



# COSMOS

User Manual

V1.0



## **Thank you for purchasing the Cosmos.**

Cosmos is a new kind of module that will help you to creating complex modulation, sounds, patterns with ease and will lead you to new sounds territories.

Inspired by early analog computers, Cosmos is a unique, innovative, very flexible and fully analog module allowing it to be used as: VCO, LFO, Ring Mod, Polarizer, "VCA", "LPG", Phase Lock Loop, Cross-Modulation, Minimum, Maximum, Logic Gates, Waveshaper, Complex gate generator, Fuzz, Distortion, Gate extractor, Trig extractor, Gate generator, Voltage generator, Trig Generator, comparator, window comparator, complex comparator, Half-Rectifier, Full-Rectifier, Inverter, Buffered Multiples, Mixer, Difference, Compressor, Sidechain, compressor, VC Clipper, VC Switch, Clock doubler, Envelope follower, and more.

With its wide fields of application Cosmos can replace many modules but it will also bring new colors to your palette thanks to its unique character. This makes Cosmos the ideal module whether you have a small case or a big system. 100% analog and with an intuitive interface Cosmos is also very easy to use, no menu and button combo problems.

## **Waranty**

BLACK NOISE warrants its products to be free of defects in materials or workmanship and to be conform with the specifications at the time of shipment for a period of two years from the date of purchase. During that period any malfunctioning or damaged units will be repaired, service and calibrated into your workshop.

This warranty does not cover any problems resulting from damages during shipping, incorrect installation or power supply, abusive treatment, or any other obvious user-inflicted fault. If your product warranty is passed, it still can be serviced as long as parts are available in our workshop. We reserve the right to charge for labor, parts and transit expenses where applicable.

Before sending your product to our workshop please contact us for RMA and details. Any unsolicited parcel will be rejected and/or returned. The postage to our workshop is on the customer. The return of your module is on us. BLACK NOISE cannot take any responsibility for damages caused during transport.

### **Contact us**

[contact@blacknoisemodular.com](mailto:contact@blacknoisemodular.com)



### **Specs**

Width: 14HP

Depth: 30mm

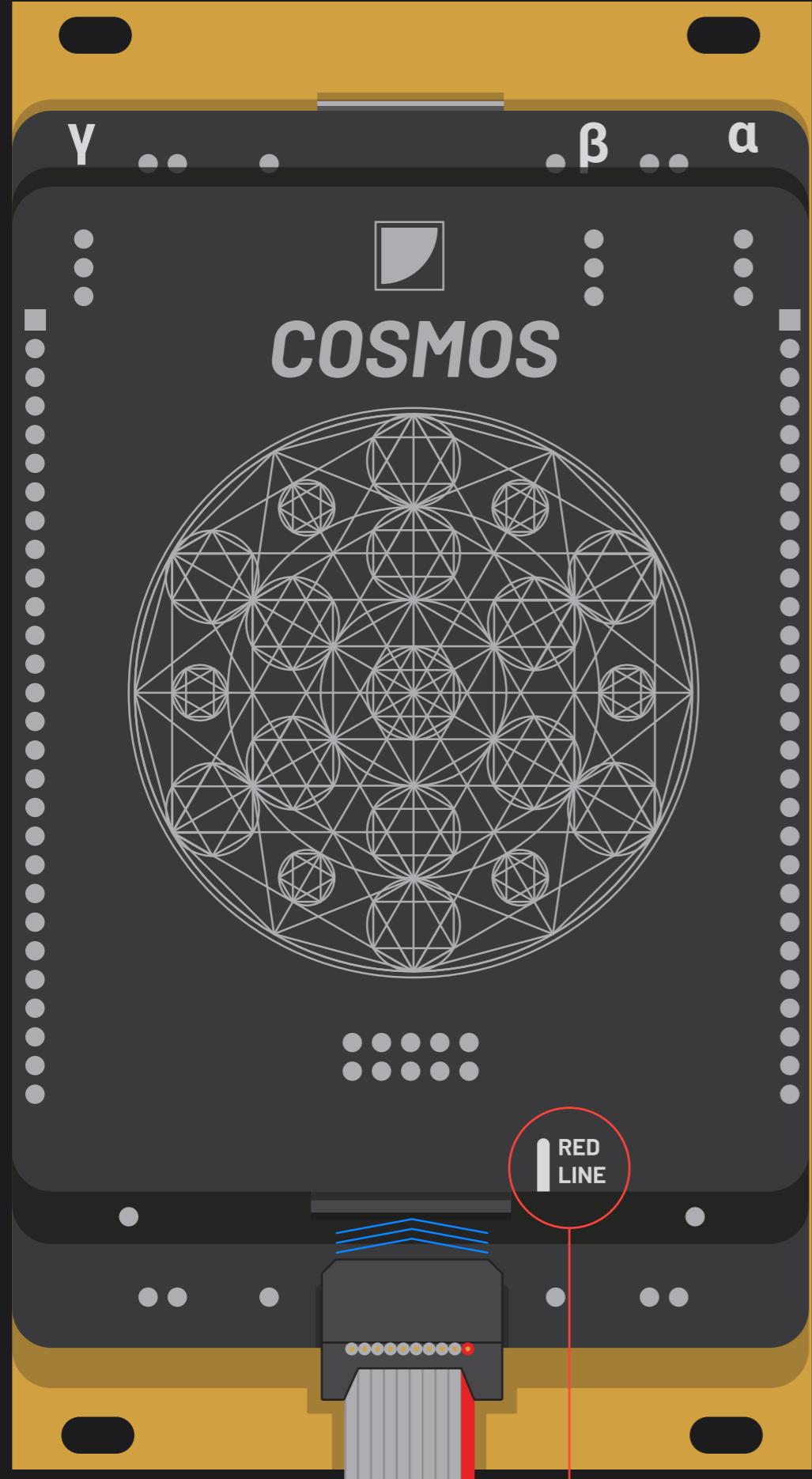
Power : +12V: 65ma

-12V: 65ma

+5V: 0ma

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# Starting the Cosmos

## Installation

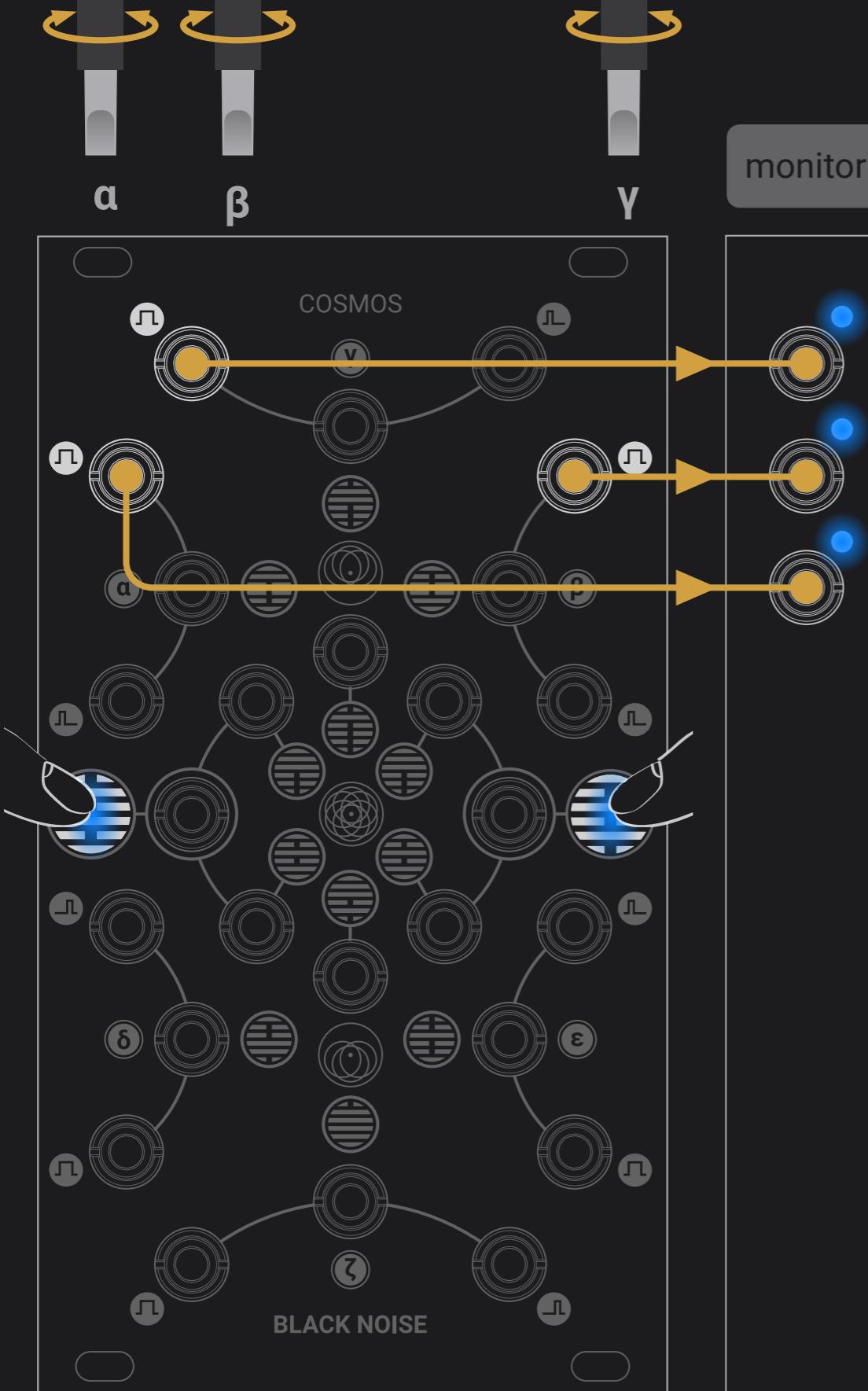
1. Turn off your eurorack system and pull of the cord.
2. Connect the provided ribbon cable's 16 pin head to you to the system's power bus, making sure the red stripe matches the one indicated on the bus
3. Connect the provided ribbon cable's 10 pin head to the Cosmos, making sure the red stripe matches the one indicated on the bus.
4. Place the Cosmos on the rails of your system and attach it with the included screws.
5. Put your system's power cord back in and turn it on.
6. Test the module by pushing firmly on the tactile pads. the Related LEDs should light up according to the pressure on the pads.
7. The Cosmos is ready. Have fun!

## !! Always use the provided ribbon to power Cosmos !!

It has a specific header orientation. Other ribbon won't damage the module, but it will not start. **Don't use the provided ribbon to power another shrouded module.**

If the test procedure described above, comes to fail, don't hesitate to reach out with BLACK NOISE.

# Starting the Cosmos

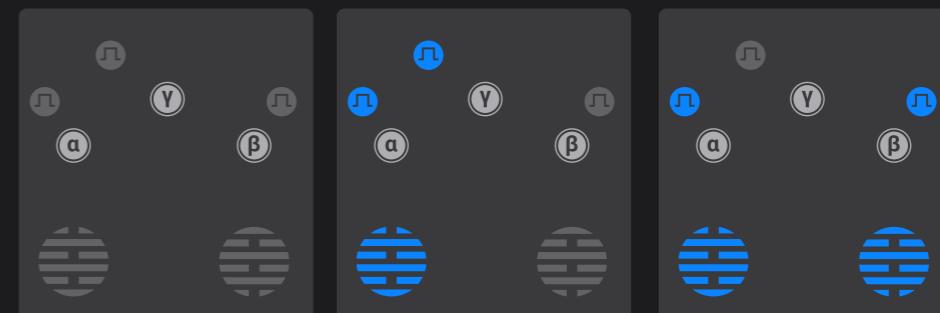


## Calibration

This step is only in case of unexpected behavior.

The module comes fully calibrated and ready to use. As the circuit is analog, some adjustment might be required over time. The trimmers on the top of the back are adjusting the threshold of their respective outputs to be converted into gates. These thresholds should be set as close as zero. Monitor the three gates output with an oscilloscope or a simple LED equipped module such as GOMA and test the module by pushing on the pads or sending gate sources to the inputs.

1. **a** should be LOW by default, HIGH when any pad is pushed. Adjust the **a** trimmer if it is not the case.
2. **β** should be LOW by default, LOW when a single pad is pushed, and HIGH when the two pads are pushed. Adjust the **β** trimmer if it is not the case
3. **γ** should be LOW by default, HIGH when a single pad is pushed, and LOW when the two pads are pushed. Adjust the **γ** trimmer if it is not the case.

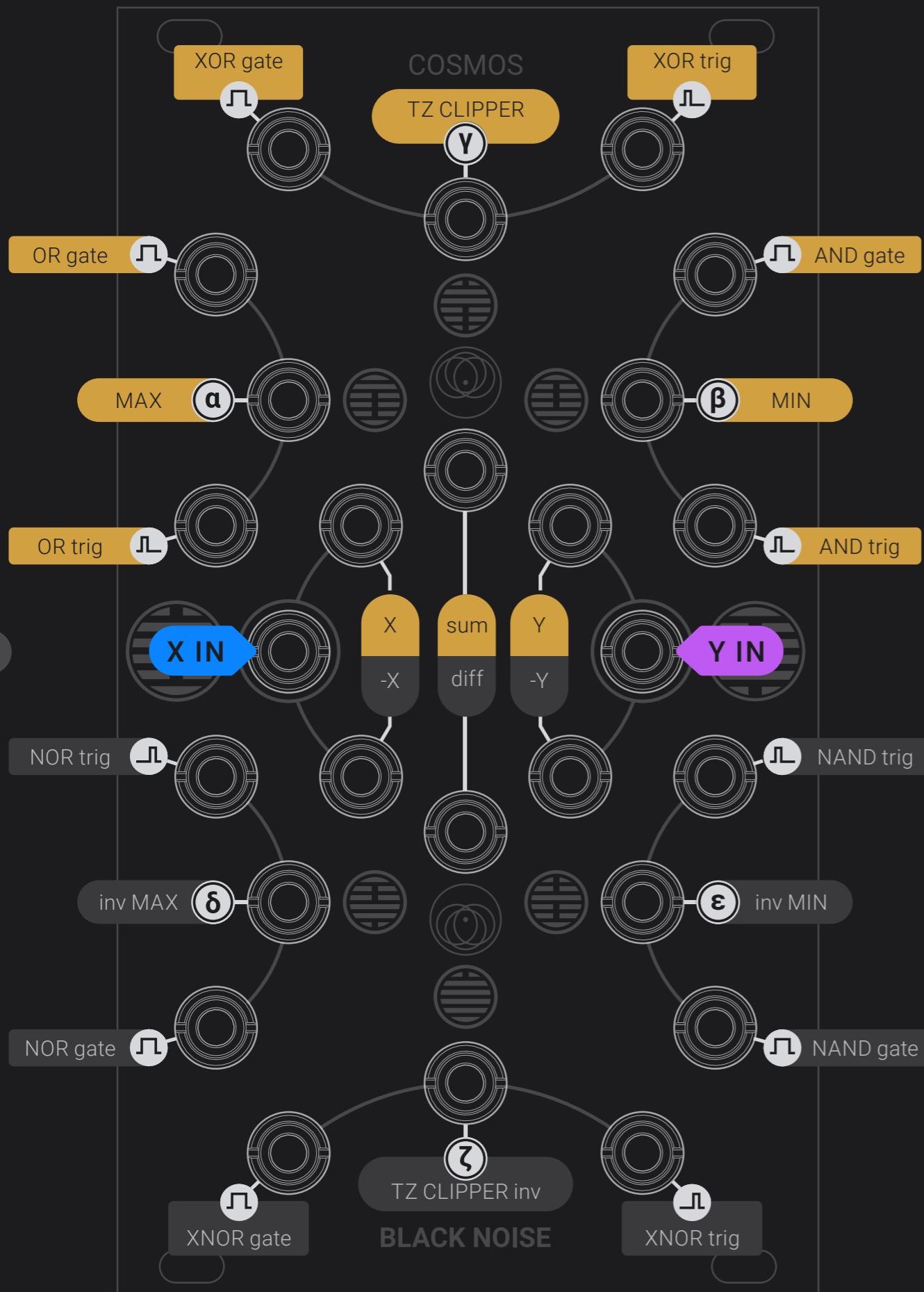


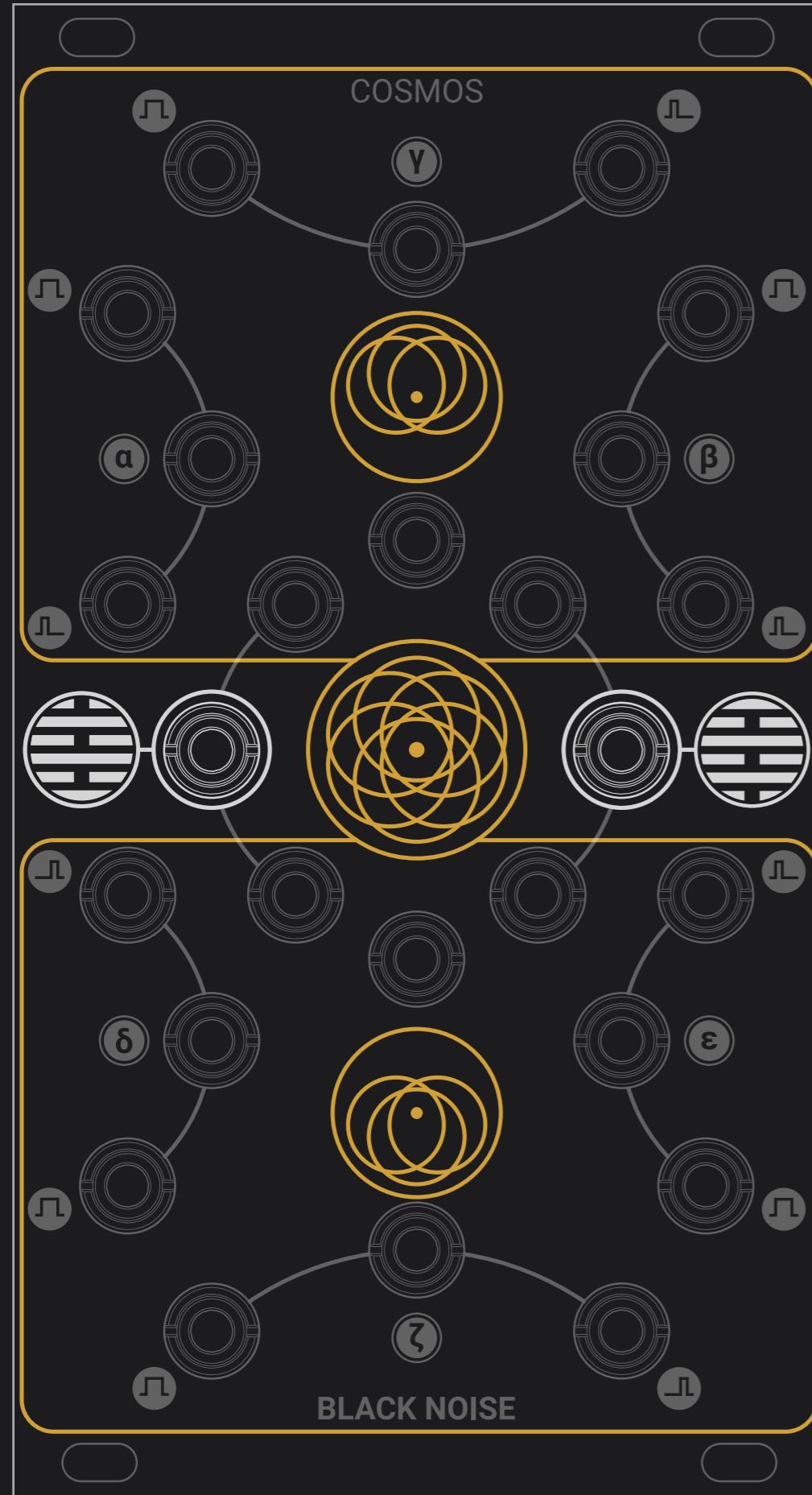


# A map of the Cosmos

## Cheat sheet

- input
- analog out
- inverted analog out
- gate out
- NOT gate out





# Looking through the Cosmos

## The Cosmos is large, but its structure is simple:



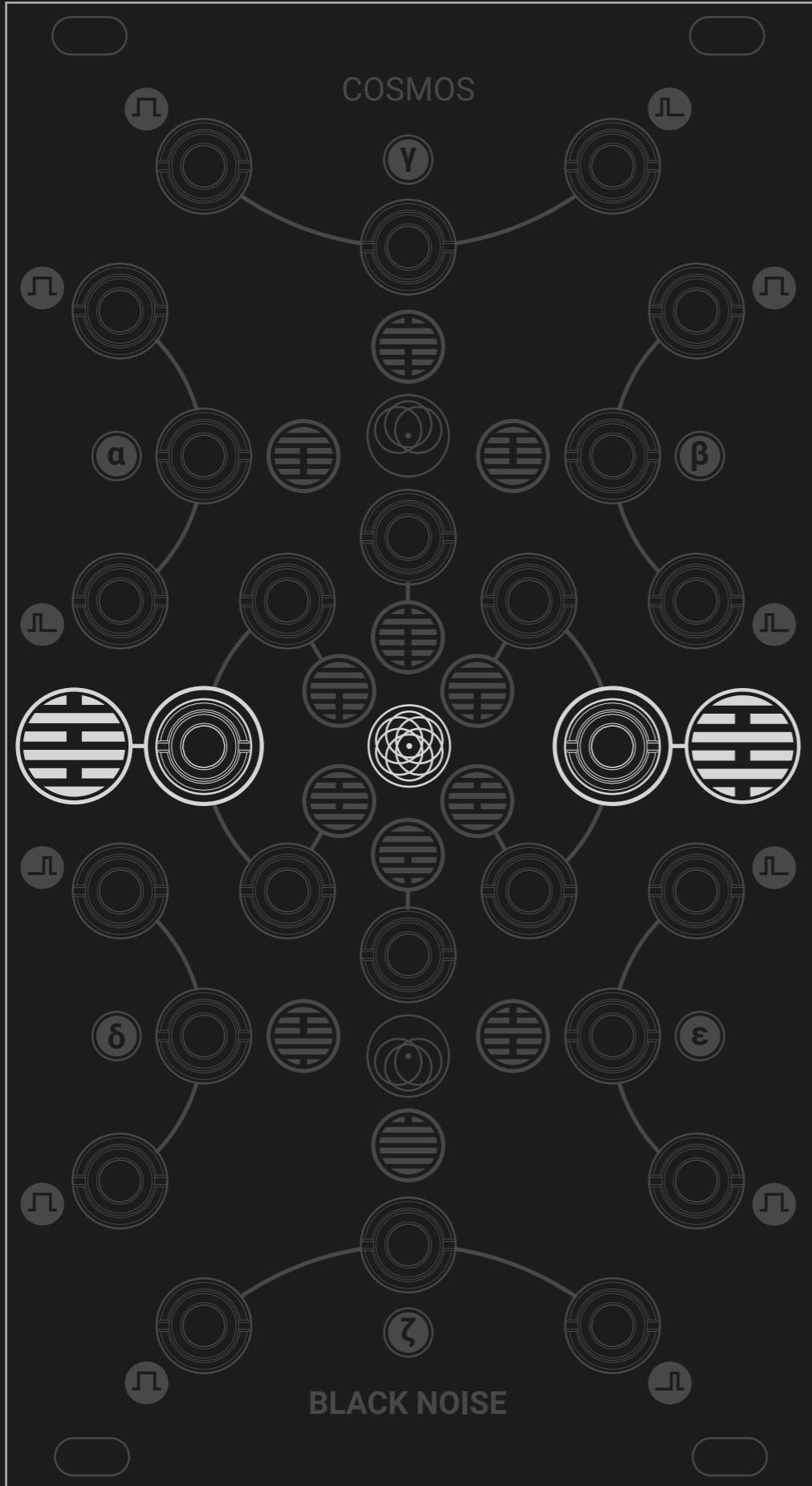
## Two inputs with normalized touch pads



