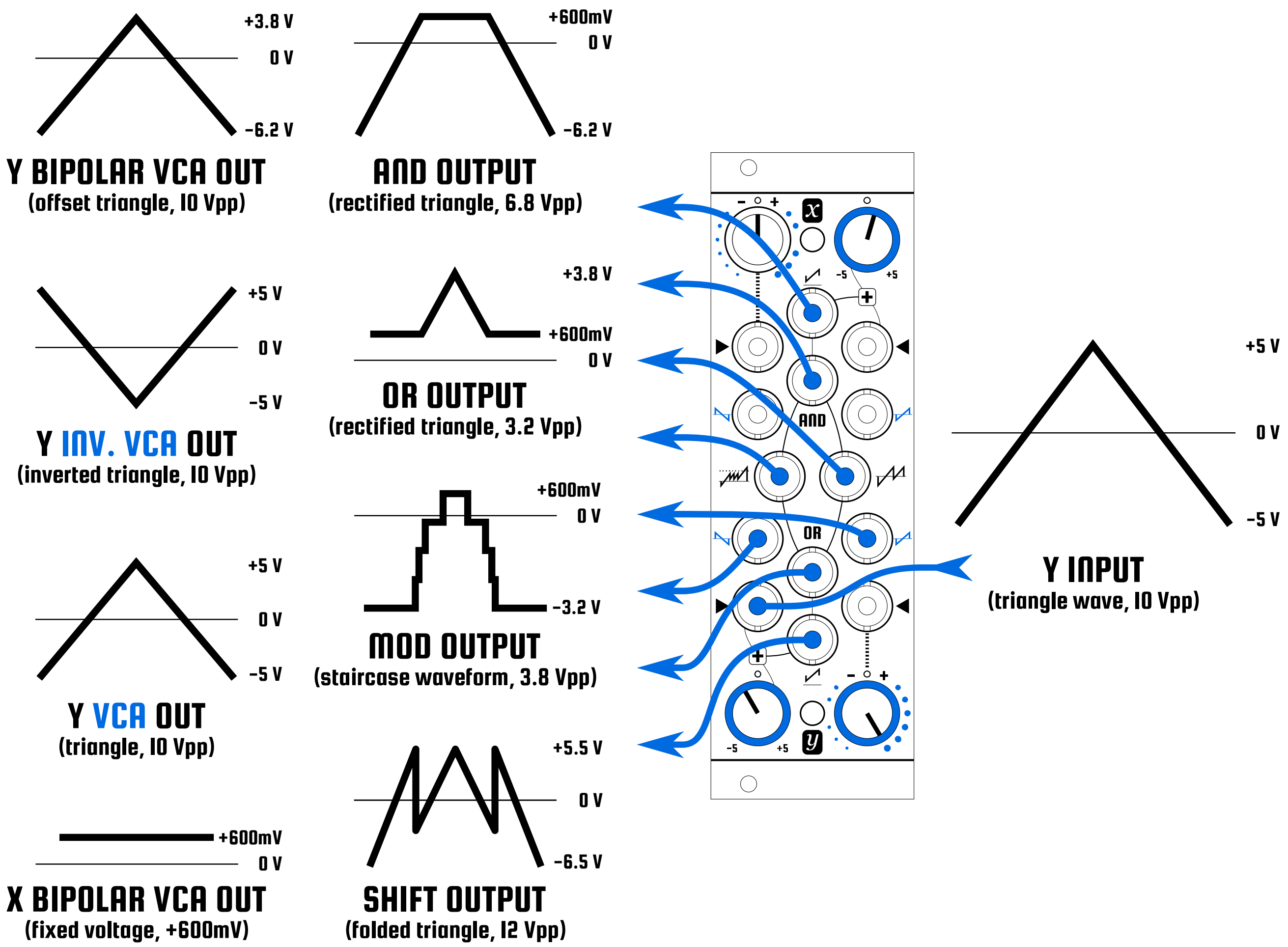
Logical mixing (with variable offset and amplitude):



