ANA2

Analog Logic

MYSTIC circuits

Contents

ANA2

Ana is a cross modulation powerhouse that derives nine different analog logic operations in tandem from two input signals. Each input channel features a processing section that attenuverts, adds, or multiplies up to six inputs before being sent to the cross modulation circuits. Ana performs a wide variety of functions including mixing, boolean logic, rectifying, cross-fading, voltage sampling, ring modulating, gate converting, bizarre wave shaping and much more. While you may have seen these functions in individual modules before, Ana combines them all into one place with all of these functions available simultaneously to give you a Swiss army knife utility that is capable of happy accidents.

At its core, Ana is an Analog Boolean Logic Processor. Boolean logic normally takes two binary gate signals and combines them into a single gate signal based on mathematical rules. While the output of a normal boolean logic circuit is always a gate, analog boolean logic can both process and output any kind of voltage signal. This means that Ana works not only with gates but also modulation, note sequences, and even audio. Whatever type of signal that you feed in is what you will get out of Ana. In fact, feeding Ana a combination of different types of voltage signals will give you a weird blend between them. Ana always gives you more than you put in, providing nine related but distinct outputs that can be derived from as little as a single voltage source or even no input at all. While this all may seem complicated, by the end of this manual you will become an Ana master.

www.mysticcircuits.com

INSTALLATION

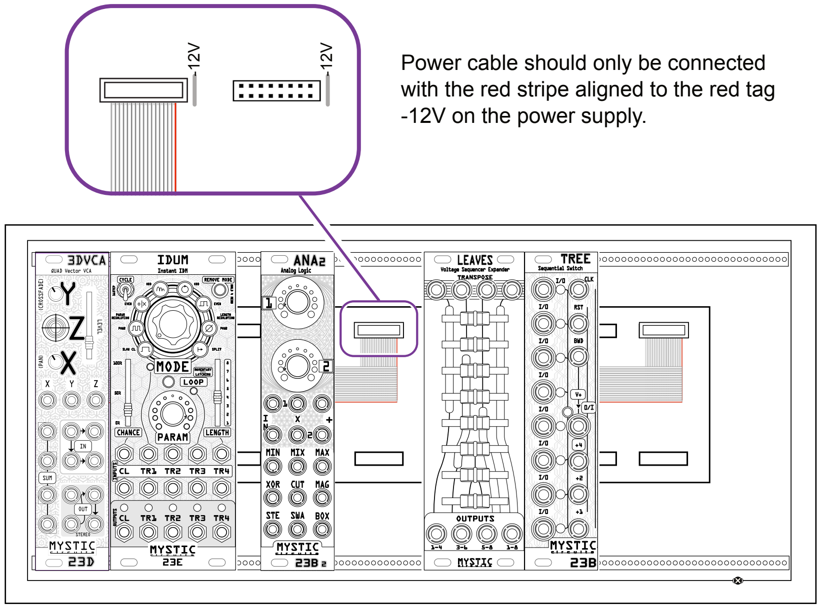
Follow the installation instructions carefully to avoid module or rack damage.

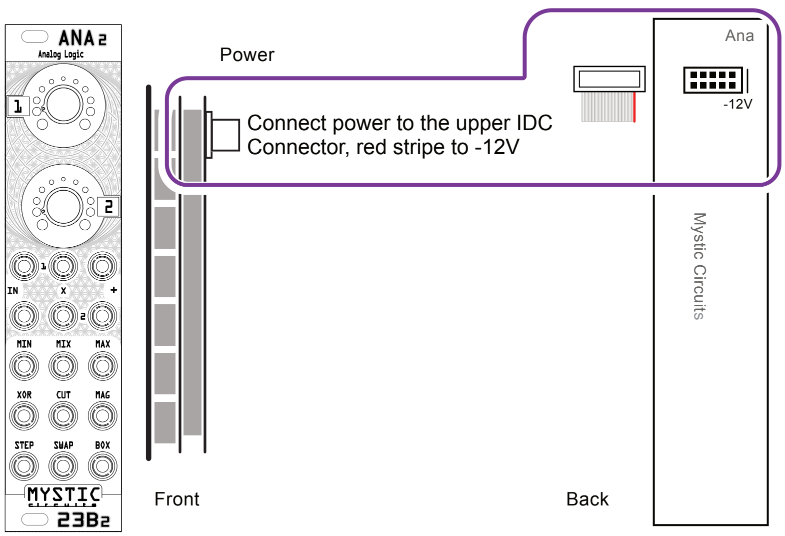
1. Ensure the power connection is off before installing the device.
2. Identify 6HP of free rack space in which to install the module.
3. Connect the 10 pin connector from the IDC ribbon power cable to the header on the rear side of the module by aligning correctly with the red stripe on the ribbon conductor nearest to the -12V pin indicator on the header.
4. Insert the cable through the rack and connect the 16 pin side of the IDC ribbon cable to the rack power supply header. Ensure that the pins are aligned correctly with the red stripe on the ribbon conductor nearest to the -12V pin on the header.
5. Position the module into the dedicated rack position.
6. Attach the 2 x M3 screws by screwing into the 2 locator holes and the rack mount taking care to not over tighten the screws.
7. Turn on the power to the rack.
8. The module will start up and be ready to use.