A top hemisphere that provides all kind of CV combination, with their logic gates and rising edge trigger counterparts



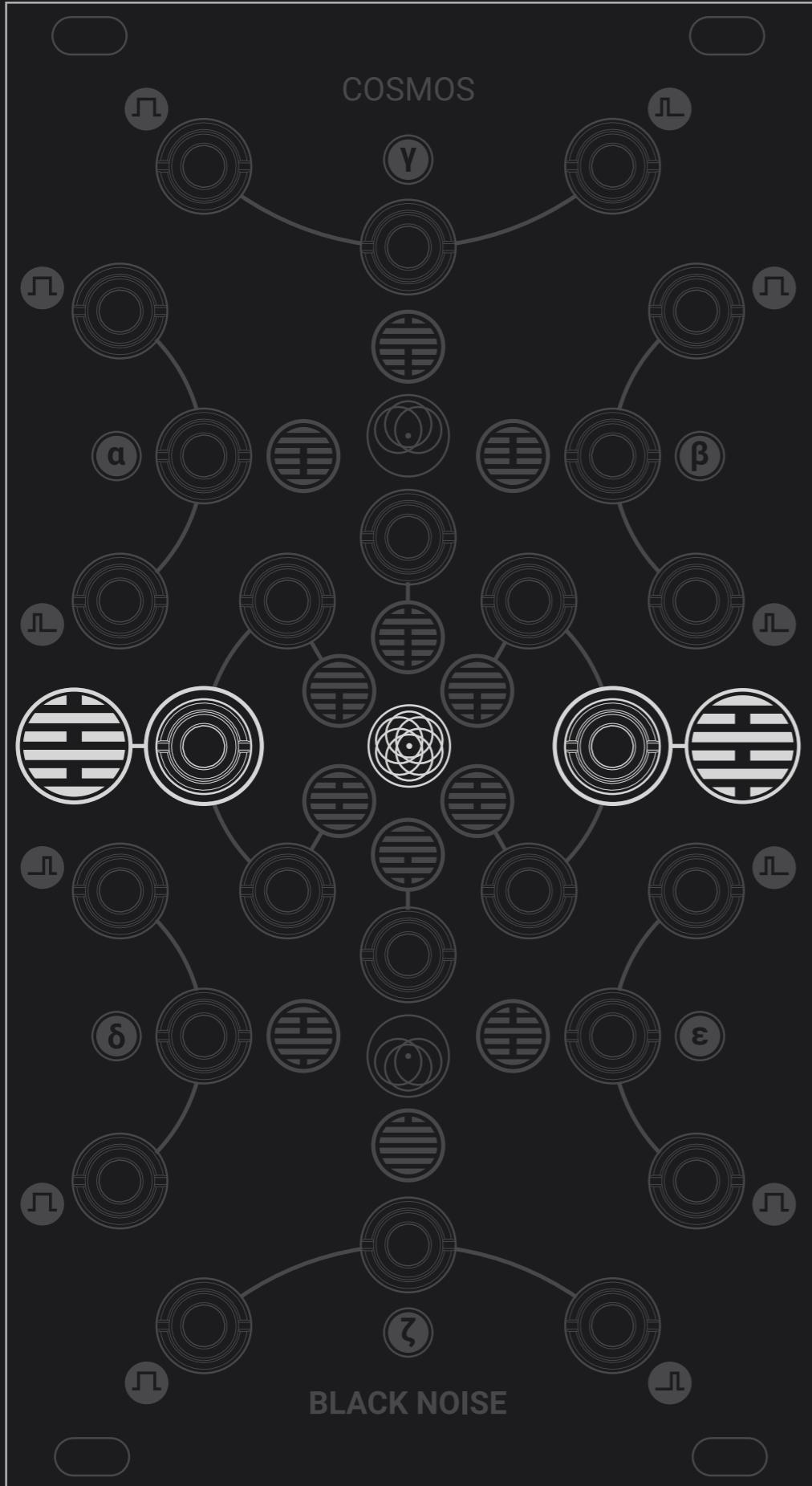
A lower hemisphere that provides a phase-inverted version of the top hemisphere, with their NOT gates logic and fall trigger counterparts.



## Entering the Cosmos

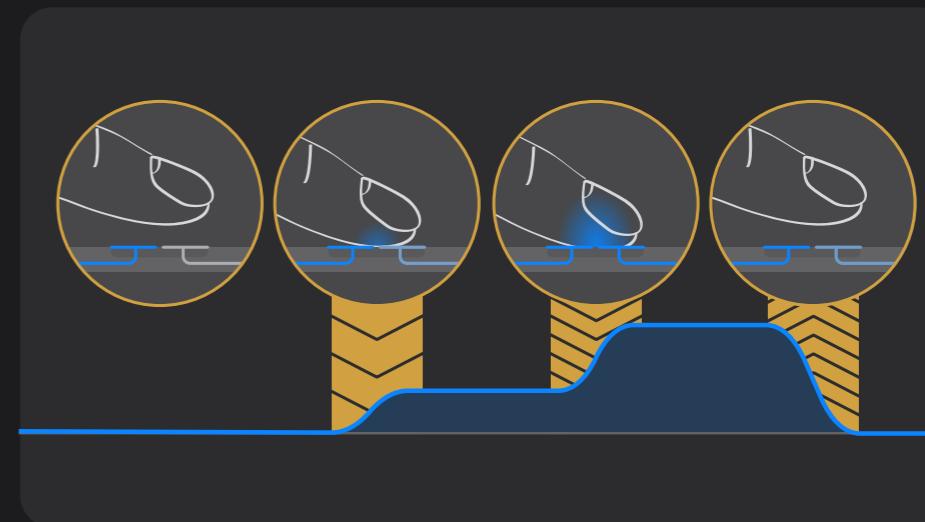
The Cosmos has two inputs: X and Y. They can process any eurorack signal. Fixed or controlled voltage; positive, negative or bipolar signals; triggers, gates or audio signal.

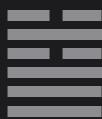
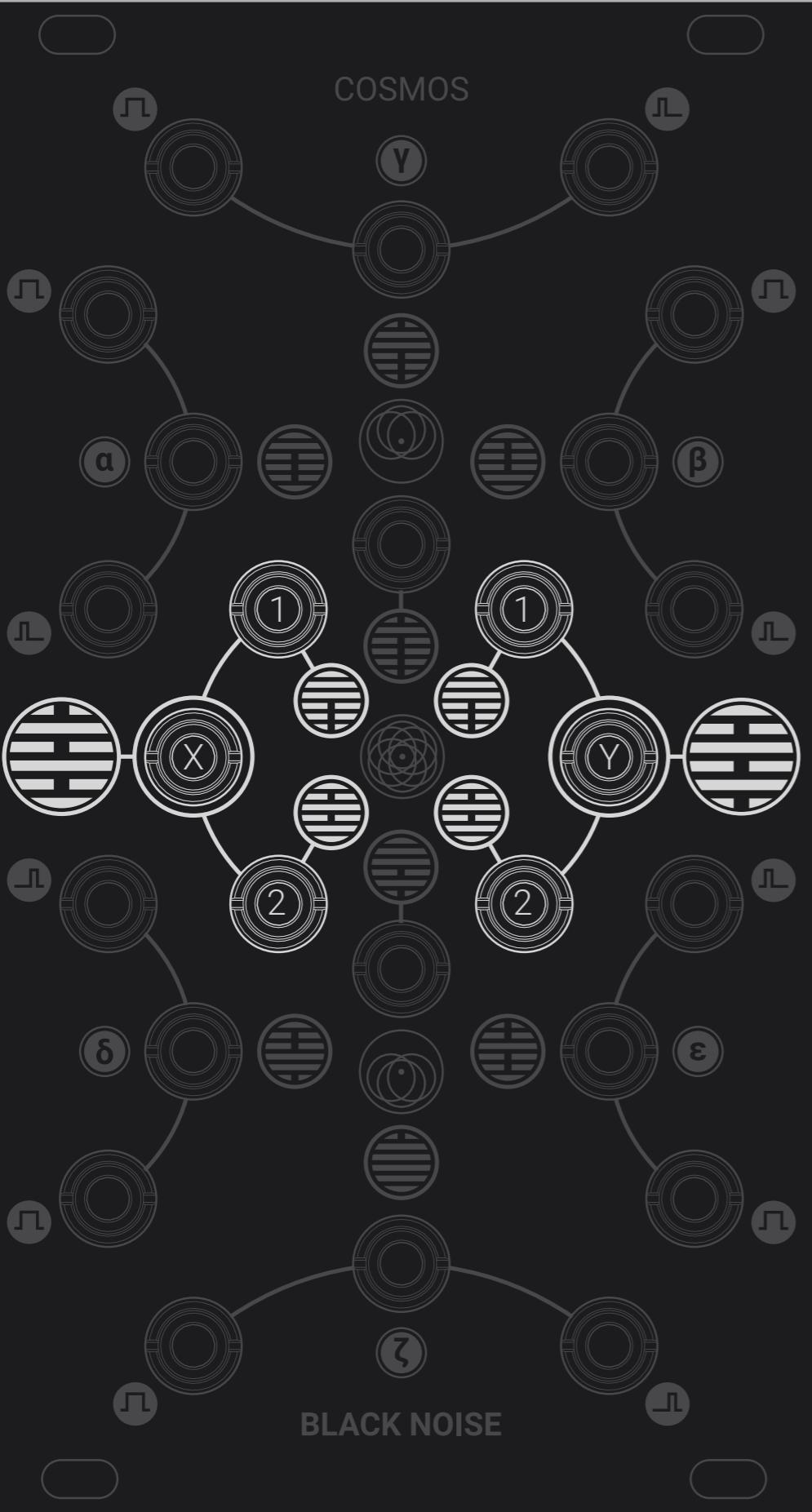




## Entering the Cosmos

When an input is not connected, it is replaced by the corresponding pad on the faceplate, providing a performance oriented voltage depending on the surface of skin in contact with the pad.





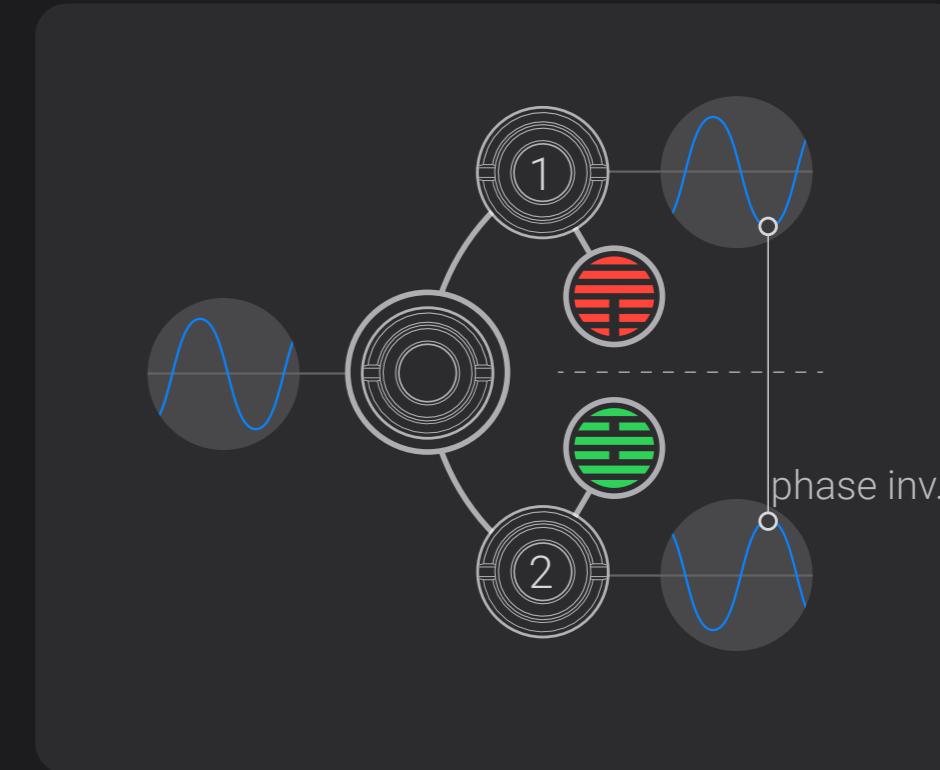
# Exploring the Cosmos

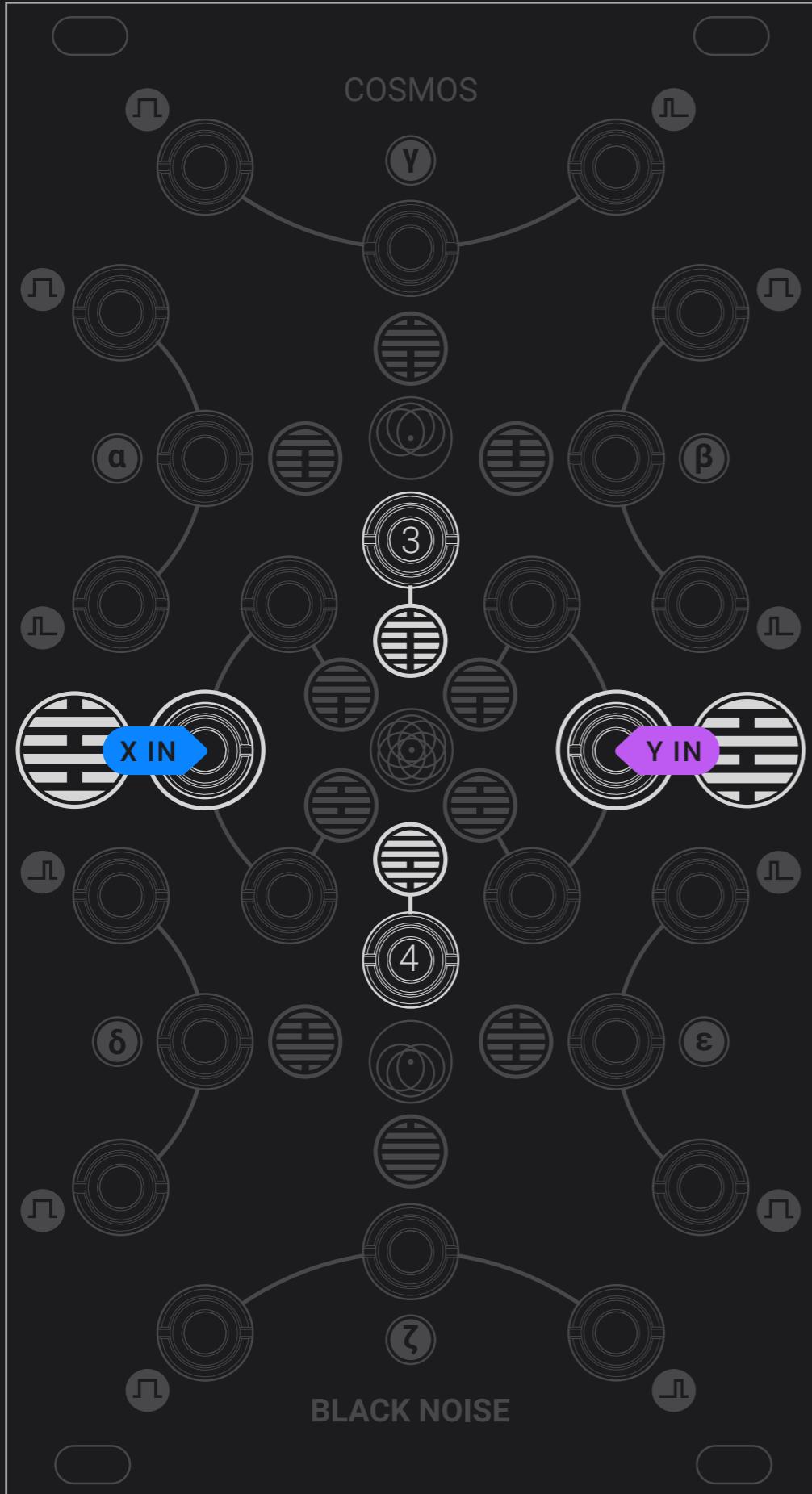


1:1 buffered copy of the corresponding signal



Phase-inverted copy of the corresponding signal



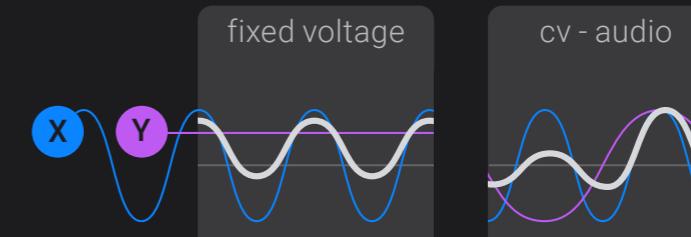


## Exploring the Cosmos



( $X + Y$ )

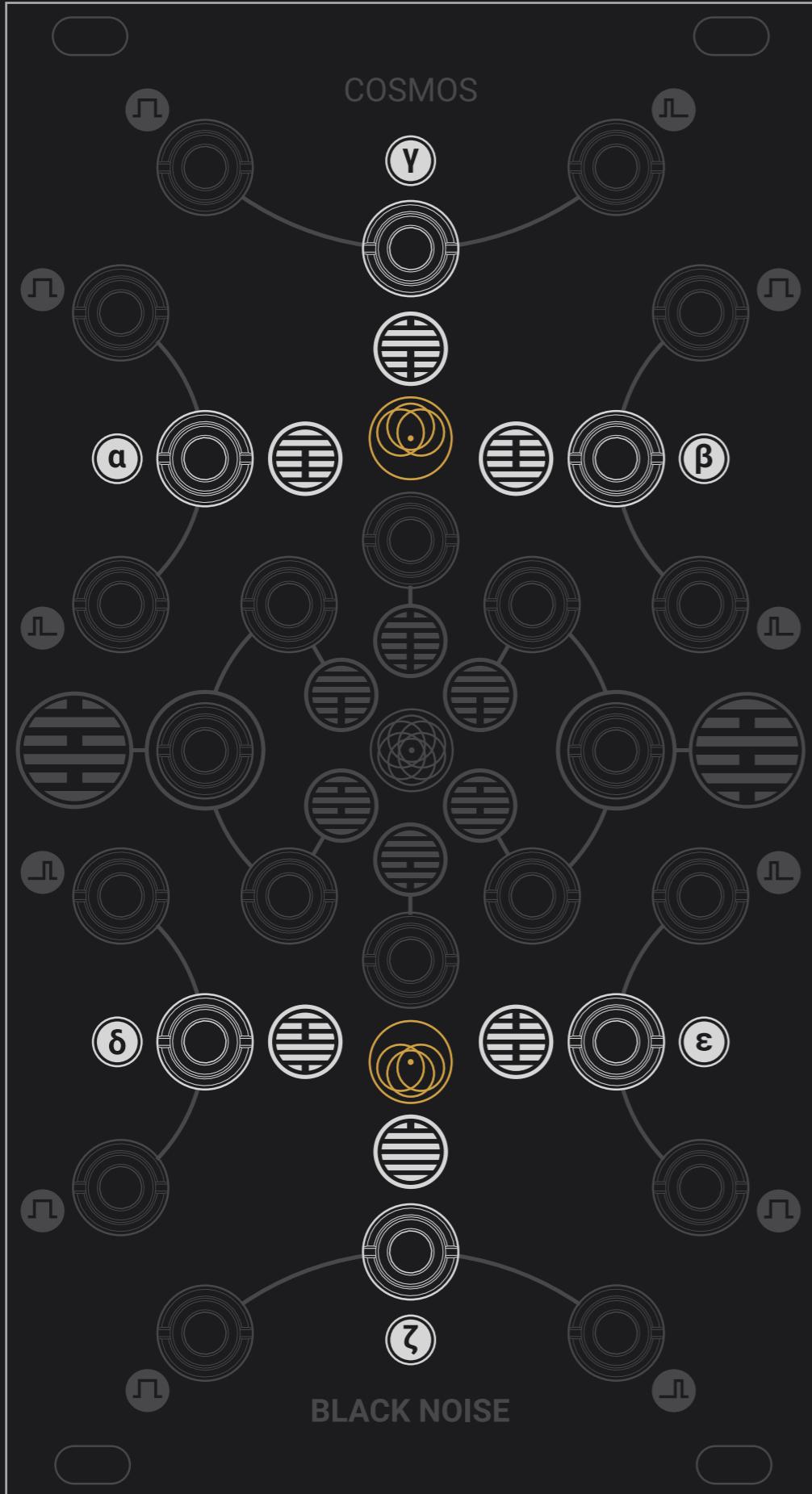
X and Y signal's value are added together and then averaged



( $X - Y$ )