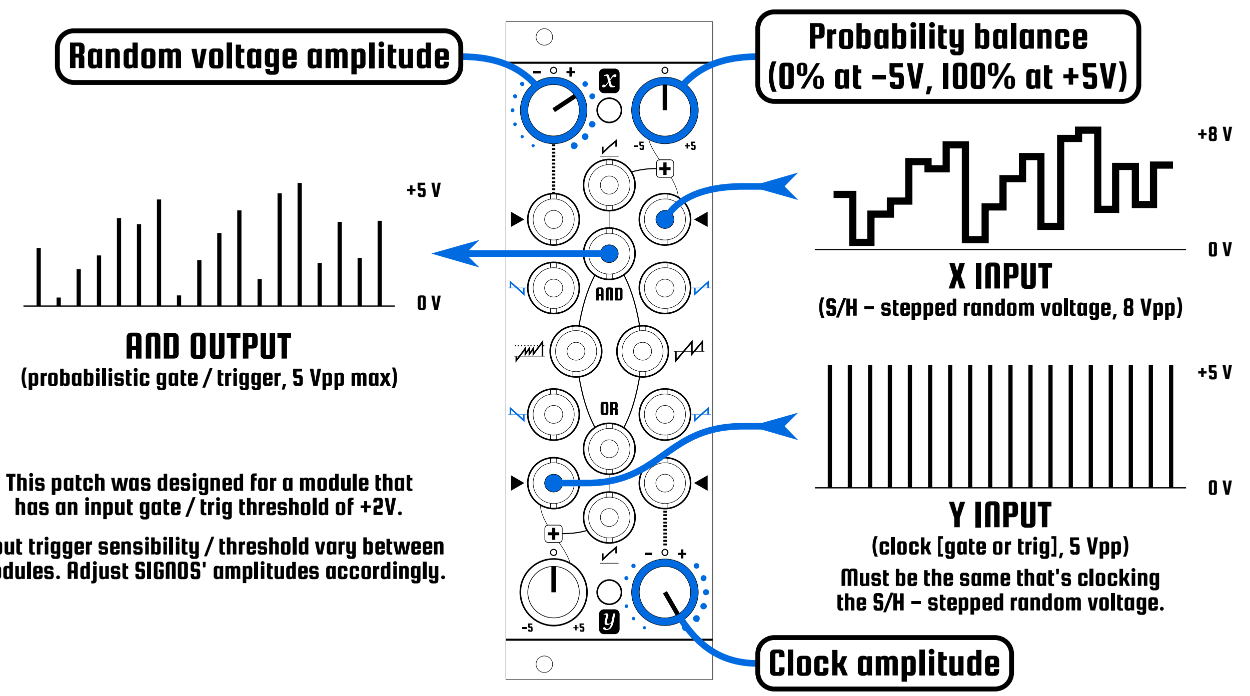
Logical crossfading:



One input, eight related outputs:



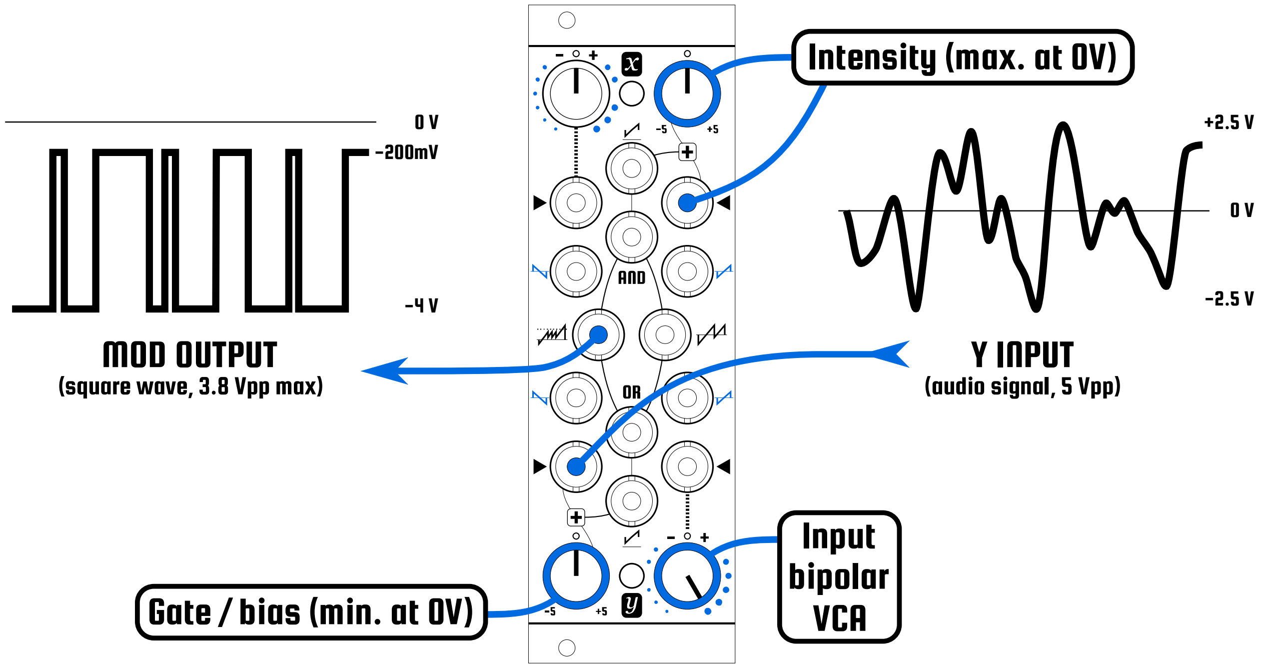
"Bernoulli gate":



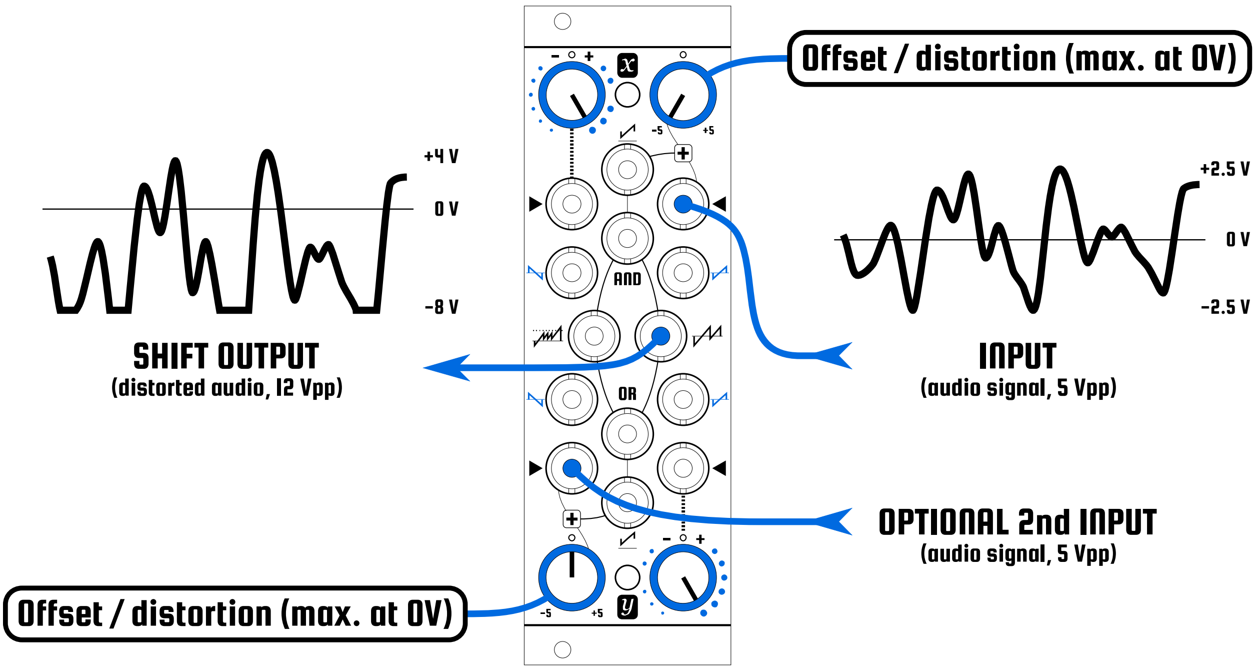
This patch was designed for a module that has an input gate / trig threshold of +2V.