Ensure the following conditions are correct for trouble free installation.

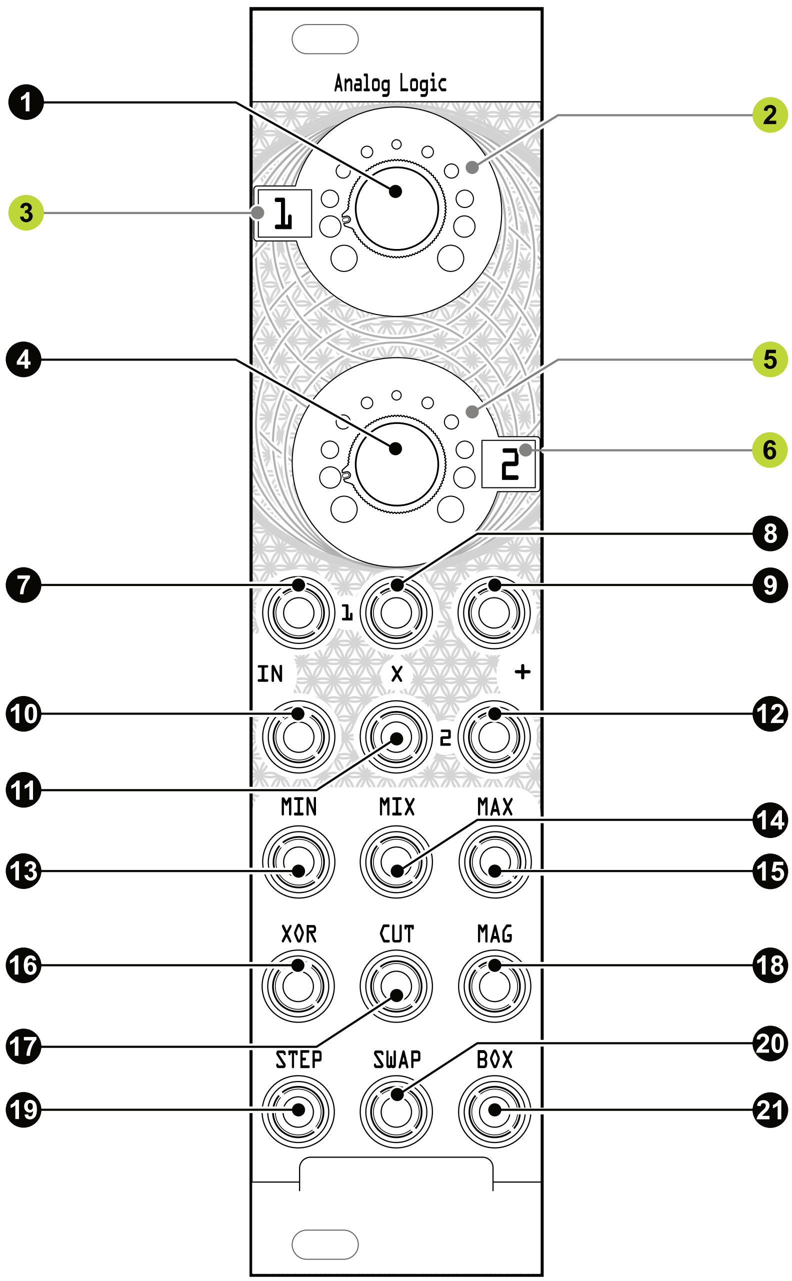
- Rack power supply can accommodate all of the installed modules total current ratings. Ana power requirements are **+12V 101mA, -12V 104mA, +5V** Not Used. Do not confuse the power connector with the expansion connector.
- Ana is **32mm deep**.
- Module power cable orientation is correct at both the rack and module side. Use the IDC ribbon cable supplied with the module.
- Ensure the rack earth / grounding is correct.
- Take care to avoid patch cables falling into the rack or touching module PCB’s

Eurorack Installation.