X signal value is added to an inverted version of Y and then averaged





# Exploring the Cosmos

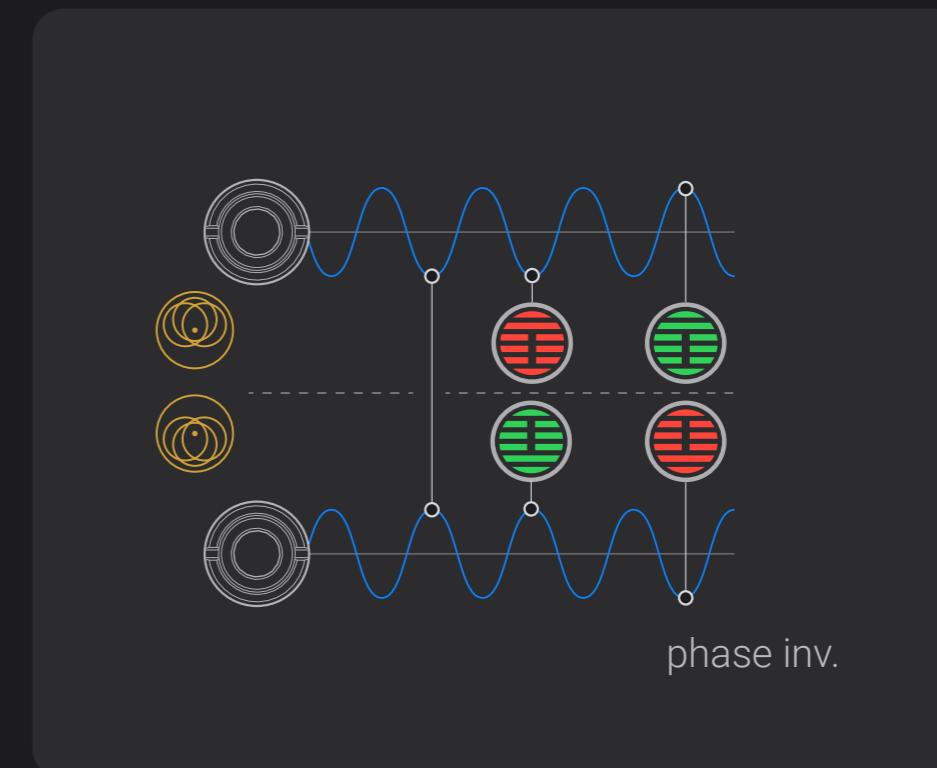
**The Cosmos has 6 processing analog outputs:**

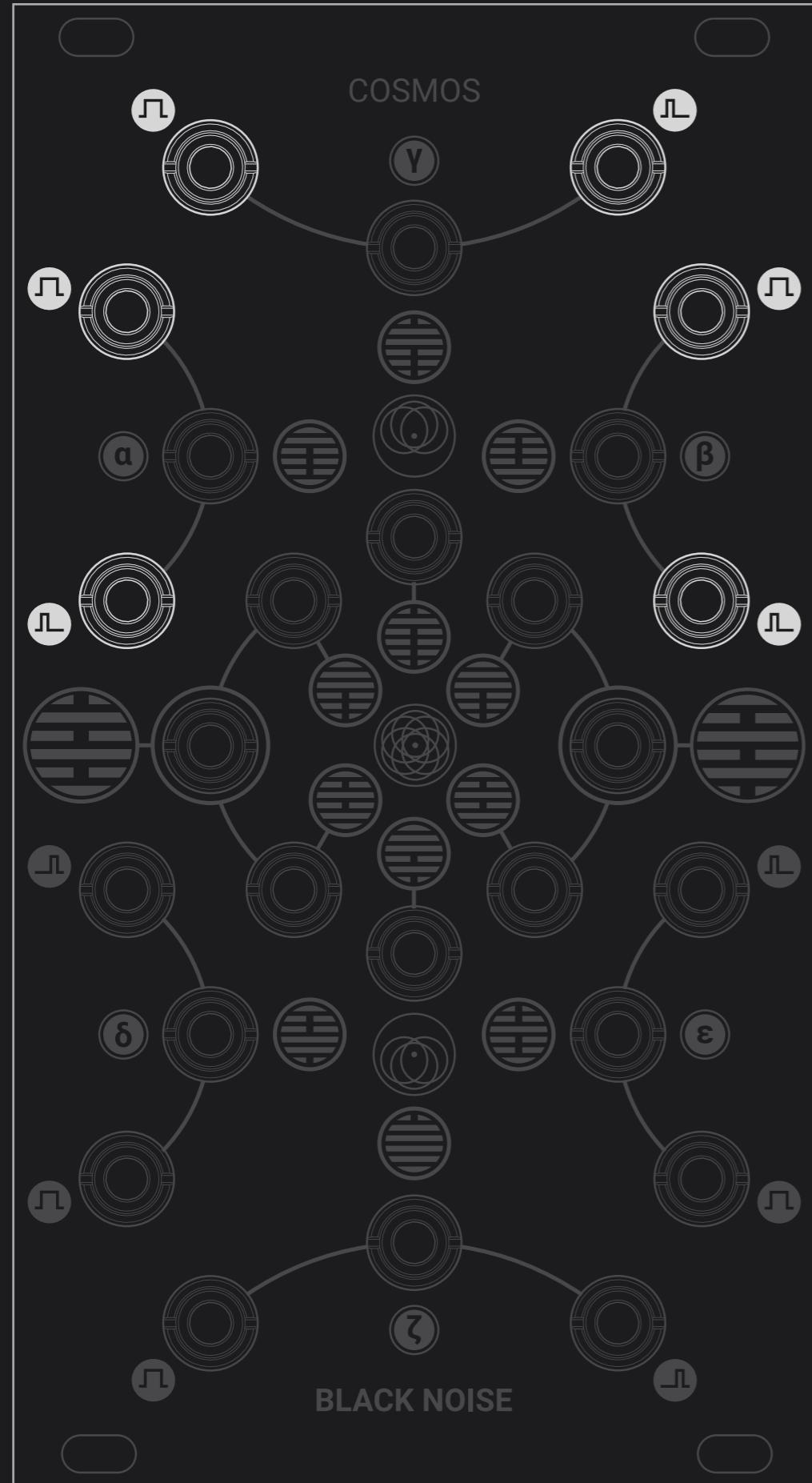


The top hemisphere's analog outputs provide an analog processing of the two input signals



A phase-inverted version is mirrored in the lower hemisphere.





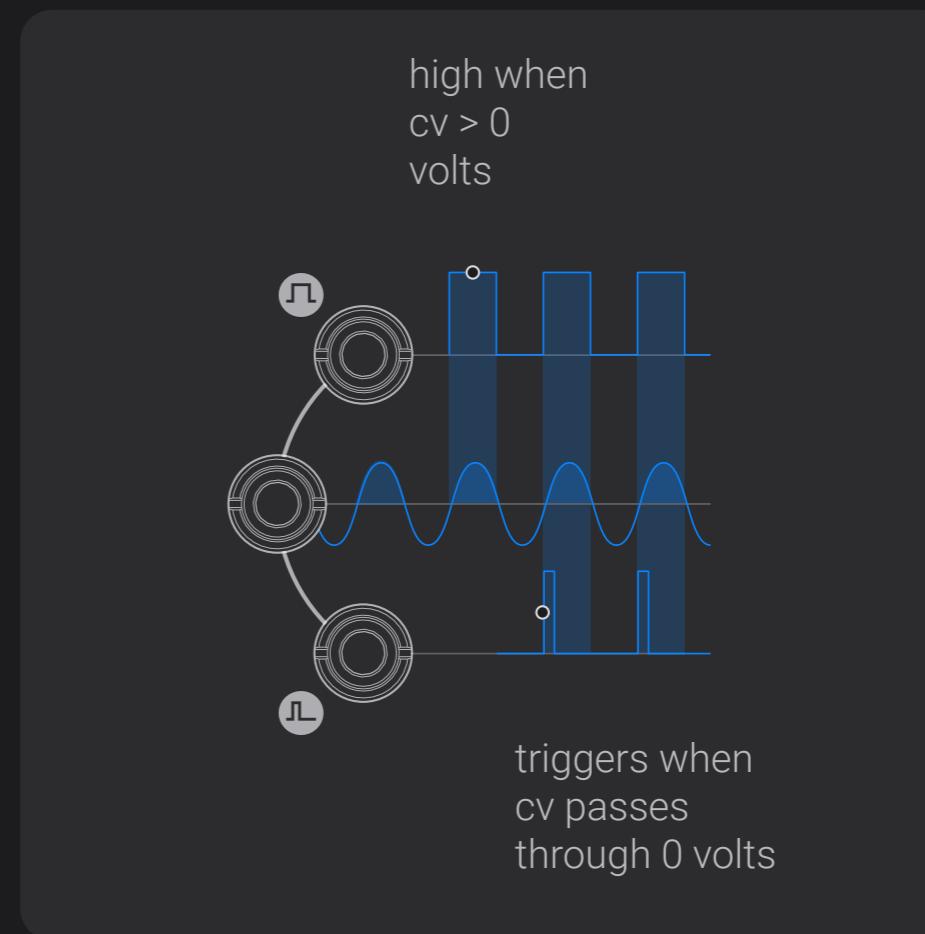
## Exploring the Cosmos



A gate output going high whenever the CV output is above 0V



A trigger output firing on the rising edge of the gate



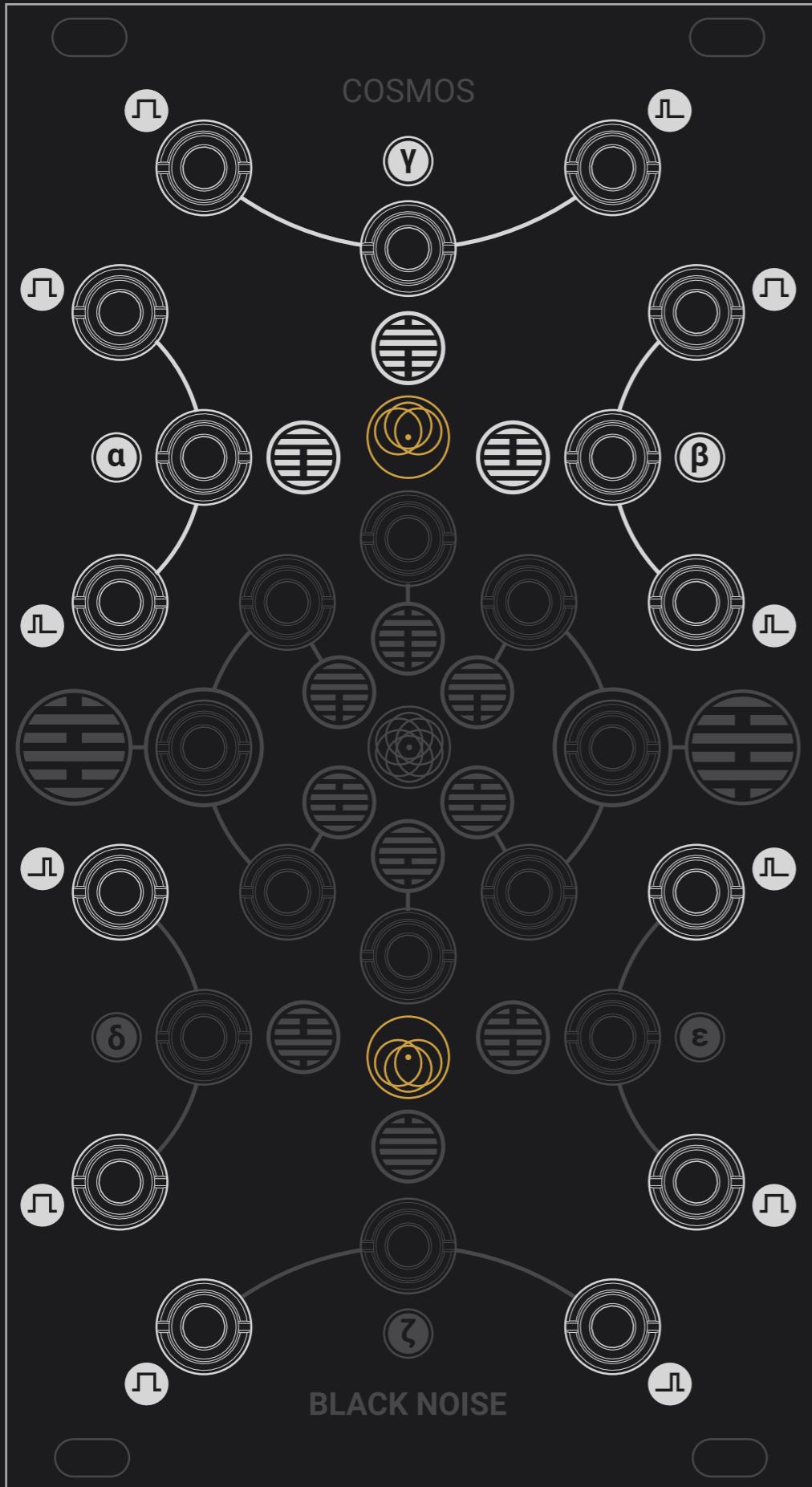


# Exploring the Cosmos

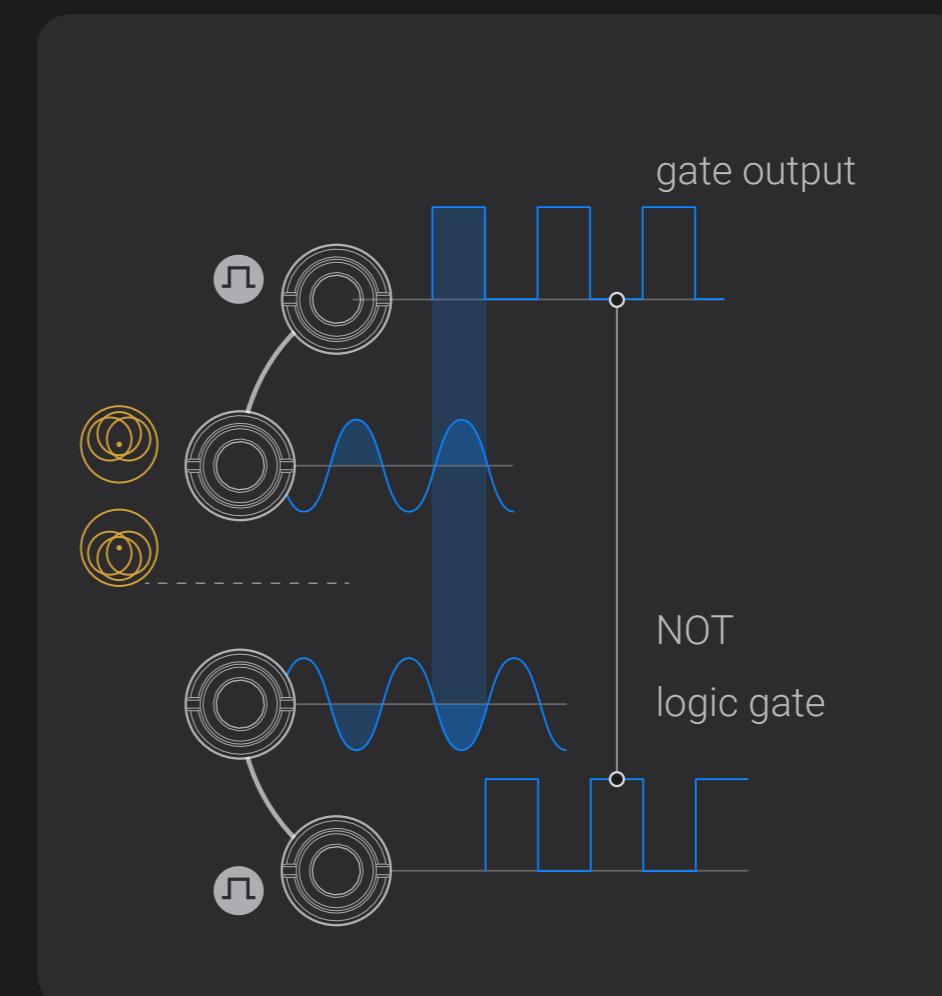
This allows a complete set of features:

All gate outputs are the binary logic version of the analog processing.

Any gate output has its NOT version in the mirrored hemisphere



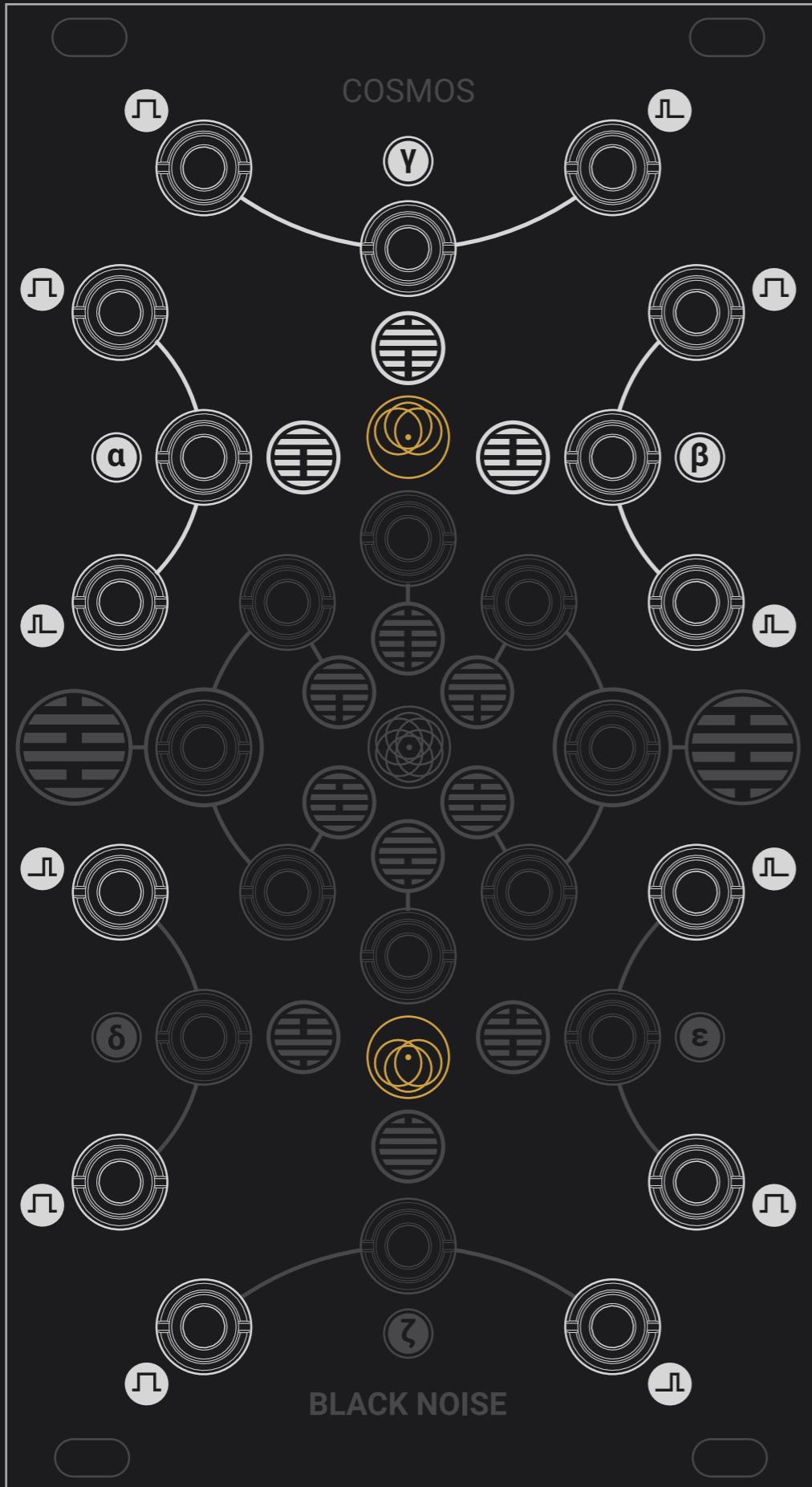
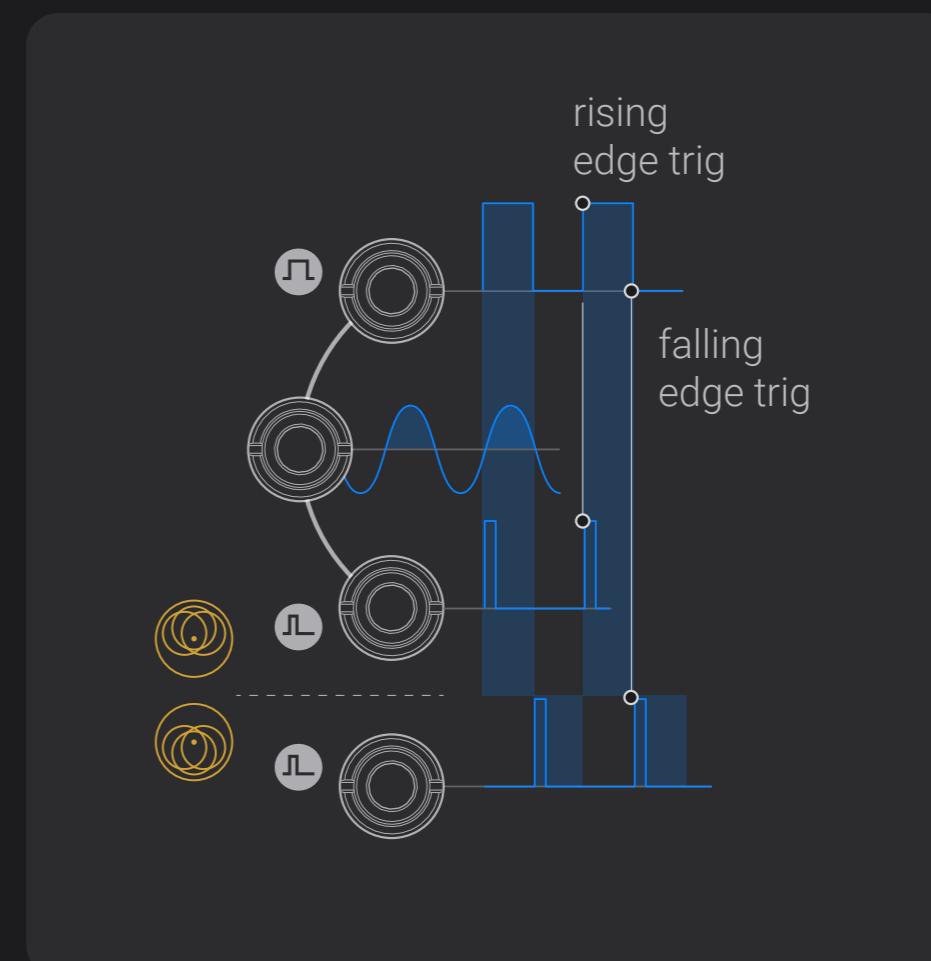
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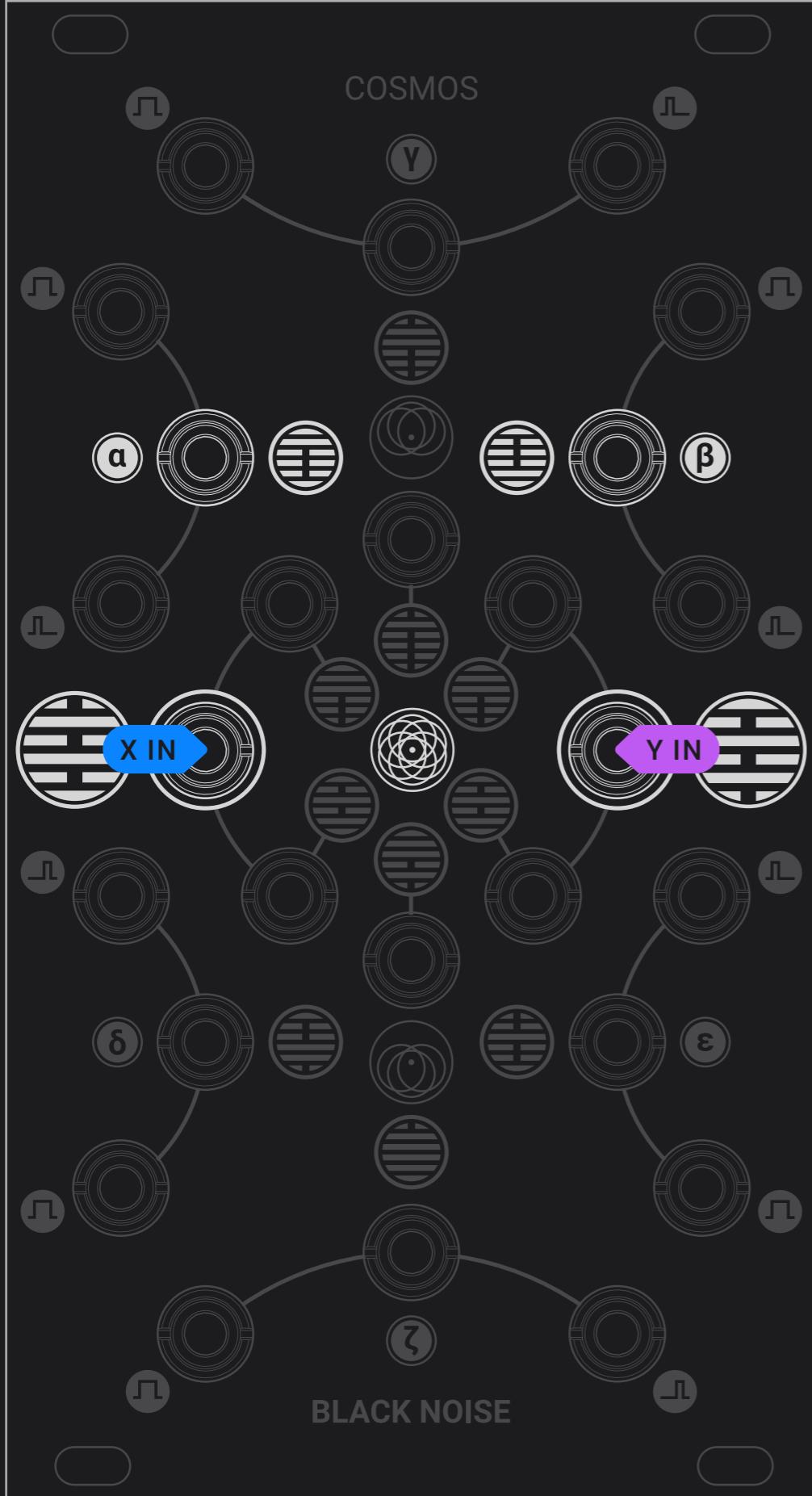