Input trigger sensibility / threshold vary between modules. Adjust SIGNOS' amplitudes accordingly.

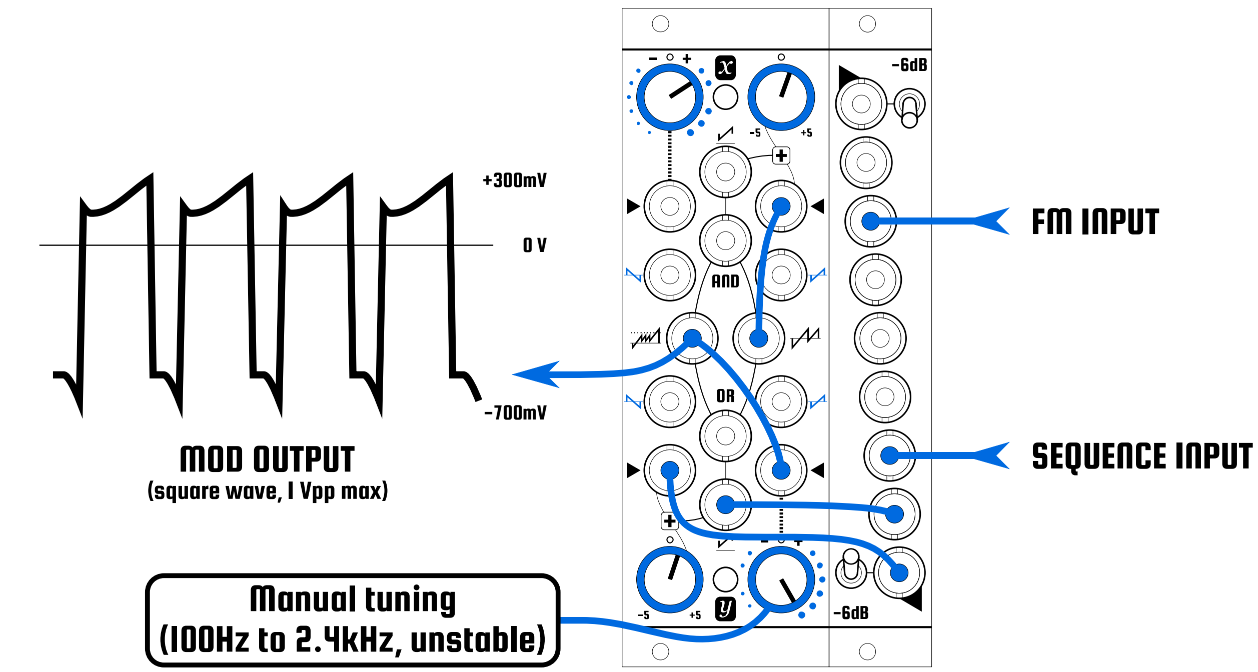
Variable bit-reduction / voltage controlled fuzz:



Asymmetric clipping / nasty distortion:



Feedback square wave oscillator:



Triangle to sine / feedback waveshaper / "wavefolder":