QUICK REFERENCE



1. Channel 1 Control Knob: Adjusts the Interaction of the upper 3 inputs.
2. Channel 1 LED Range Indicator: Shows the positive and negative control knob setting.
3. Channel 1 LED Window Indicator: Final voltage level, green = positive, red = negative.
4. Channel 2 Control Knob: Adjusts the Interaction of the lower 3 inputs.
5. Channel 2 LED Range Indicator: Shows the positive and negative control knob setting.
6. Channel 2 LED Window Indicator: Final voltage level, green = positive, red = negative.
7. Channel 1 Main Input: When patched here the control knob will act as an attenuverter.
8. Channel 1 Multiplier input: Multiplies the input going into Main Input 1.
9. Channel 1 Sum input: When patched here the control knob will act as an offset. When the main input is also in use this signal is added to the attenuverter output.
10. Channel 2 Main Input: When patched here the control knob will act as an attenuverter.
11. Channel 2 Multiplier input: Multiplies the input going into Main Input 2.
12. Channel 2 Sum input: When patched here the control knob will act as an offset. When the main input is also in use this signal is added to the attenuverter output.
13. Min Output: Minimum voltage between the two inputs.
14. Mix Output: Sum of the two inputs.
15. Max Output: Maximum voltage between the two inputs.
16. XOR Output: Exclusive OR of both inputs.
17. Cut Output: Non-linear crossfader.
18. Mag Output: Difference between both channels, output is always positive.
19. Step Output: Track and hold, clocked from the two inputs.
20. Swap Output: Switched output from either of the two inputs or no input.
21. Box Output: Bipolar comparator, generates a 3-level square wave.

INPUT SECTION

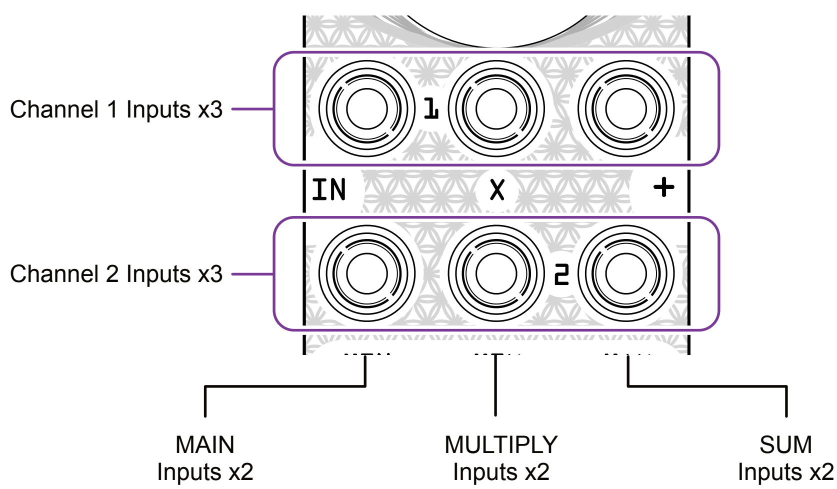
Ana offers a variety of ways to process your input signals before being sent to the cross modulation circuits. The two input channels each have three inputs that behave in different ways, and how they are patched will determine the behavior of each channels' control knob. This knob attenuverts, offsets, or with nothing patched acts as a static voltage. For those that don't know, an attenuverter affects both the amplitude and polarity of incoming signals depending on the position of the attenuverter knob. Thinking like the hands of a clock, with the knob at noon the attenuverter output will be close to zero. From this position, turning the knob clockwise increases the output level positively. Turning the knob counter-clockwise past noon will instead increase the output level but with the positive and negative portions of the wave flipped.

Even with no inputs patched the channel knobs will influence the behavior of Ana. When no inputs are patched into any of the inputs of a channel's input section, the channel knob will create a static voltage that can be either positive or negative based on the knob position.