# Exploring the Cosmos

Any gate output finds the corresponding trigger output acting as its rising edge detector, while the mirrored trigger output acts as its falling edge detector

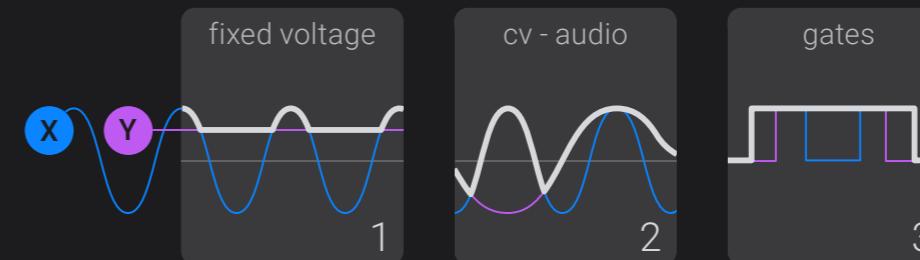




## Exploring the Cosmos

(a)

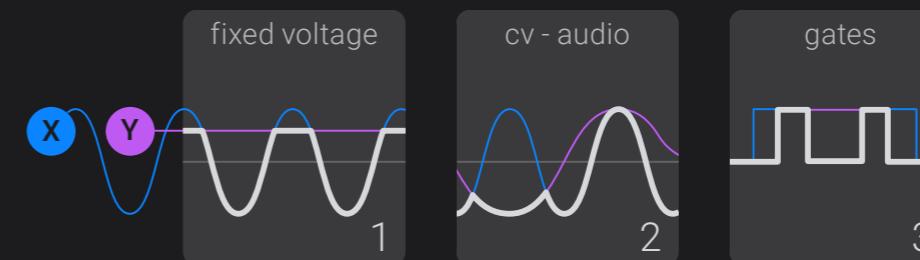
**Max - OR:** highest value of the two signals



1. A fixed voltage sets the lowest value for the other signal
2. Two waveforms combine themselves with one another
3. Gate is high when any input is high (OR logic).

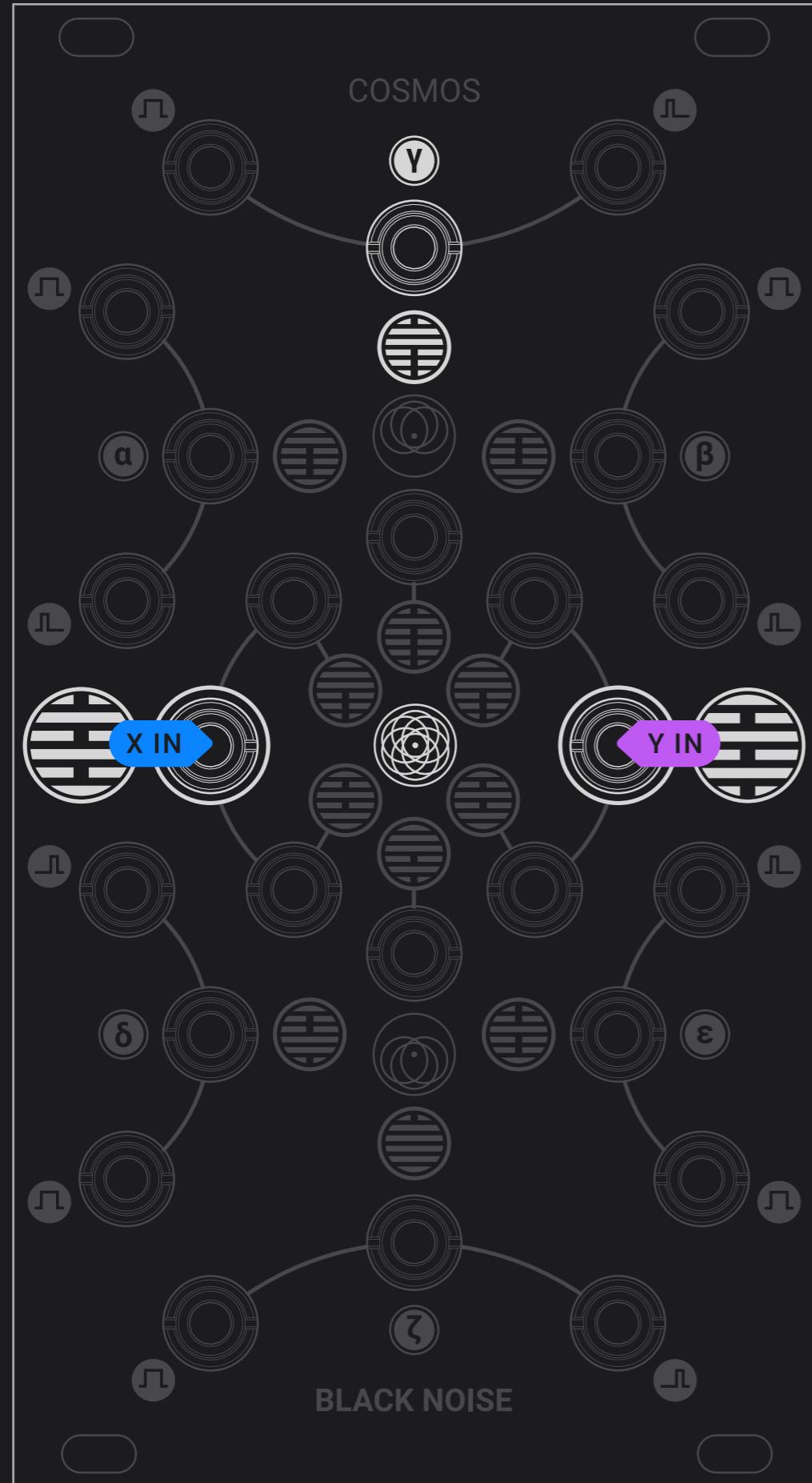
(β)

**Min - AND:** lowest value of the two signals



1. A fixed voltage sets the highest value for the other signal
2. Two waveforms carve themselves in each other
3. Gate is high when both inputs are high (AND logic)

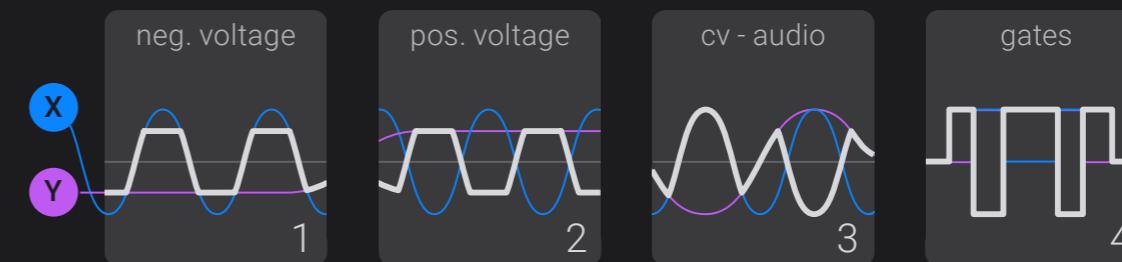




# Exploring the Cosmos

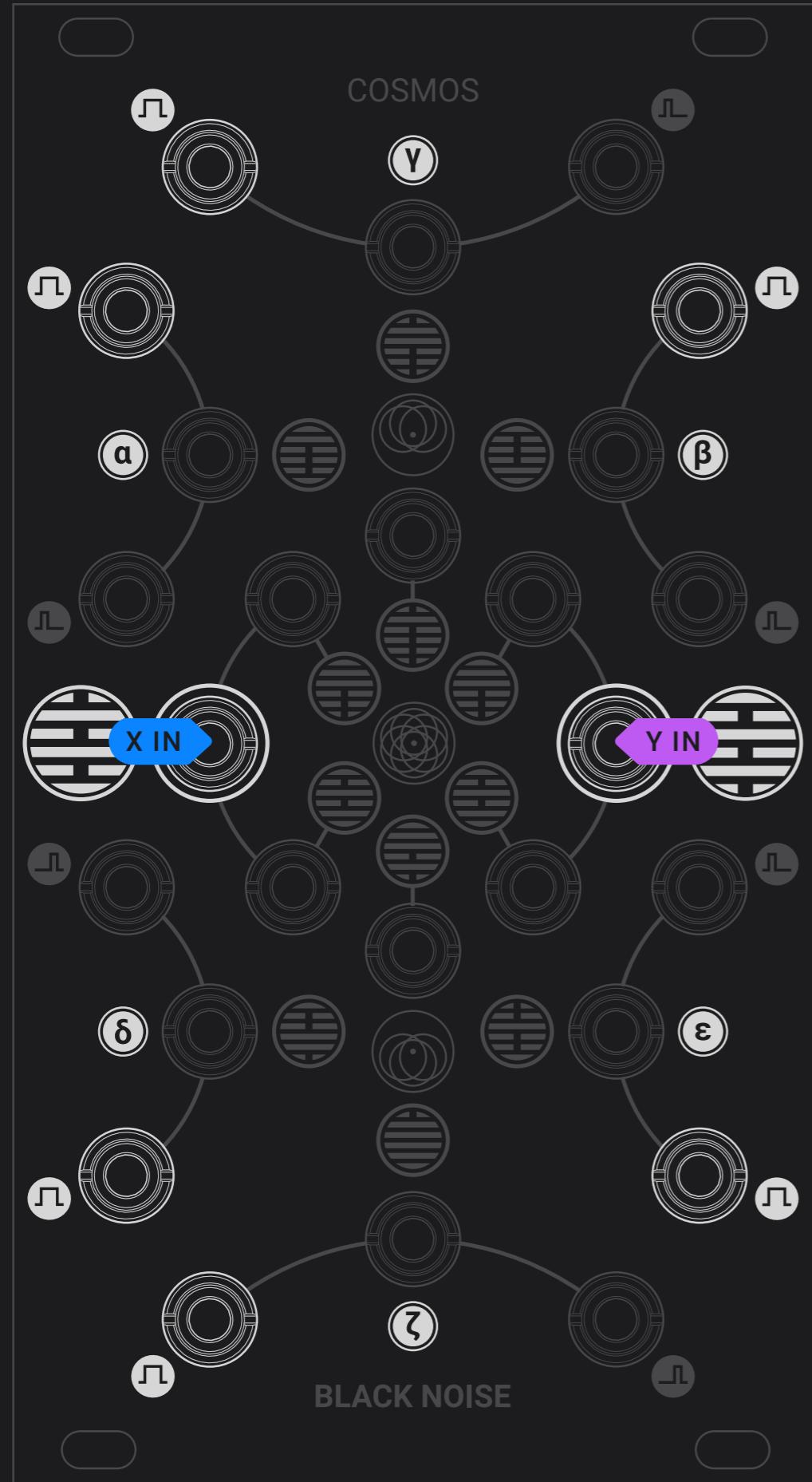


**Though-zero clipper - XOR:** a positive input inverts the other one and keeps the value closer to zero, producing a unique “analog XOR”, somewhere in between bipolar clipping and ring modulation.



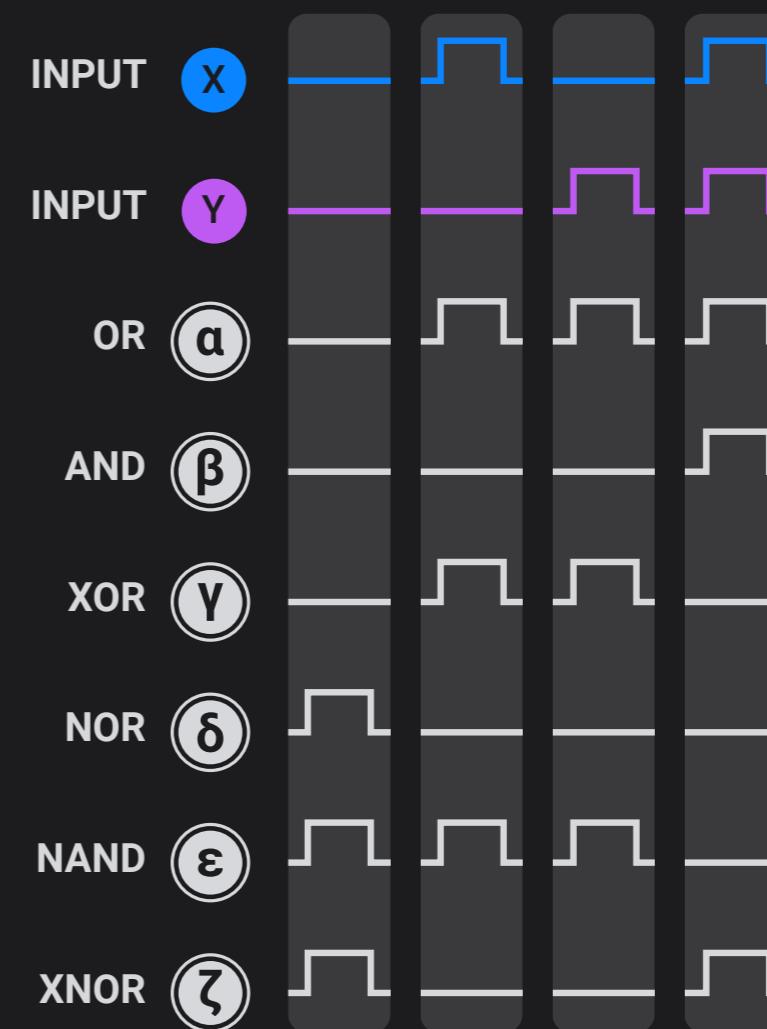
1. A negative voltage clips the peaks of the other signal
2. A positive voltage inverts and clips the peaks of the other signal
3. Two waveforms clip and invert each other's phase
4. Gate is high when only one input is high (XOR logic)





# Exploring the Cosmos

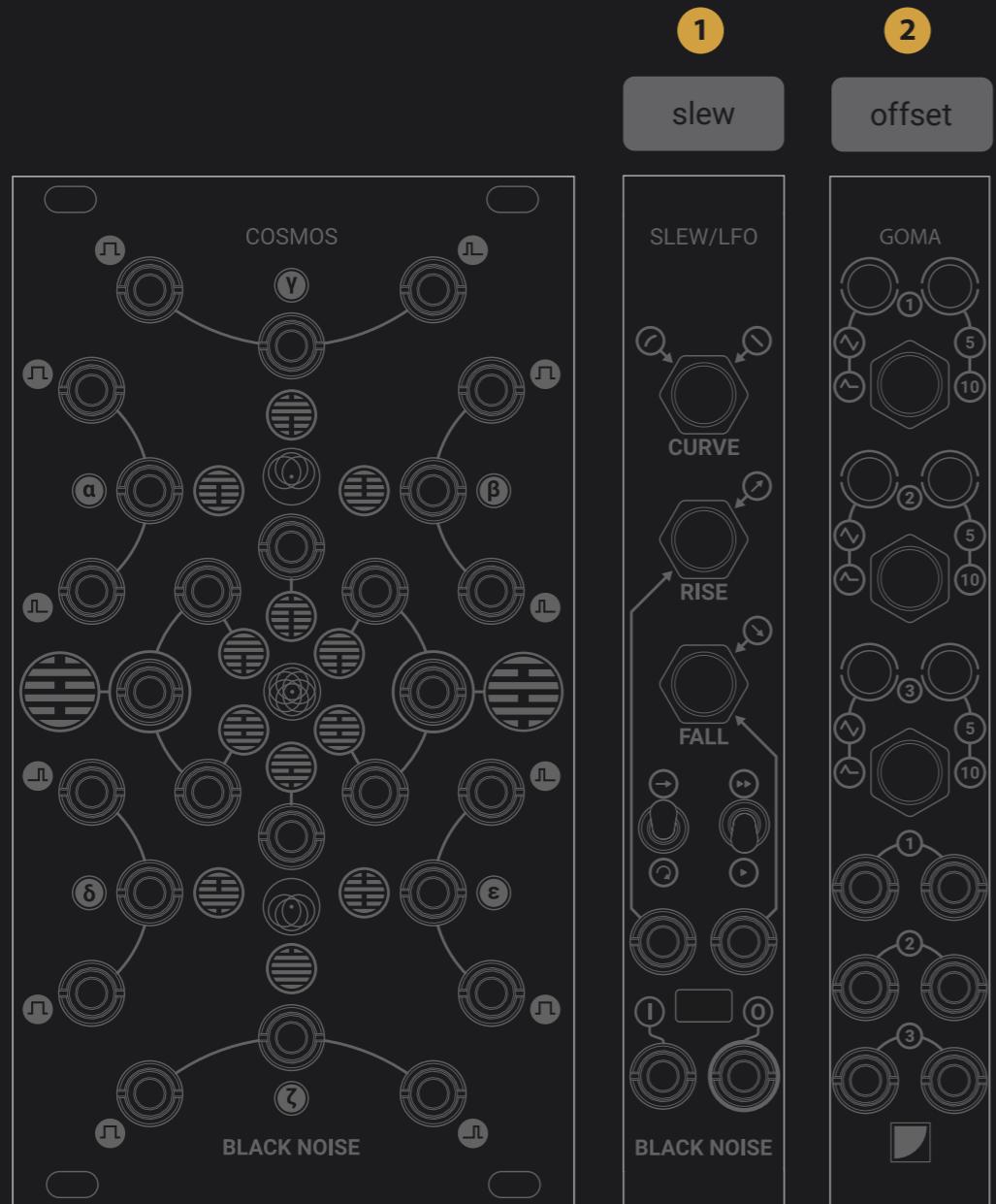
**The gates outputs** are high when their corresponding analog output is above zero. Consequently, they cover all classic binary logic functions.





# Controlling the Cosmos

## Patch ideas



Cosmos is a very deep module. Even though everything is in plain sight, many powerful features are unveiled by feedback and self-patching. It is an analog multifunctional tool, there is no buttons to switch modes: it is endlessly reconfigurable using only patch cables.

This is why the Cosmos comes with an extensive and growing patch library for audio processing or generation, and for CV and gate applications.