The leftmost input for each channel is the main attenuverter input. When a signal is patched into this input with no other inputs used, the relevant channel knob will behave as an attenuverter as described above.

The middle input for each channel is the multiply input. This essentially lets you control the position of the attenuverter with a voltage. When a signal is patched into this input, the relevant channel knob will control the amplitude and polarity of the overall multiplication. The multiply section for each channel is essentially a bipolar VCA. Most synthesizer VCAs only affect the amplitude of a signal positively, while a bipolar VCA affects the amplitude in both the positive and negative realms. The channel knob acts as an attenuverter for the bipolar VCA modulation.

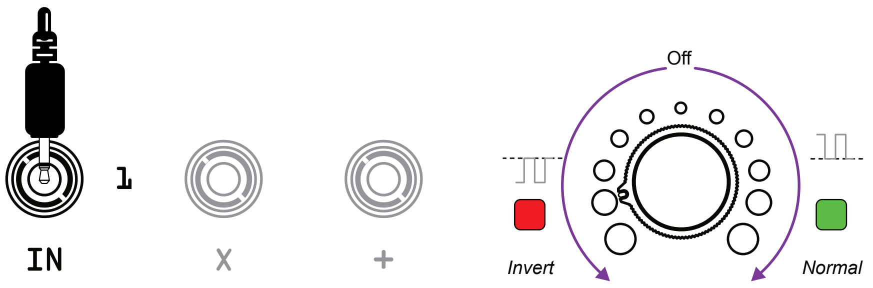
The rightmost input is the sum input. This adds another voltage to the output of the attenuverter before heading into the logic circuits. If both the main input and multiply inputs are unpatched the channel knob will act as an offset to the signal patched into the sum input, shifting the input signal up or down by turning the knob clockwise or counter clockwise respectively.



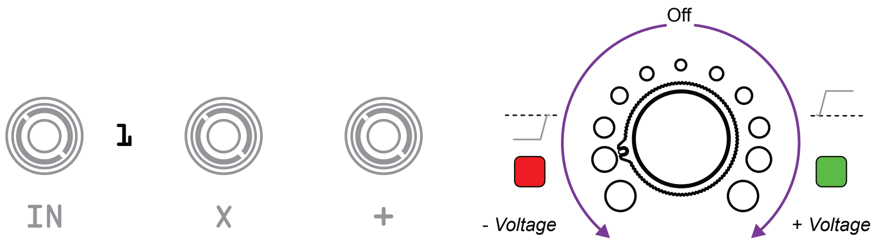
CHANNEL CONTROL KNOBS

Each input channel has its own channel control knob that allows the user to interact with the input signals. This knob operates differently depending how the relevant input section is patched, however each of the two channel control knobs operate in the same way.

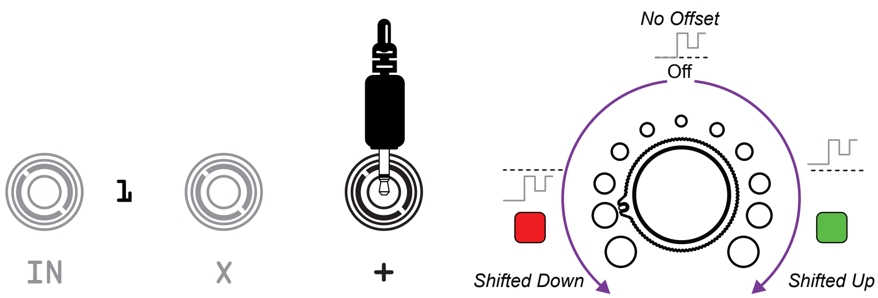
When a signal is patched only into the main input, the knob will act as an attenuverter. This means no signal at its centre position, increasing signal level when turned clockwise, and increasing the inverted signal level when turned counterclockwise. Note that the multiply input allows for voltage control of the attenuverter knob.