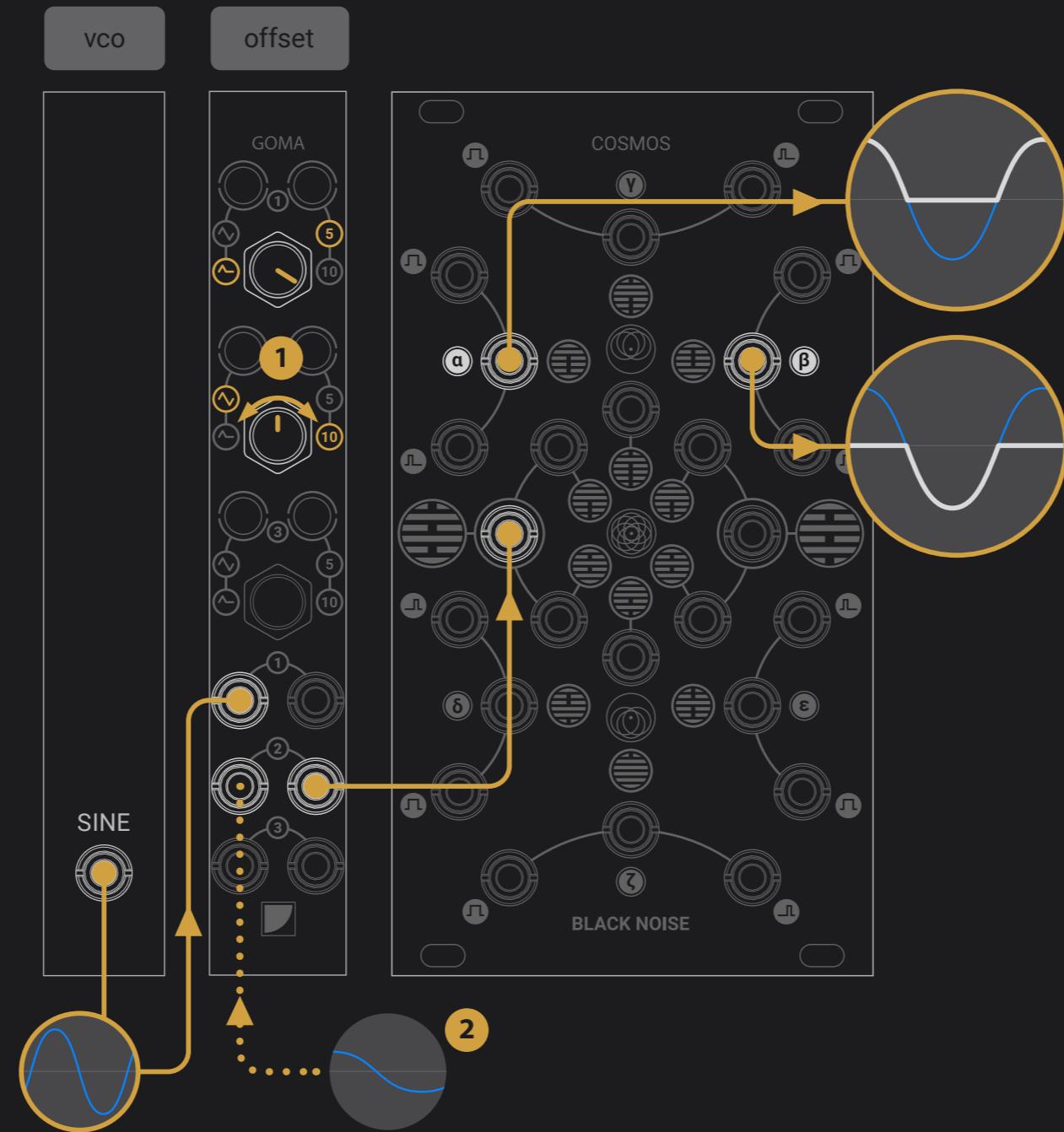
The Cosmos is the heart of an analog computer, it will find its most powerful applications when combined to basic building blocks of analog computing:

1. a slew limiter is useful for everything time related: setting the length or the delay of a gate, slowing down the reaction of a feedback loop, ...
2. An offset generator / attenuator allows to operate the Cosmos, adjusting thresholds, setting input values

## Disclaimer

These patches are tested and illustrated with modules from the BLACK NOISE Catalog. The patches can be performed using similar eurorack modules, though different results might be expected. Digital modules are not recommended for audio rate processing. The required type of module is always labelled over the patch.





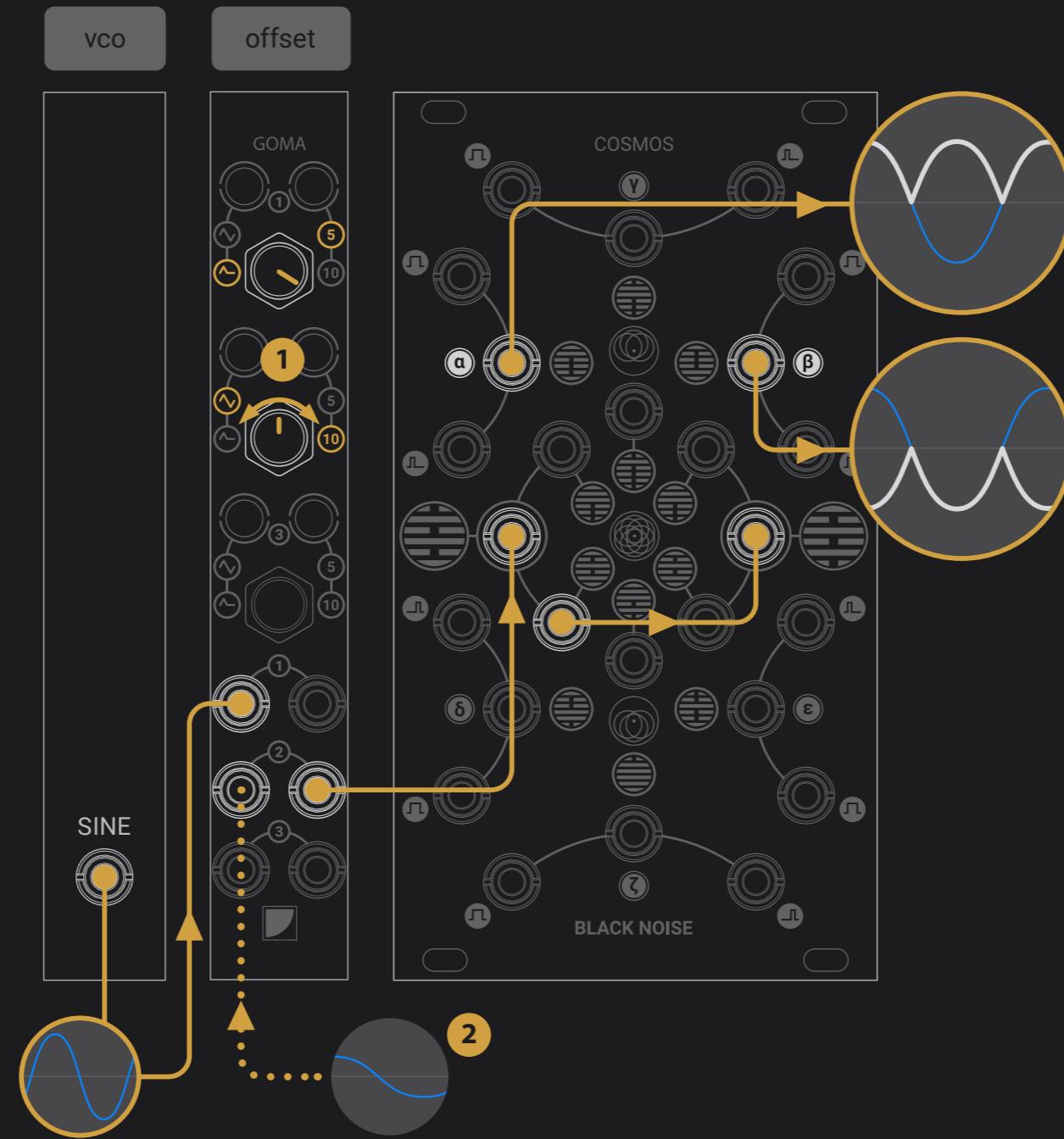
## Half-Wave rectifier

positive or negative rectifier with offset and CV control

In this patch uses analog logic to exclude or isolate negative CV.

Patch a signal into any input of the COSMOS, the MAX output works as a positive rectifier and the MIN output works as a negative rectifier.

1. The source signal can be sent through an offset generator from -5 to +5V such as a GOMA, to adjust the point of rectification.
2. Patching a CV signal to GOMA's 2nd input makes the comparator CV controllable.



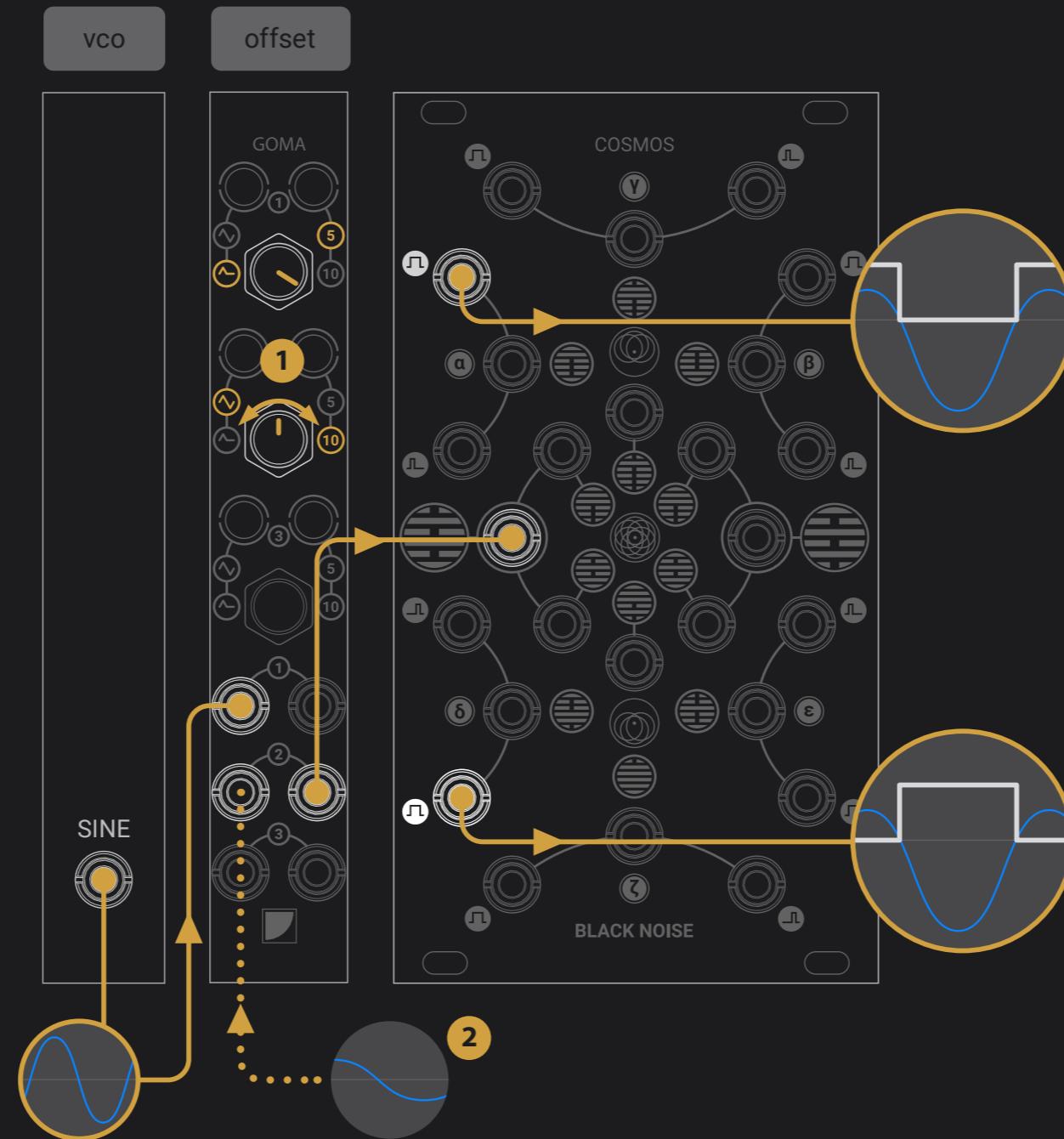
## Full-Wave rectifier

In this patch uses analog logic to reflect all negative values in the positive domain. Consequently a a full-wave negative rectifier can also be obtained.

Patch a signal into any input of the COSMOS and patch the corresponding inverted output to the second input. The MAX output works as a full-wave rectifier, while the MIN output provides a full-wave negative rectifier.

**absolute value with offset and CV control**

1. The source signal can be sent through an offset generator from -5 to +5V such as a GOMA, to adjust the point of rectification.
2. Patching a CV signal to GOMA's 2nd input makes the rectification CV controllable.



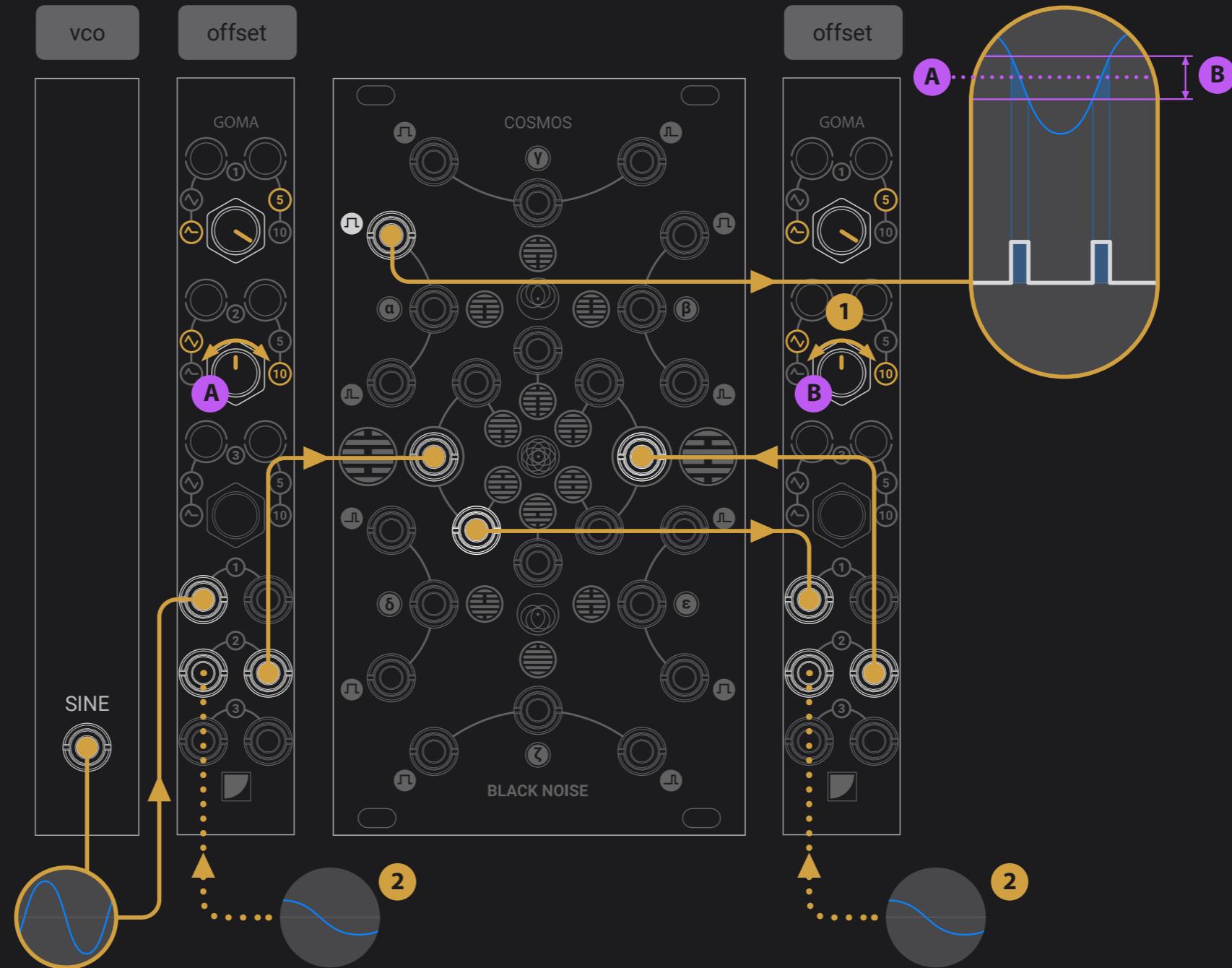
## Comparator

variable, CV controled or A/B comparator for audio and CV purposes

This patch provides a gate high when the source signal is higher than a defined threshold. The OR gate output of COSMOS works as an “over zero” comparator, so the original signal has to be offset by the opposite of the desired threshold beforehand. The NOR gate offers a gate high whenever the source signal under the threshold.

1. GOMA can be used to do the offset. With the 2nd channel unpatched, the knob can be used as a variable threshold.

2. Patching a CV signal to GOMA's 2nd input makes the device CV controllable.



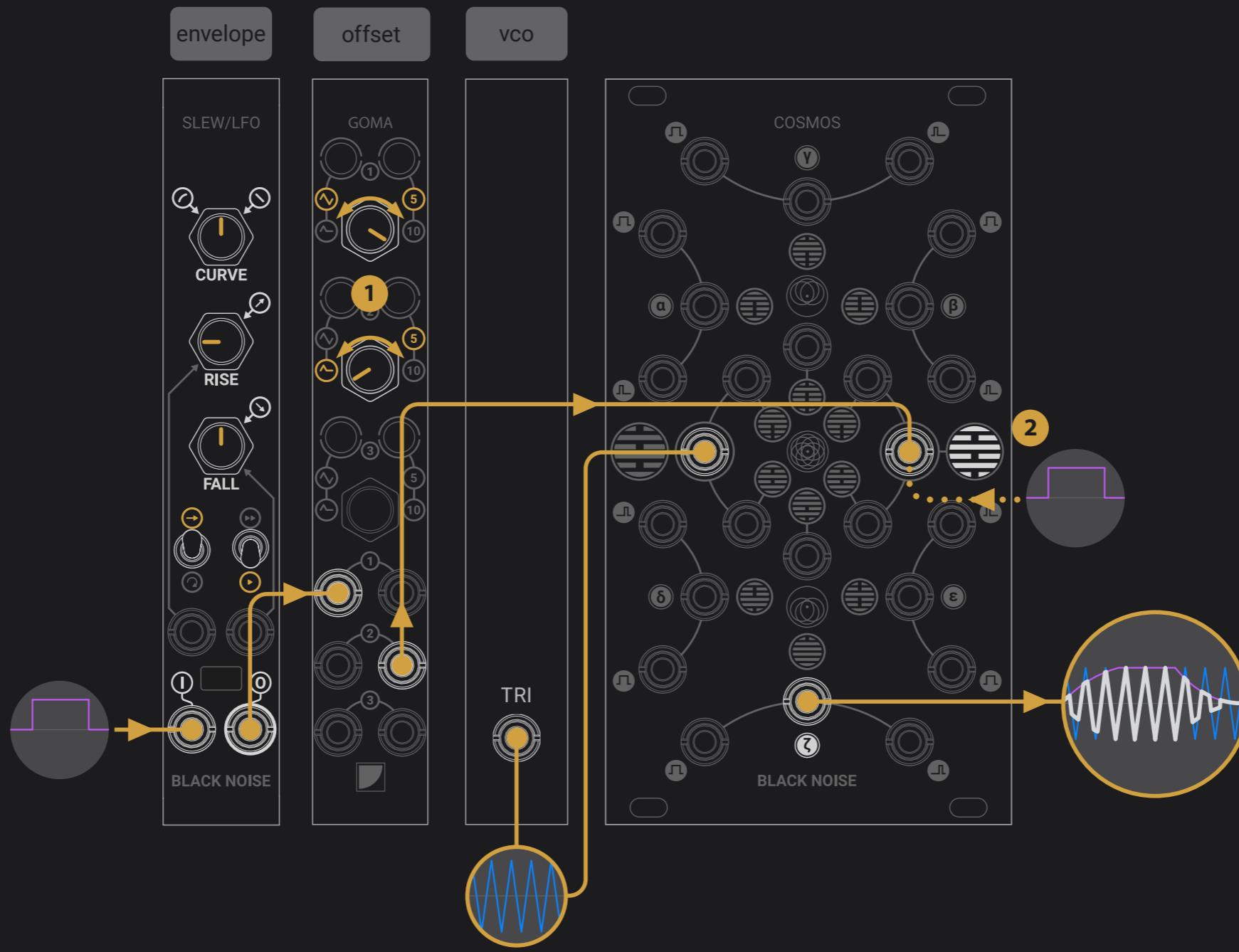
## Window Comparator

**CV controllable level and width zone to compare a signal**

This patch offers a gate high when a signal is within a minimum and maximum value. This window is defined by its center and its width.

Patch a signal through an offset generator and then into the X input of the COSMOS. This offset sets the opposite value of the center (A). Patch the corresponding inv. output to another offset generator and then to the Y input. This offset sets the value of the width (B). The OR gate is high when the signal is within the window.

1. When setting the width (B) very low, this patch can be used to an “equal” comparator, getting a high gate when the signal is equal to A.
2. Patching a CV signal to GOMA’s 2nd input makes the comparator CV controllable.



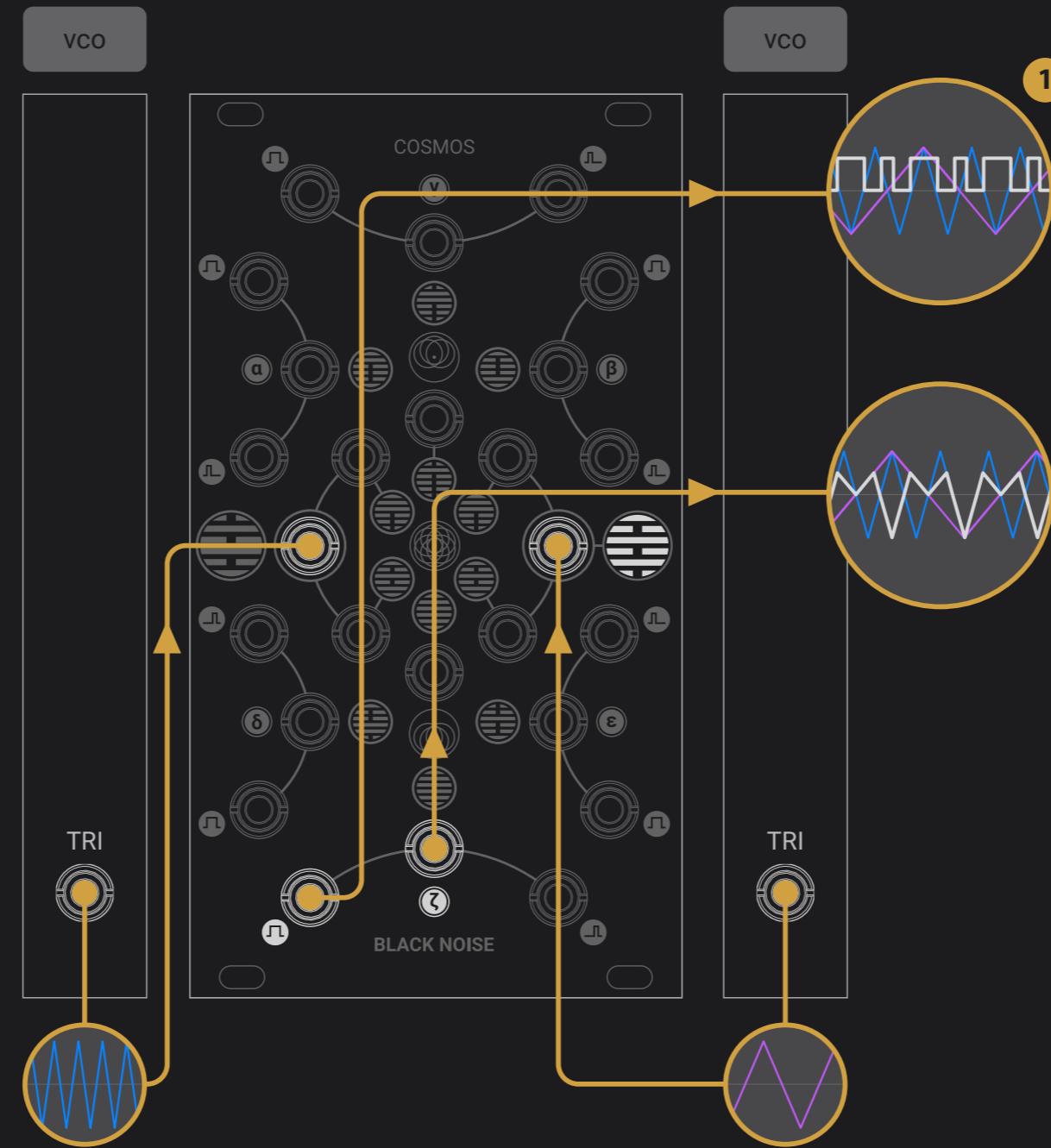
## Clamping VCA

This patch turns the COSMOS into a VCA with character. While the VCA is transparent at max level, a lower level introduces clamping and light distortion to the sound.

Patch a signal to the X input. Patch a modulation source such as an envelope into the Y input. The inv. TZ CLIP of the COSMOS provides the main signal clamped by the modulation source in both positive and negative domain, acting like a VCA.

## VCA with wave shaping for audio and CV

1. The modulation signal can be sent through an offset generator from -5 to +5V such as a GOMA, providing a larger set of control. The offset opens the VCA manually, and an attenuverter offers finer control over the modulation.
2. Using a gate or the touch plate instead of the modulation source can turn the device into a simple mute switch for audio and CV.



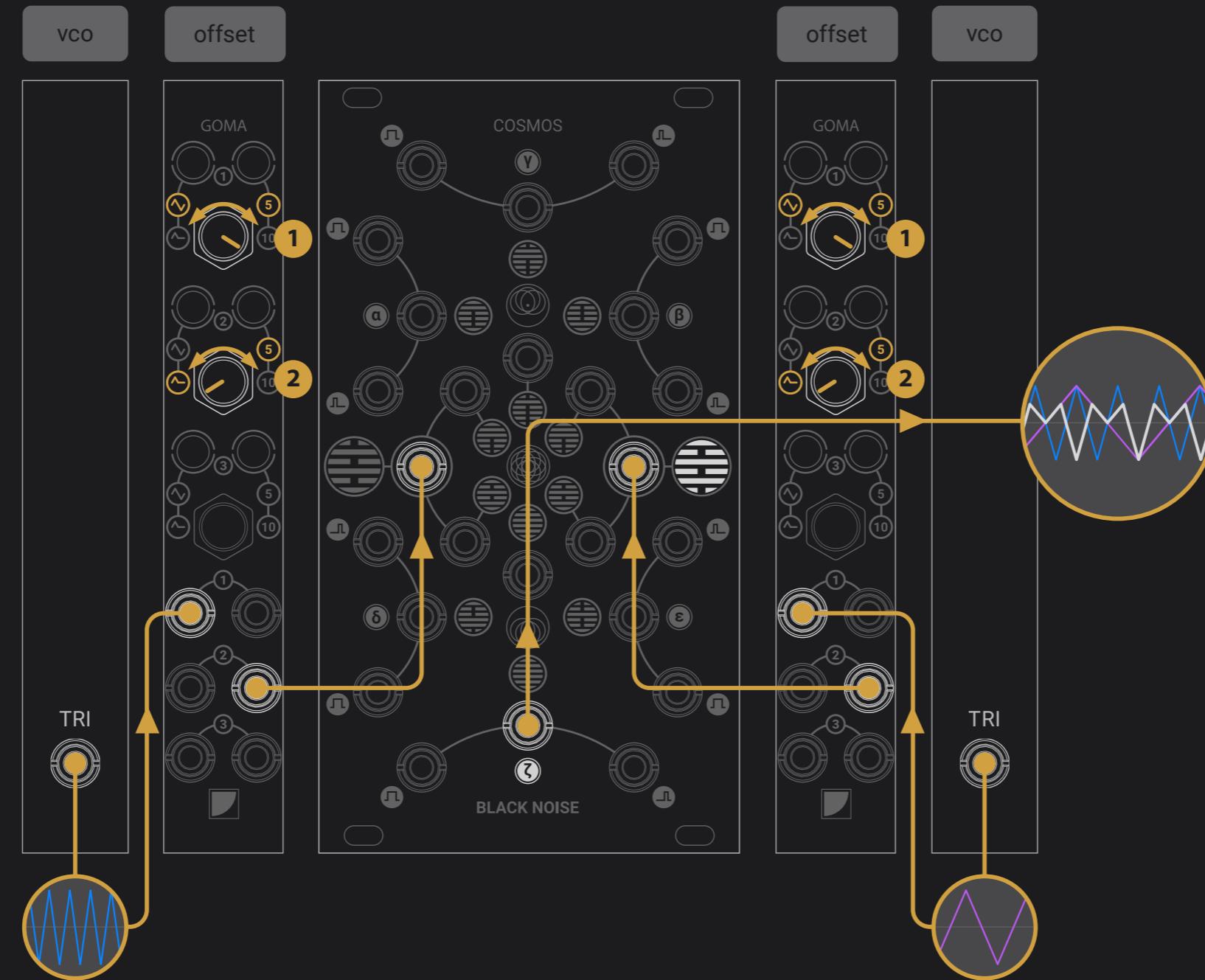
## Clamping ring modulation

ring mod with character

This patch takes advantage of the TZ clipper circuit of COSMOS with waveforms clamping and inverting each other, adding an interesting beefiness to the classic ring modulation effect.

Patch each VCO to the input of COSMOS. The TZ inv output provides a rich clamping ring modulation effect.

1. The TZ inv gate output provides a digital ring modulator, known for its aggressive tone.



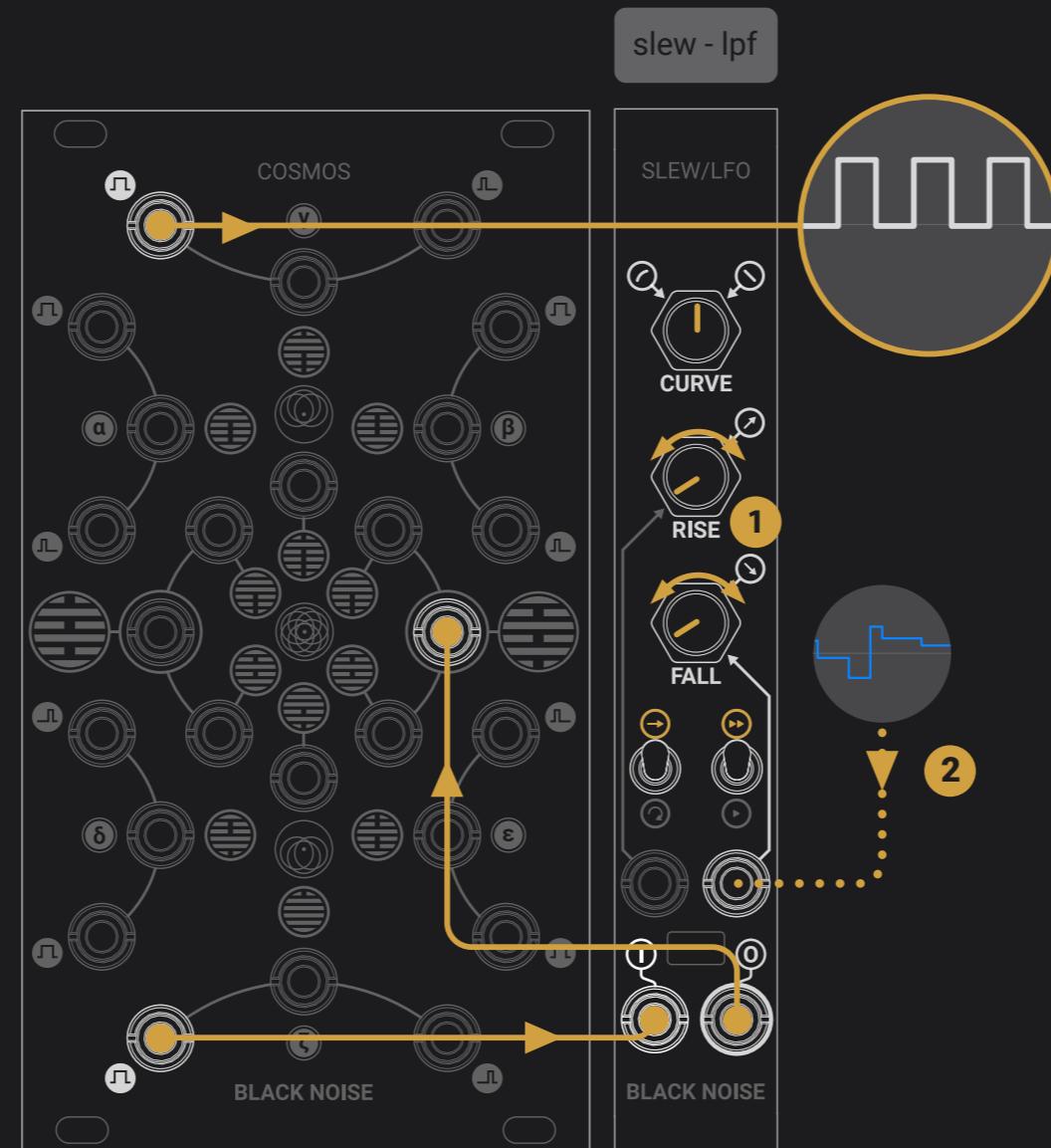
## Complex ring modulation

This patch extends the previous clamping ring modulation system for more control over the harmonic content. The frequency of one VCO can take the high ground over the other one, and offsets allows a smooth blend between RM and AM.

Patch each VCO through an offset and attenuator such as GOMA and then into COSMOS. The TZ inv output provides a rich clamping ring modulation effect.

### clamping RM/ AM with harmonic content control

1. Unlike classic ring modulation, attenuating the source signals affects the harmonic content of the sound.
2. Adding an offset to one of the signals offers many variations around the ring modulation concept: fully open, clamping ring modulation, clamping amplitude modulation. The result is widely differing on whether the offset VCO has a higher or lower frequency than the bipolar VCO. This transition is CV controllable by sending a CV signal in GOMA's Ch2.



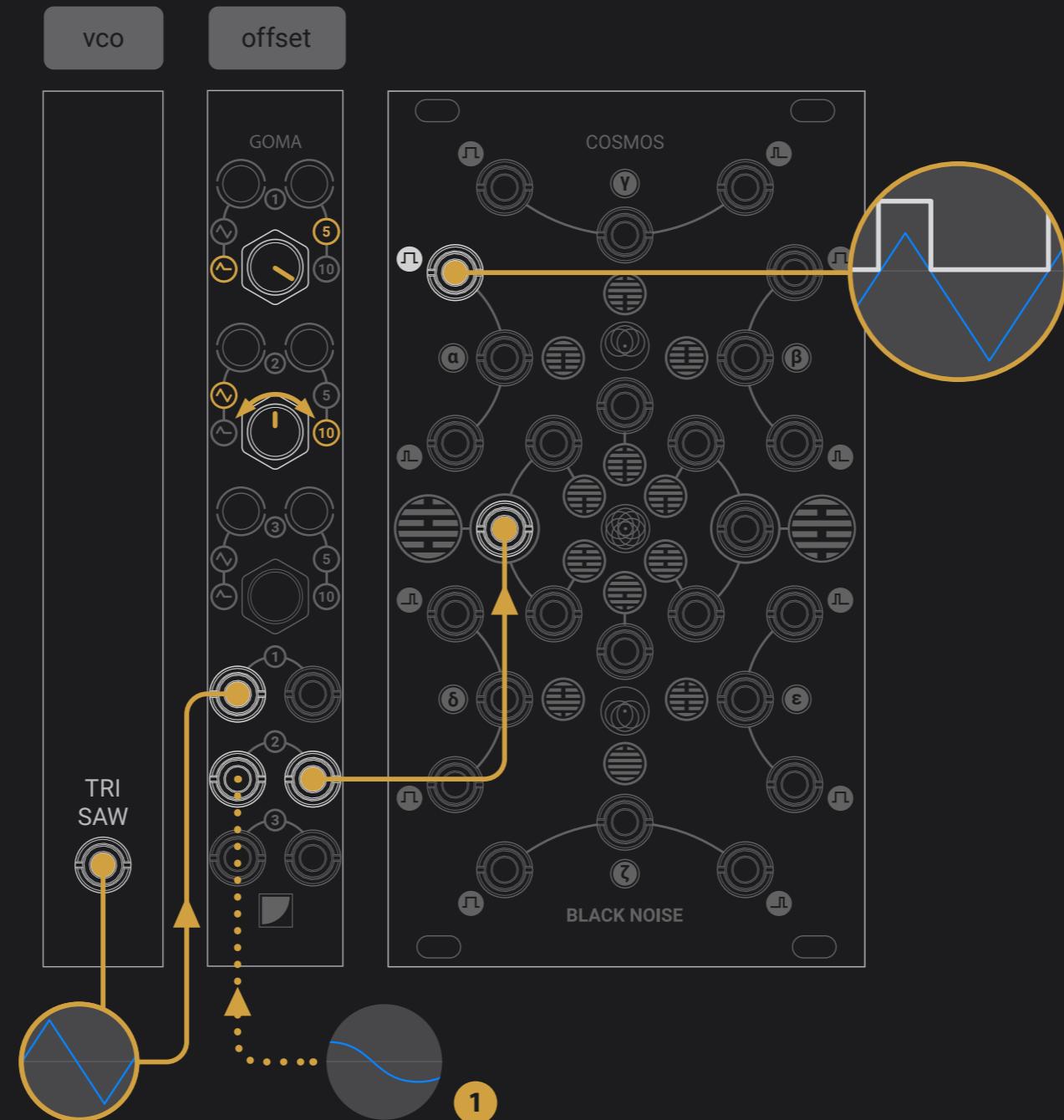
## Oscillator

Cosmos can self-oscillate by feeding its own XNOR gate back to the input, which creates a perpetual inverting logic chain at the highest frequency permitted by its analog components.

Insert a slew or a filter feedback in the feedback path to have control of the frequency.

**self patched squarewave CV controlled oscillator**

1. The slew time will define the pitch of the oscillator.
2. Control the slew time with a sequencer to make it a complete VCO (2).



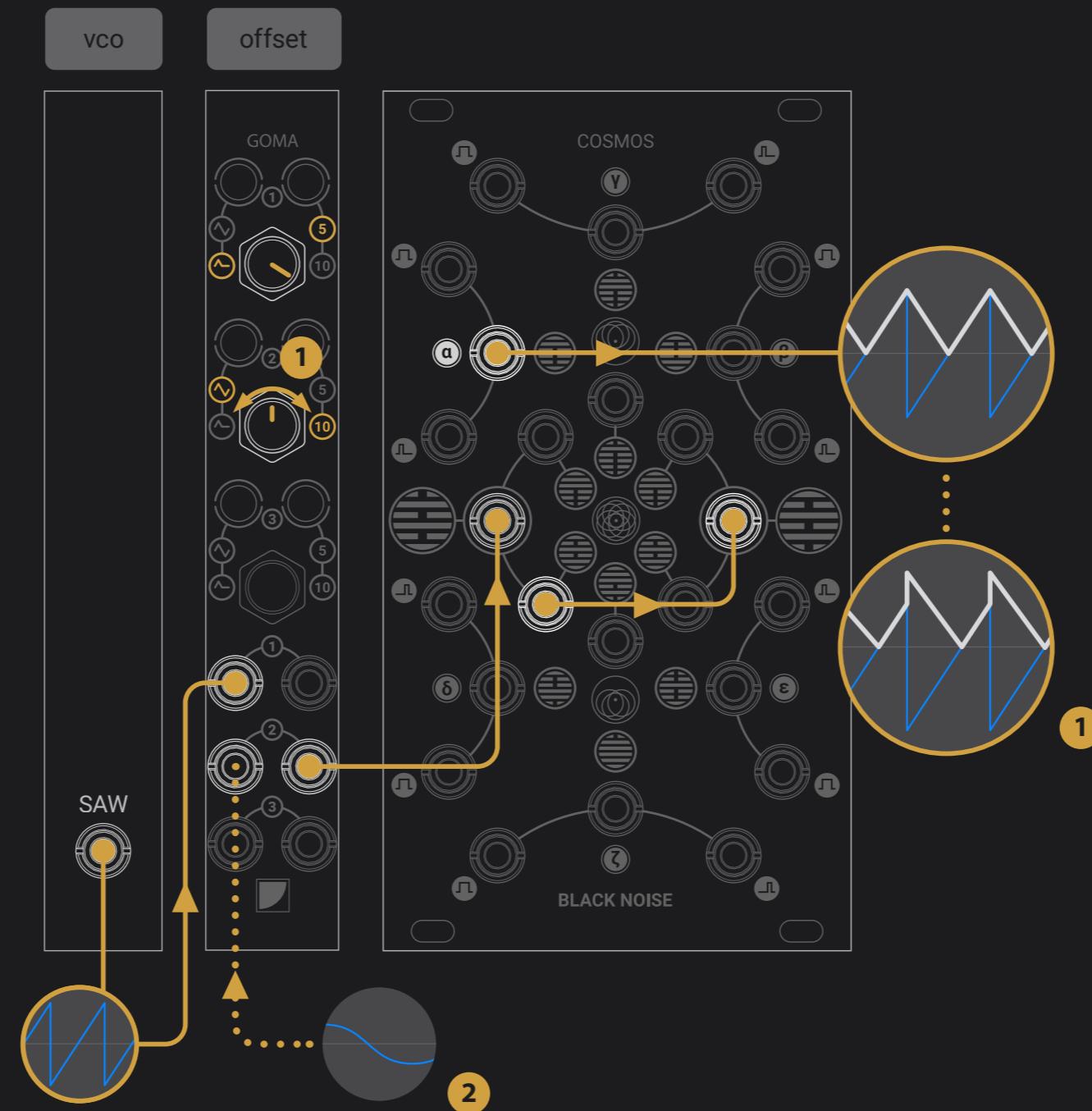
## Triangle or saw to variable pulse width

CV controllable pulse width

Using the COSMOS as a comparator can provide pulse width modulation to a simple VCO.

Patch triangle or saw wave VCO trough an offset generator and then into any input of COSMOS. This offset defines the amount of signal that triggers the “over zero” comparator to be found at the OR gate output.

1. Patching a CV signal to GOMA's 2nd input makes the device CV controllable.



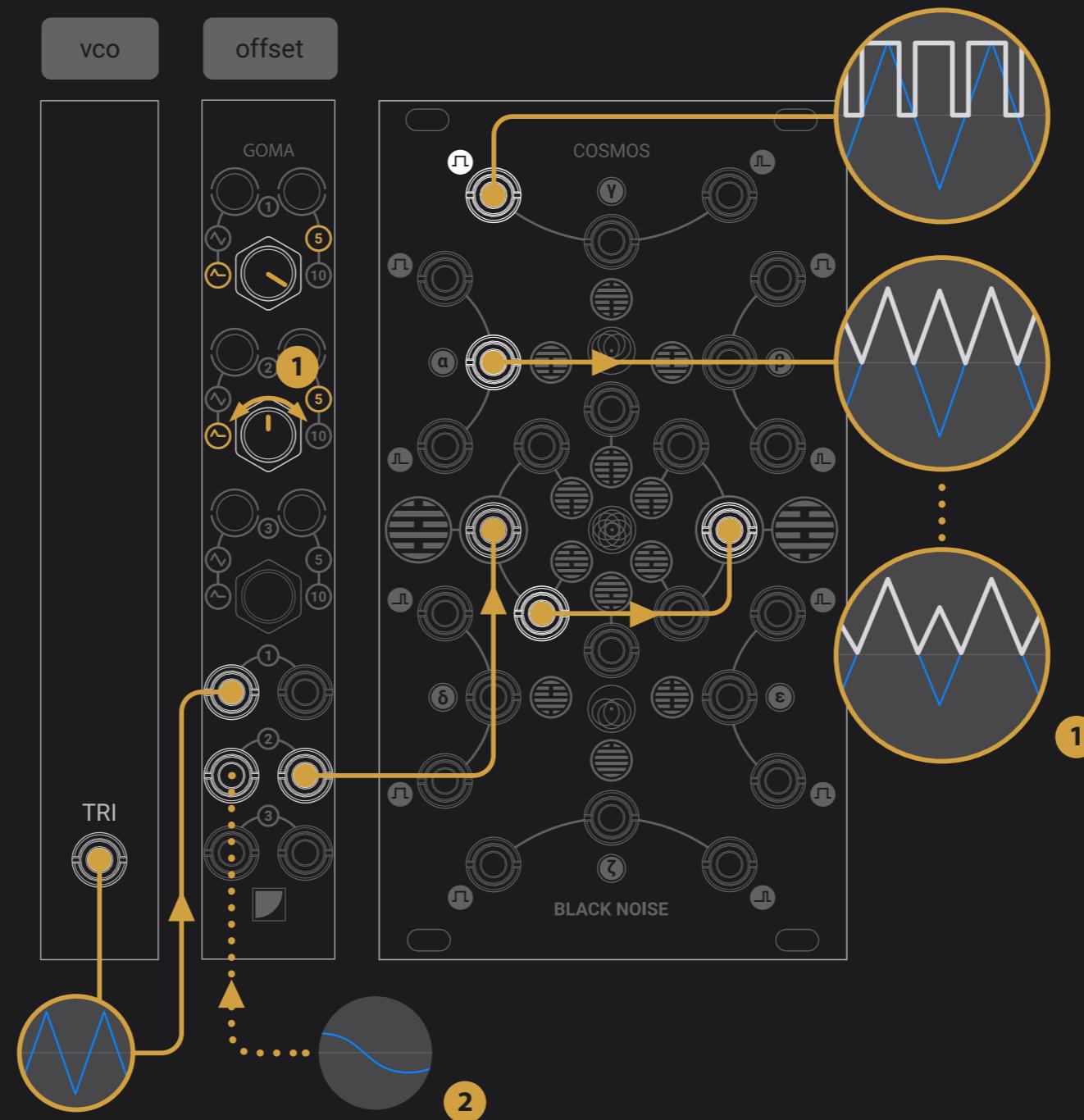
## Saw wave to triangle wave

**Using COSMOS as a full-wave rectifier can turn a saw wave into a triangle wave or anything in between like the "shark tooth" wave found in the Minimoog.**

Patch a bipolar saw wave into the X input of the COSMOS and patch the corresponding inverted output to the Y input. The MAX output works as a full-wave rectifier converting the saw into a triangle.