With nothing patched into any of the inputs the control knob will simply output a static voltage. The control knob will adjust the static voltage level and polarity in this scenario



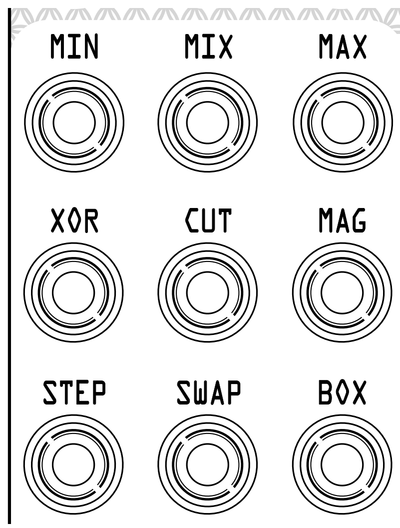
When a signal is patched only into the sum input, the knob will act as an offset. This allows us to shift the input signal in a positive or negative direction without changing the amplitude or polarity of the signal. When a signal is also patched into either the main or multiply inputs any signal patched into the sum input will be added to the results of the attenuverter voltage processor.



OUTPUT SECTION

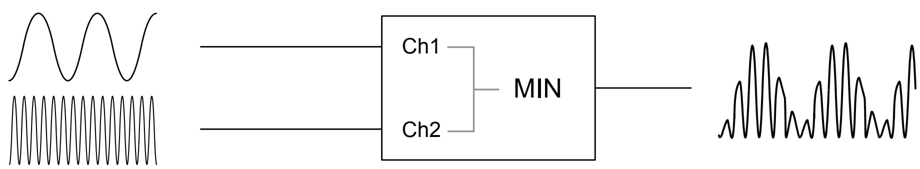
The bottom row of jacks surrounded by a silver border make up Ana's output section. Each of these outputs performs a unique analog computation that combines both of our input channels in nine different ways. This makes it so that Ana is capable of creating as many as nine correlated voltage sources all based off of as little as one input signal. While you may find a single output on Ana useful for a specific function such as a VCA or rectifier, part of the magic of Ana is that all of the other outputs are also simultaneously active and ready to be patched to the rest of your rack.

Outputs x9

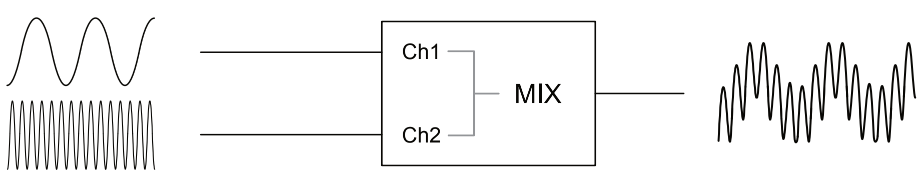


Output	Function
MIN	Minimum of both channels: outputs the lowest voltage between both of the input channels.
MIX	Mixture of both channels: outputs the sum of both of the input channels.
MAX	Maximum of both channels: outputs the highest voltage between both of the input channels.
XOR	Exclusive OR of both channels: a somewhat unique take on a through-zero VCA that uses clamping instead of attenuation of a signal.
CUT	Bizarre non-linear combo: best I can do is that it is sort of the crossfader version of the XOR output's VCA. Gives some nice wave folder-y shapes.
MAG	Magnitude: gives the difference between both channels, handy in that this output is always positive so great for filters and VCAs.
STEP	Track and hold: an output that is the sum of 2 track and hold circuits where both the clock and sample inputs are derived from the input channels.
SWAP	Switch output: an output where both channels are dynamically switched on or off, output is either channel 1, channel 2 or 0.
BOX	Bipolar comparator: outputs a 3 level square wave that allows us to pulse-width modulate the positive and negative portions of a wave.

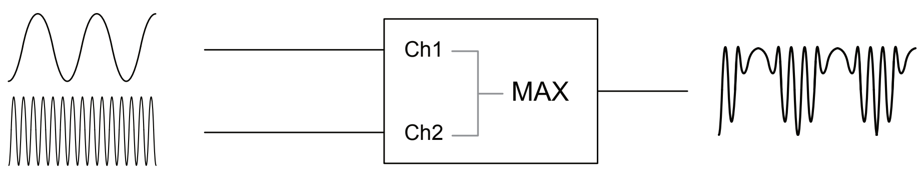
Output	Function
MIN	Outputs the lowest voltage between the two input channels. This computation is the analog logic version of a Boolean "And Gate" and will behave like an And Gate when used with gates or triggers. And Gates normally allow a gate signal to silence another gate signal, almost acting like a spigot which turns on and off a stream of gates. When used with other voltage sources, a low voltage on either of the channels will pull this output low, essentially choking the other channel. This output is ideal for modulating parameters that you want to be a low value most of the time but to fluctuate into higher values only every once in a while.