**shark tooth and filter-like wave shaper**

1. The source signal can be sent through an offset generator from -5 to +5V such as a GOMA, providing hybrid wave forms such as the "shark tooth" wave.
2. Patching a CV signal to GOMA's 2nd input makes the device a CV controllable wave shaper with result close from classic subtractive filter.



## Triangle wave to +1 oct VCO

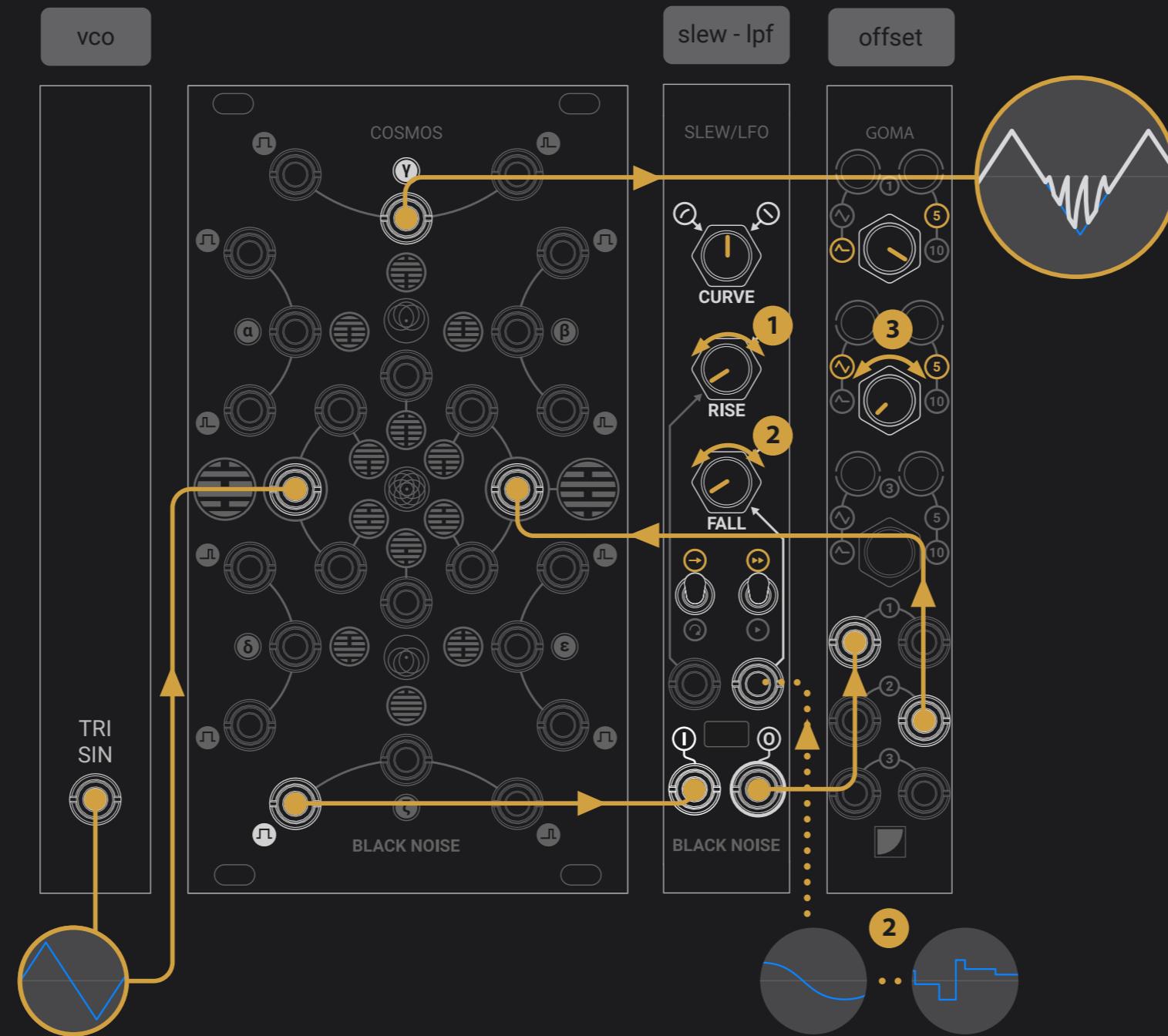
adding triangle or pulse wave VCO tracking one octave higher

This patch uses full-wave rectification to turn a triangle VCO into a copy playing one octave higher. A square wave VCO can also be obtained and then mixed back with the original signal for more beefiness.

Patch a bipolar triangle wave into any input of the COSMOS and patch the corresponding inverted output to the Y input. The MAX output provides a copy playing one octave higher. A square wave version can be found in the OR gate output.

1. The source signal can be sent through an offset generator from -5 to +5V such as a GOMA, providing a sync-like sweep effect on both triangle and square wave outputs.

2. Patching a CV signal to GOMA's 2nd input makes the device a CV controllable sync effect.



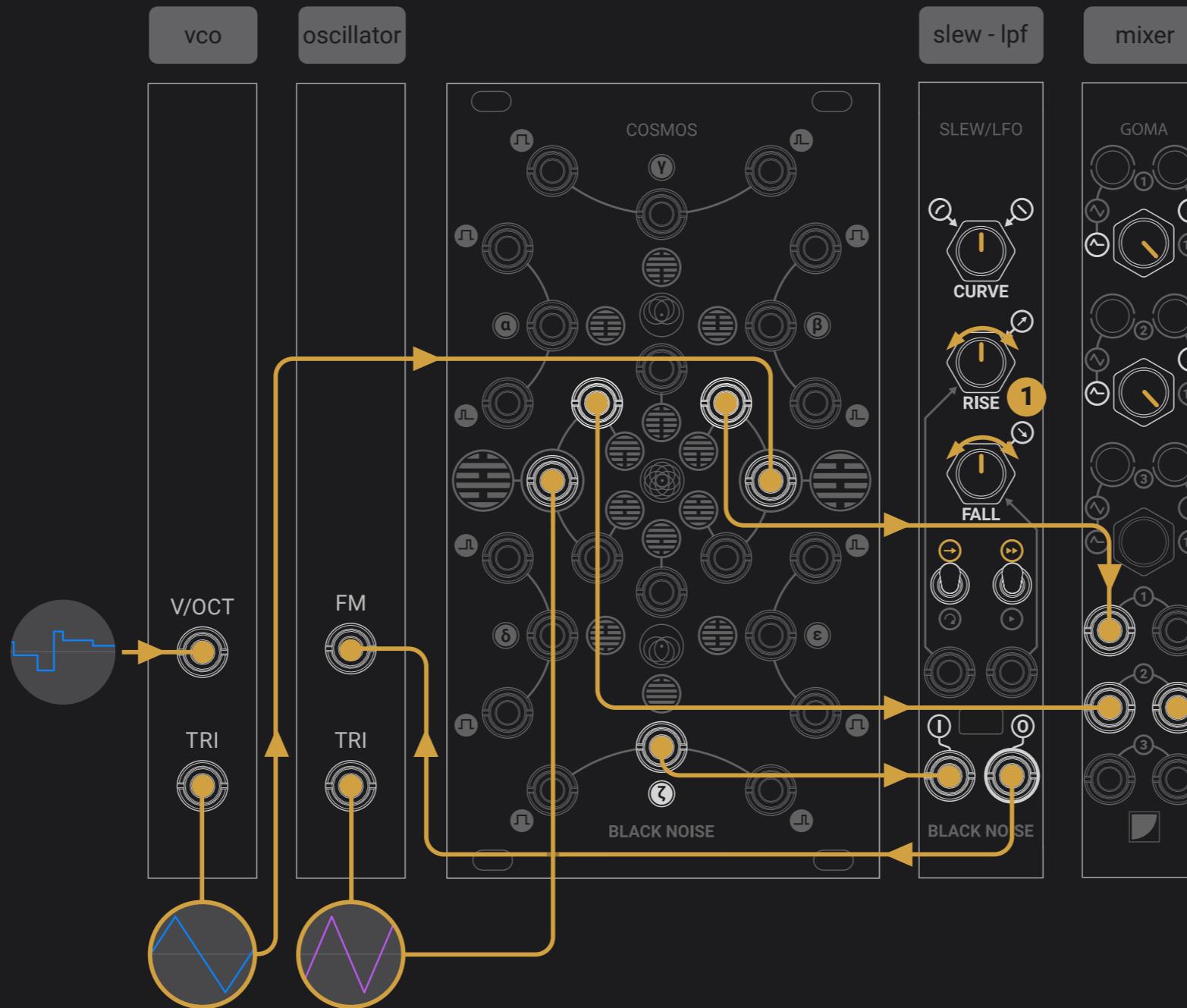
## Harmonic wave shaper

asymmetric wave folding like effect

This patch uses the self-oscillating capabilities of the COSMOS to add harmonics to a simple oscillator, with results close to wave folding or sync effect, with a lot of fine-tuning available.

Patch an oscillator into the X input of Cosmos, patch the TZ clipper gate output thought a Slew LFO, add a negative offset with a GOMA and patch the result to the Y input. The TZ clipper output provides the source wave form wave with extra harmonics.

1. The Rise parameter sets the smoothness of the harmonics.
2. The Fall parameter sets the number of harmonics. This parameter can be CV controlled with an LFO or a sequence to follow the source VCO.
3. The negative offset sets the amount of harmonic content.



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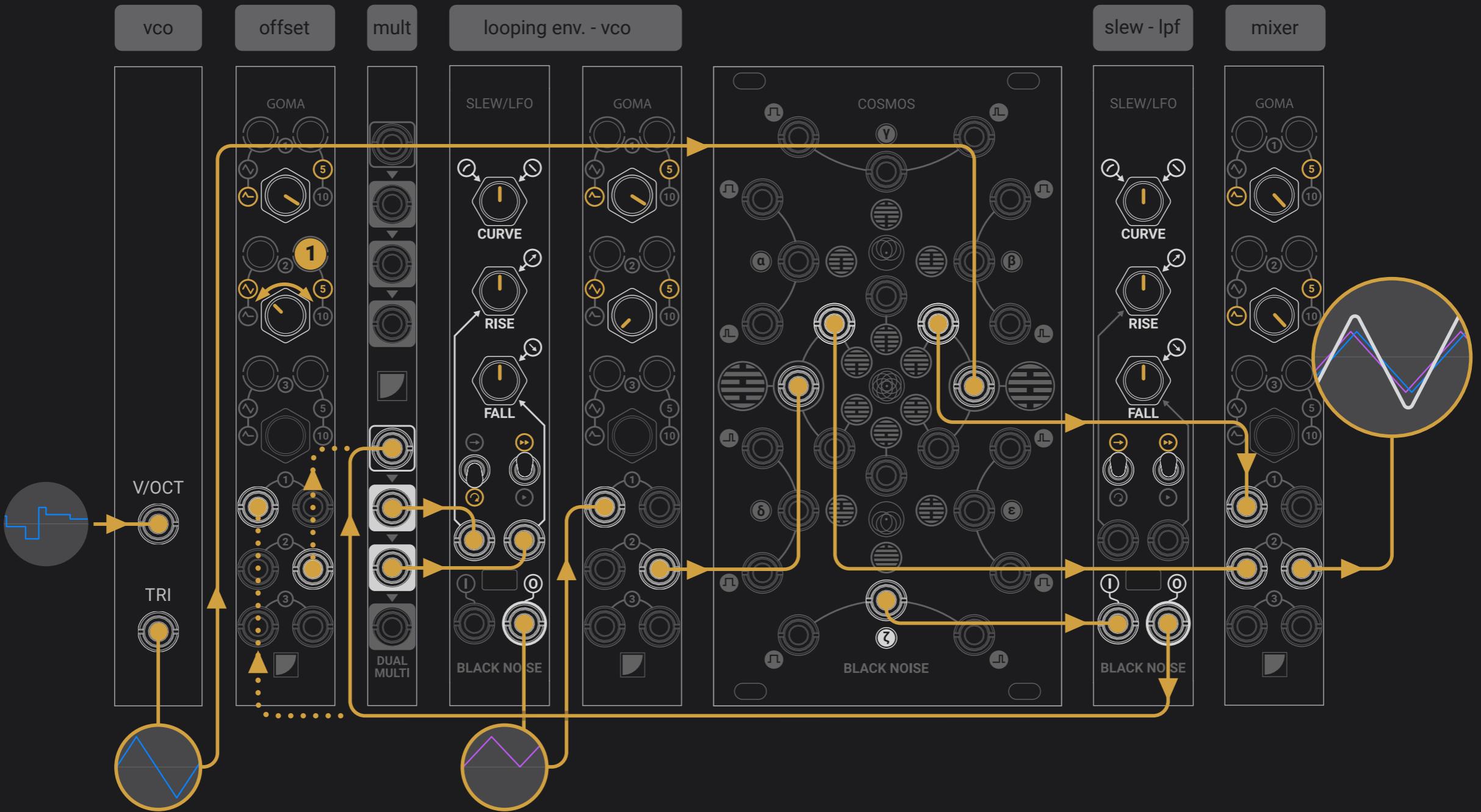
## Phase locked loop: VCO tracking

In this patch, the phase locked loop concept is intended for dubbing an oscillator with any oscillating device (VCO, audio-rate ran LFO) with perfect pitch tracking over a few octaves, and tonal result similar to classic PWM effects.

Patch the main VCO (controlled by a keyboard or a sequencer) and the dubbing VCO into the COSMOS. Send the Inv. TZ clip out though a slew (a filter can also work) to introduce a light phase delay. Patch the result back into the FM input (exponential or V/oct) of the dubbing VCO. Adjust the slew time for best result.

syncing two oscillators together

1. Fine-tuning the slew offers several timbre options. The slew parameter can also be modulated.



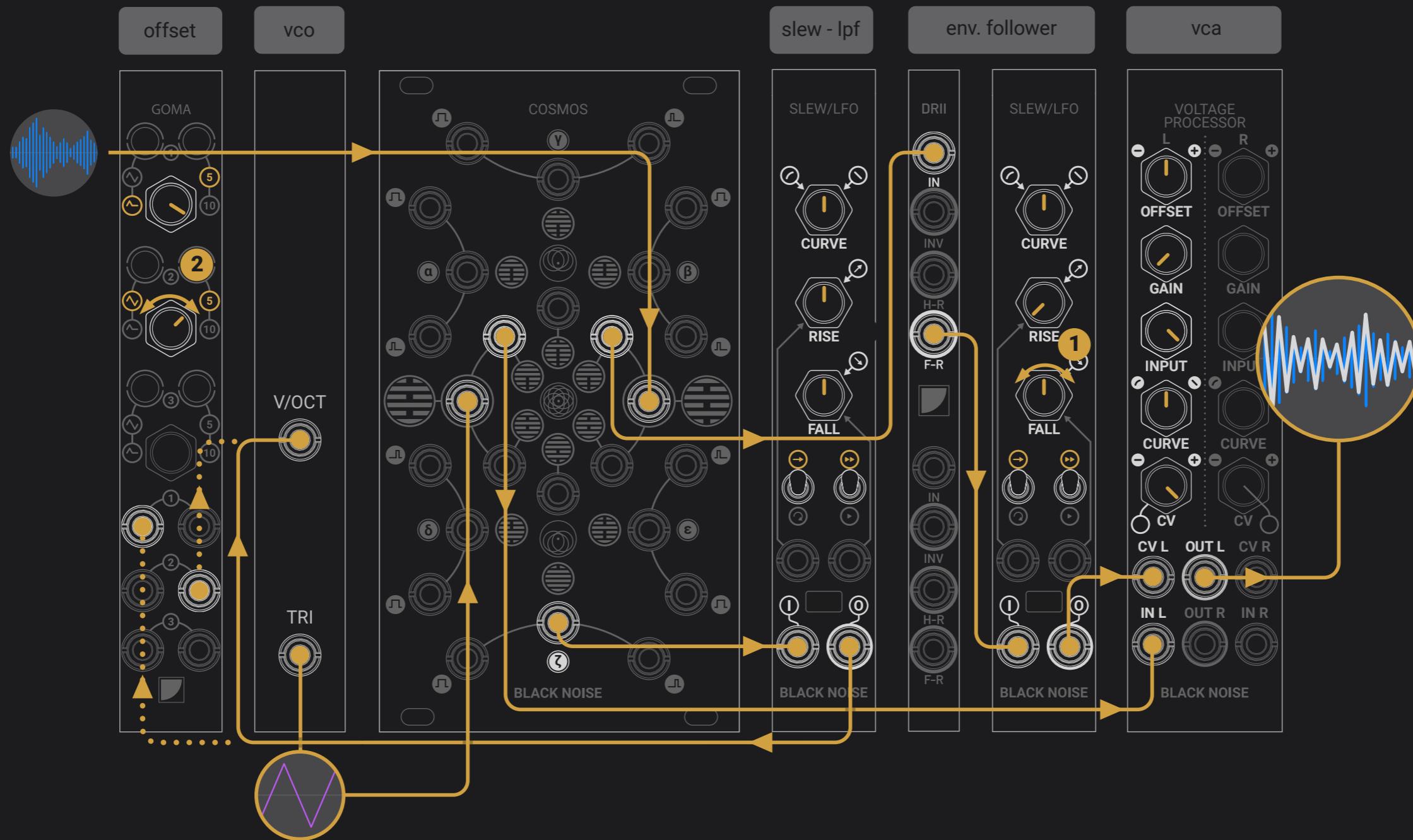
## Phase locked loop: looping envelope

vco tracking with an audio rate looping envelope

In this patch uses the previous PPL tracking concept for turning a looping envelope into an additional VCO with perfect pitch tracking over a few octaves, and sync sweep effects.

The patch is very similar to the phase locked loop: VCO tracking, but the oscillating device is a looping envelope. It requires a -5V offset to make it a proper bipolar oscillator. The inv. TZ clip out is sent back to the rise and fall time.

1. The Inv. TZ CLIP out can be sent through an offset generator from 0 to -5V such as a GOMA, to create a rich sync-like tone. This offset can be modulated for classic sweep effect.



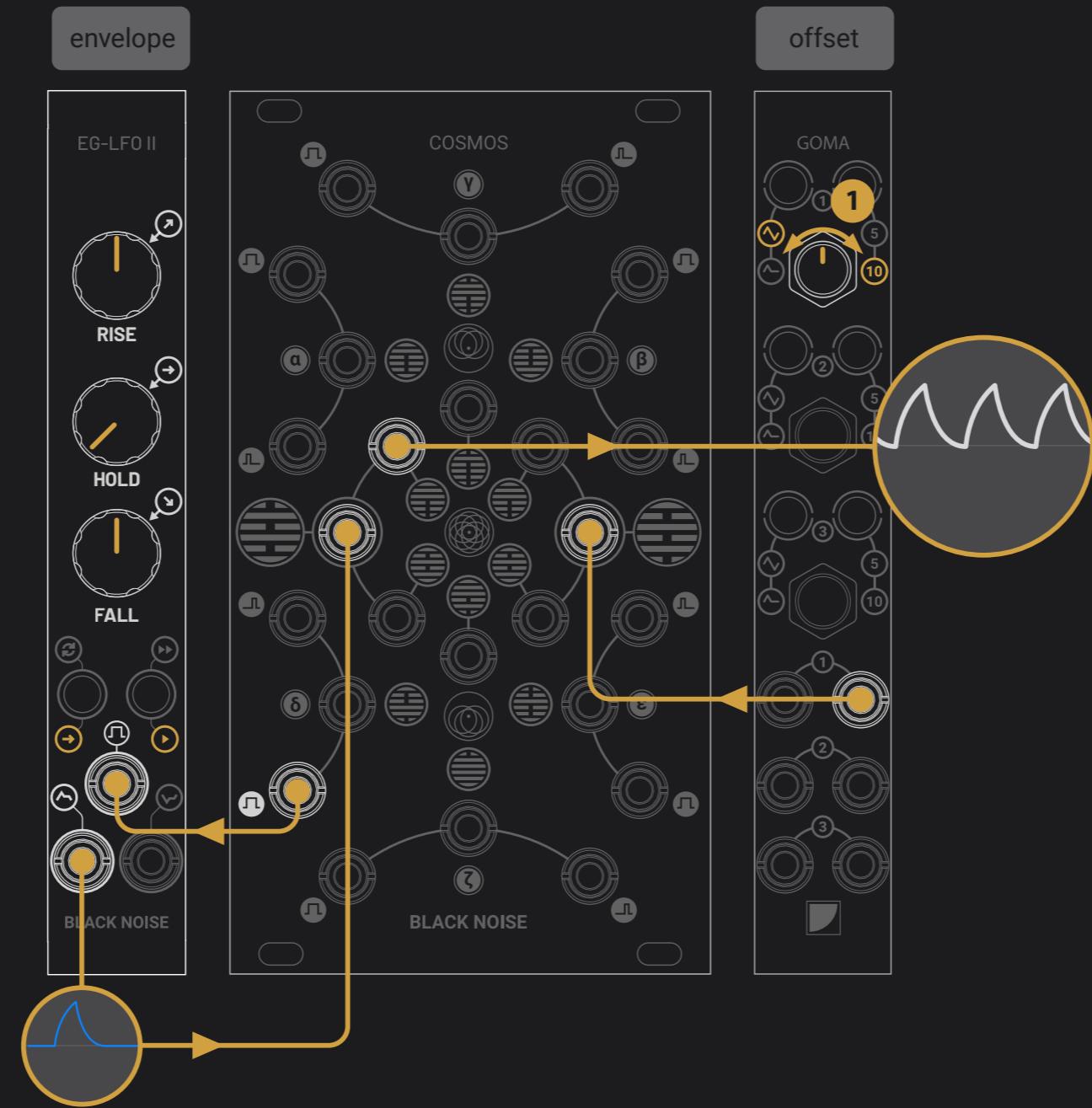
## Phase locked loop: external tracking

In this patch uses the previous PPL concept for tracking an external sound source such as a guitar, synth or voice, with perfect pitch tracking over a few octaves, including portamento, pitch bend and vibrato effects. Harmonic content can be affected for an effect close to analog re-synthesis.

The patch is very similar to the phase locked loop: VCO tracking, but the main VCO is replaced by an amplified external sound source. Better results are achieved with simple or filtered sound with low harmonic content. Upfront effect or reverb should be avoided.

**pitch tracking an external audio source**

1. The synthesized sound can follow the dynamic of the original sound. Send a copy of the sound source through an envelope follower, or a full-wave rectifier and a slew. Use the result to control a VCA processing the VCO.
2. The inv. TZ CLIP out can be sent through an offset generator from 0 to +5V such as a GOMA, to create a rich sync-like tone. This offset can be modulated for classic sweep effect.



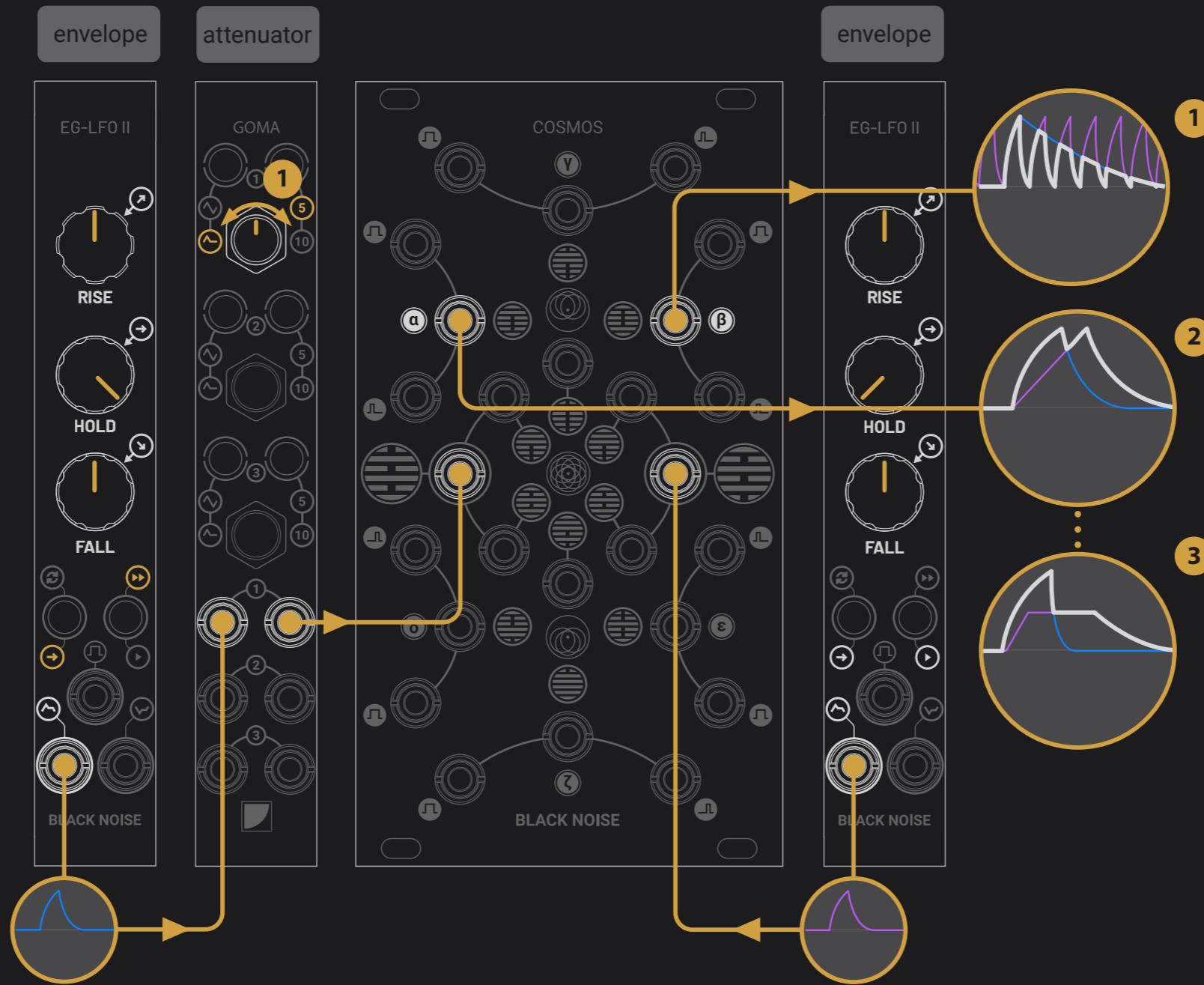
## Envelope to LFO

This patch loops an envelope by triggering at the end of its cycle. It requires an envelope that performs both attack and decay cycles from a trigger, such as EG LFOII.

Patch an envelope into any input of COSMOS and use the NOR gate to trigger it, the envelope can be reused in the corresponding buffered output.

turning classic envelope into looping envelope

1. The envelope signal can be sent through an offset generator from -5 to 0V such as a GOMA, providing more control over the looping point.

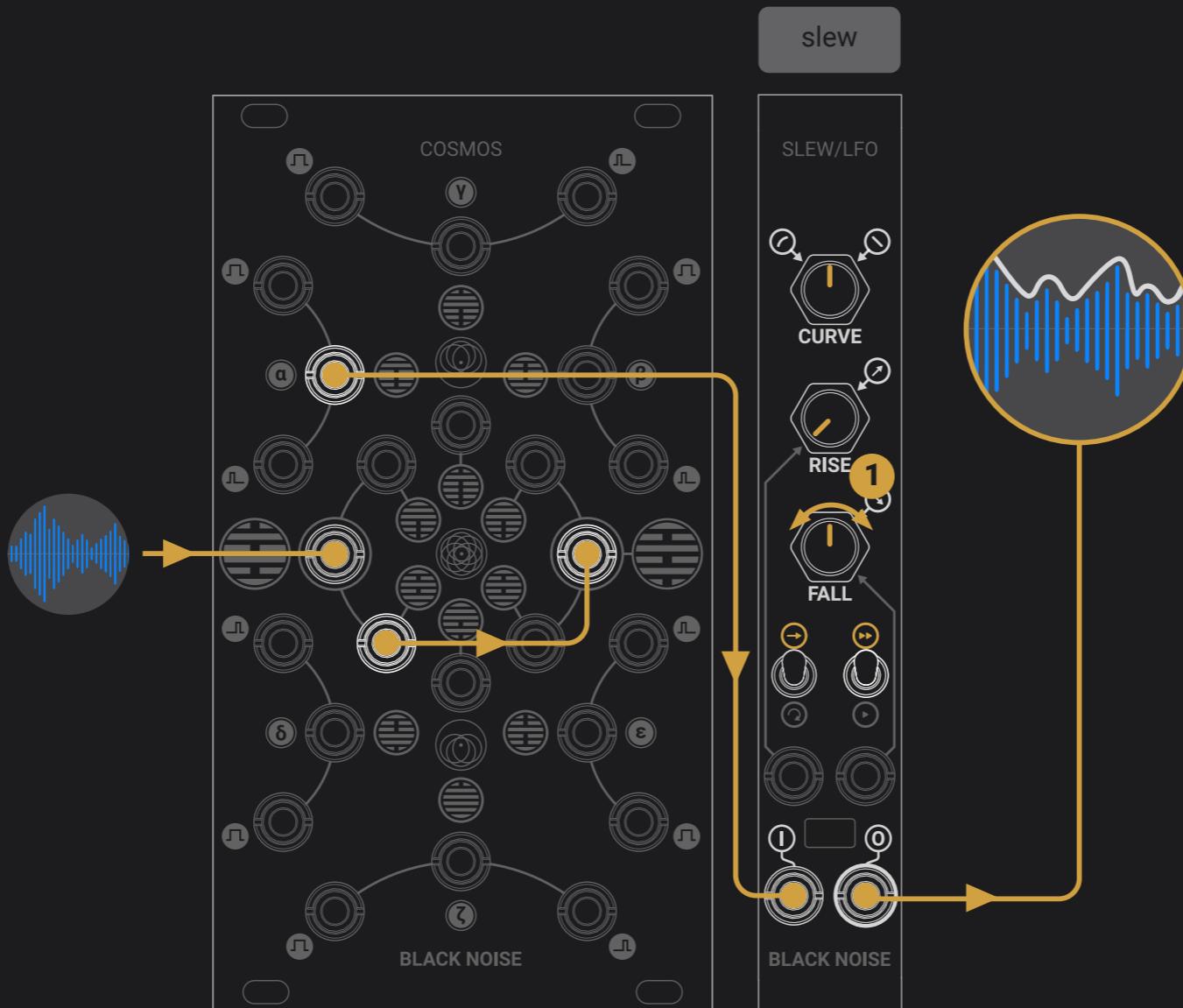


## Envelope combiner

complex envelope from 2 simple ones

This patch uses analog logic operations to combine two envelopes together. Patch the two envelopes into COSMOS and use the MIN and MAX outputs as complex envelopes.

1. A classic ADSR can be made by the MAX combination of a short envelope and a longer attenuated slewed gate.
2. A classic double peak "clap" like envelope can be made by the MAX combination of two envelopes with different attack times.
3. An interesting burst envelope can be made with the MIN combination of a decaying envelope and a fast LFO.



## Envelope follower

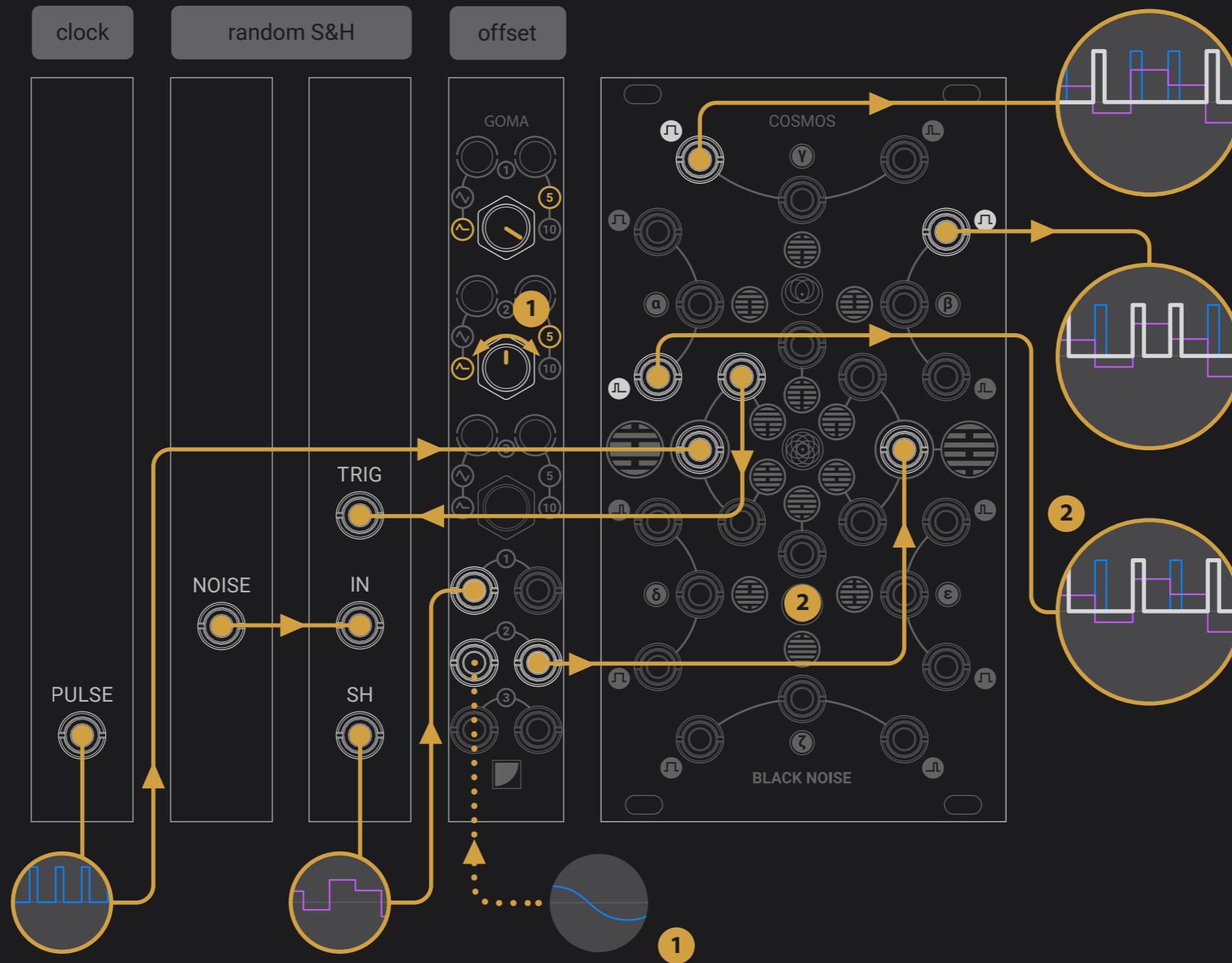
While a slew processor is often known as a basic envelope follower, the COSMOS can be used as a full-wave rectifier to make sure every peak is brought in the positive range to be converted in CV.

This process is especially efficient with rich and dynamic signals such as voices or drum kits.

Patch an audio signal into the X input of the COSMOS and patch the corresponding inverted output to the Y input.

**audio signal rectification**

Patch the MAX output to a slew module with fast processing and short rise. The slew output is a CV signal following the dynamic of the audio source.



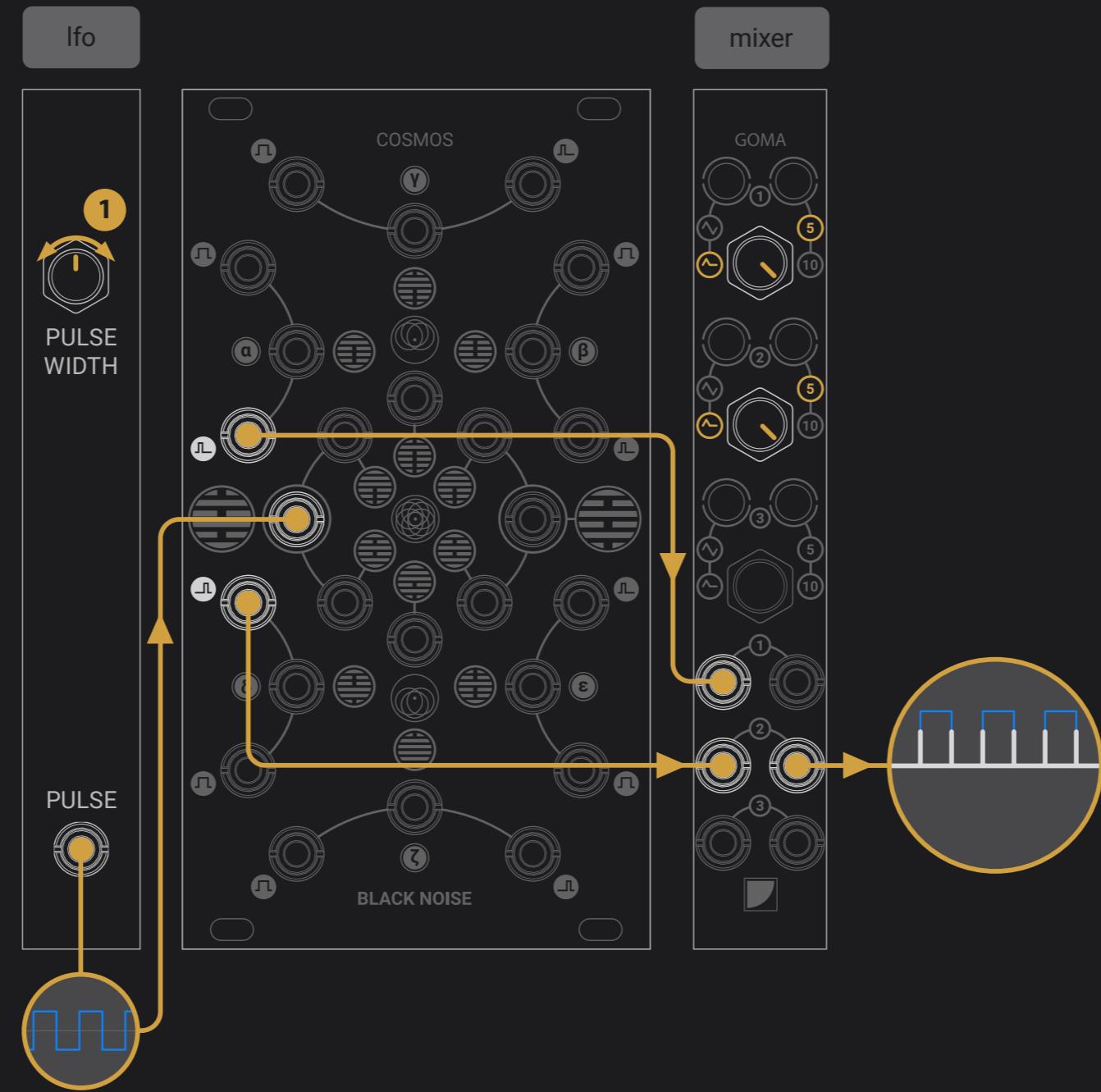
## Random Gates

This patch sets a probability for an incoming gate to randomly come out from two different outputs. This probability can be defined manually or controlled by CV. The other available outputs extend the COSMOS as a complete probabilistic drum sequencer.

Patch a clock into the X input and use the corresponding buffered output to trigger a random sample and hold (S&H) with noise as a source). Patch the S&H output through an offset generator such as GOMA, then into COSMOS Y input. The XOR and AND outputs emit clock beats in random alternation depending on the S&H signal polarity.

### CV controllable analog Bernoulli gates and random drum sequencer

1. The source signal can be sent through an offset generator from -5 to +5V such as a GOMA, to define the probability to have the random gates coming from XOR or AND.
2. The other outputs provide interesting experimental results, expanding the device to a complete random rhythm generator: the OR trig output offers a third random rhythm, and all the lower ports' gates offer interesting downbeat rhythms.



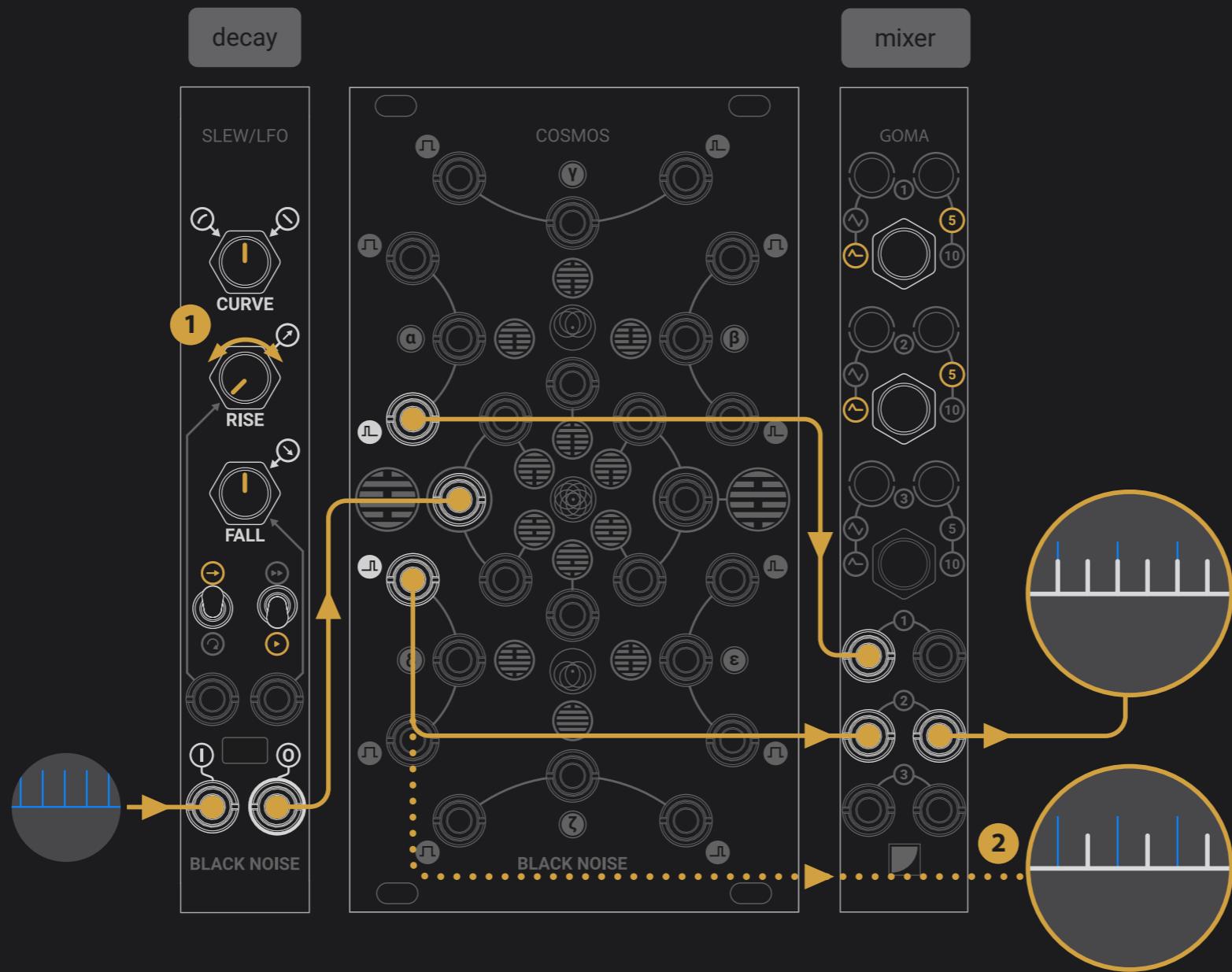
## Clock multiplier with Swing

This patch is a 2x clock multiplier with the ability to adjust the swing effect of the double stroke.

Patch a pulse wave LFO to any input of COSMOS, mix the OR and NOR triggers to have a new clock made from the rising and falling edge of the gate.

converting gates to double triggers with voltage controlled swing

1. Adjusting the pulse width of the source signal adjusts the swing effect of the off-beat.



## Trigger multiplier with delay

converting triggers to double triggers with voltage controlled delay

This patch offers a similar result than the previous one, with triggers as sources instead of gates.

Patch a clock into a slew and set the fall to a short setting. Mix the OR and NOR triggers to have a new clock made from the rising and falling edge of the gate.

1. Adjusting the fall of the slew adjusts the delay of the off-beat.
2. Using only the NOR trig out provides a trigger delay controlled by the slew time.