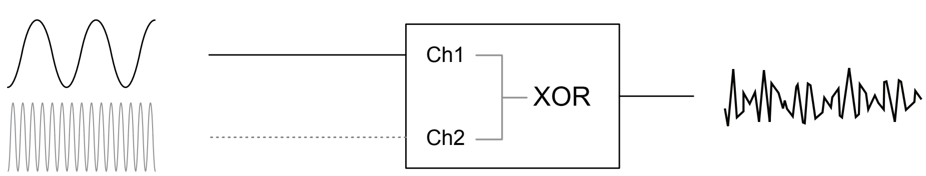
Output	Function
MIX	Mixes the two channels together. This behavior is simple enough but was conspicuously missing on Ana v1 and opens a whole new range of functions to Ana v2 to help solidify it's Swiss army utility. With this output you can for example use Ana as a four input mixer or a normal attenuvert / offset voltage processor, both of which will be shown in the example patches section. However, this Mix output also gives you unadulterated access to the bipolar VCA functionality of the input processors. Please keep in mind that bipolar VCAs are notoriously difficult to "zero out". This means that even with no signal plugged into the multiply input for either channel there will probably be some input bleeding into the output



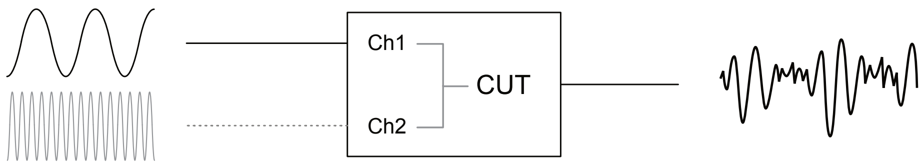
Output	Function
MAX	Outputs the highest voltage between the two input channels. This circuit is somewhat complementary to the MIN output and as such it always outputs the opposite channel of the MIN output. Similarly to MIN, the MAX output also computes a Boolean logic function, being an "Or Gate", when used with gates or triggers. Or gates are used to add multiple streams of triggers together and as such the MAX output can be used to add fills to a normal trigger sequence, mix multiple outputs of a clock divider, or create new sequences from multiple sequencers. It is important to note that MAX will actually work similarly to MIN in that a high voltage will choke the behavior of the other input. Unlike MIN, the MAX output will pass through either channel unaffected even if the other channel is at zero volts. MAX is perfect for voltages that normally like to be held high but move to lower settings every once in a while



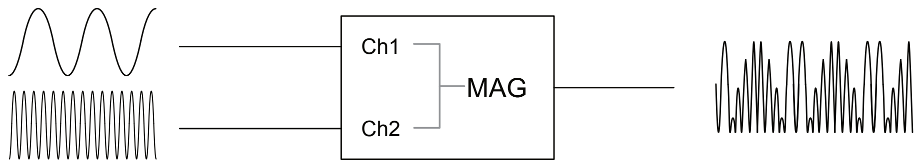
Output	Function
XOR	Multiplies the two inputs using a unique bipolar clamping circuit. This output combines the diode logic circuits used for MIN and MAX to compute an analog "Exclusive Or Gate" (XOR Gate). When used with triggers or gates an XOR gate will invert a stream of gates based on whether a second stream is low or high. Because we are working with bipolar analog voltages and not with simple on/ off binary signals this XOR gate behaves a bit differently with triggers and gates. If you would like to use the XOR output with gates it is advised to plug those gates into the "SUM" inputs and add a slight negative offset using the channel knobs. For audio purposes this output behaves like a bipolar VCA but because of the clamping behavior the VCA distorts as it closes instead of when it is fully open. This output is great for modulating parameters that like to sit around a specific value but can move in either a positive or negative direction from there. Keep in mind that like with a normal XOR gate, two positive voltage inputs will result in a negative voltage output.



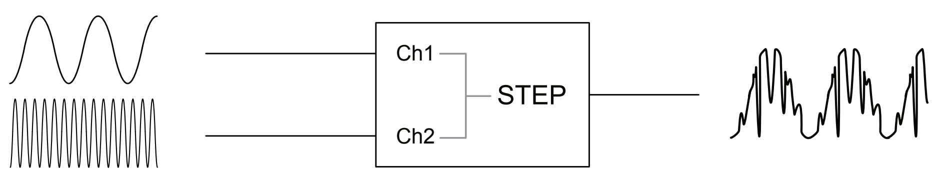
Output	Function
CUT	This output is probably the hardest to explain of any of the outputs. The core circuit of CUT is quite simple: it subtracts the XOR output from both channels and then adds the results of each subtraction together. In practice this makes CUT behave in a lot of different ways depending on what XOR is doing. One of the most interesting things about CUT is that it can perfectly replicate either input channel just by changing the channel controls, meaning that it can be used as a crossfader (details in the example patches). However, when the channel controls are somewhere between both inputs you get some very glitchy wave folding and non-linear cross modulation. I have found this output to be particularly useful for mixing multiple kinds of modulation together as it sort of gracefully switches between each input channel without drastically changing the overall voltage range in a way that the other outputs don't seem to do as well



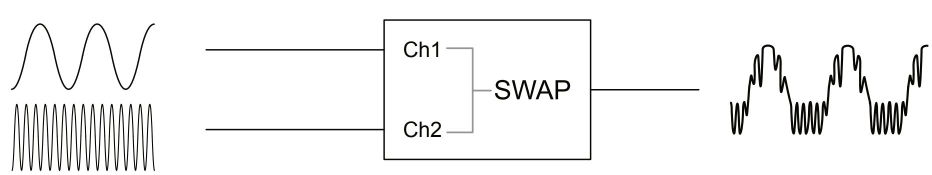
Output	Function
MAG	Computes the absolute difference, or magnitude, between both inputs. The wonderful thing about MAG is that the output is always positive and changes whenever either input changes. This makes it a perfect candidate to modulate parameters that only want to move in one direction such as a VCA's amplitude, a filter's cutoff frequency, a wave folder's fold amount, etc. At audio rate MAG makes an excellent frequency doubler/ octave up effect that can be voltage controlled for interesting wave animation types of sounds. For you feedback freaks out there MAG is quite useful for introducing chaotic behavior to a feedback loop, try using it with a filter to recreate some classic strange-attractor chaos circuits.



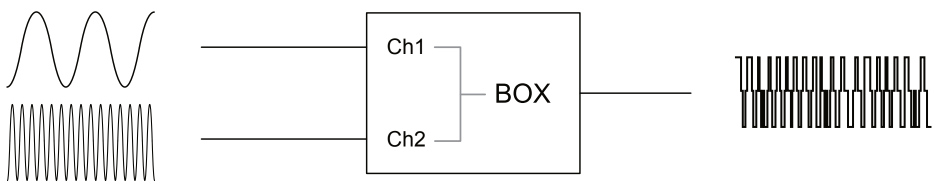
Output	Function
STEP	Generates pseudo-random stair stepped signals. This uses a circuit called a track and hold that will pass an input signal from its track input until a gate is received at its hold input, at which point the output is held steady until the hold input gate goes low again. A track and hold differs from a sample and hold because the original signal can pass through when the hold input is low whereas a sample and hold will hold the output steady until a new clock edge is received at the hold input. These sorts of circuits are quite useful for doing anything from generating stepped, quantized signals from a smoothly changing input to making downsampler style aliasing distortions. The unique thing about Ana's STEP circuit is that it is actually two track and holds that track both channels while the gate signals to control the hold inputs are automatically generated from the input signals. Some of you might recognise this output from Ana v1, the new version of this circuit has actually been improved quite a bit. Ana v1 only tracked channel 1's input whereas Ana v2 tracks both channels and then adds the results together. Also the actual track and hold circuit has been revamped to have better accuracy, speed, and less voltage drift



Output	Function
SWAP	A two channel switch that outputs either channel 1, channel 2, or no signal. Similarly to the STEP output the control signals for the switches are automatically generated by both channel's inputs. When using SWAP with audio the switches generate a lot of sharp transitions and clicks when switching one or both channels off which makes it an excellent distortion that adds a lot of harmonics but maintains more of the original audio's integrity than the BOX output. Just like XOR, this output likes to modulate parameters that mostly want to be at a specific value but can wander off in either direction. This output's simplicity betrays its utility, something interesting is always going on at the SWAP output.



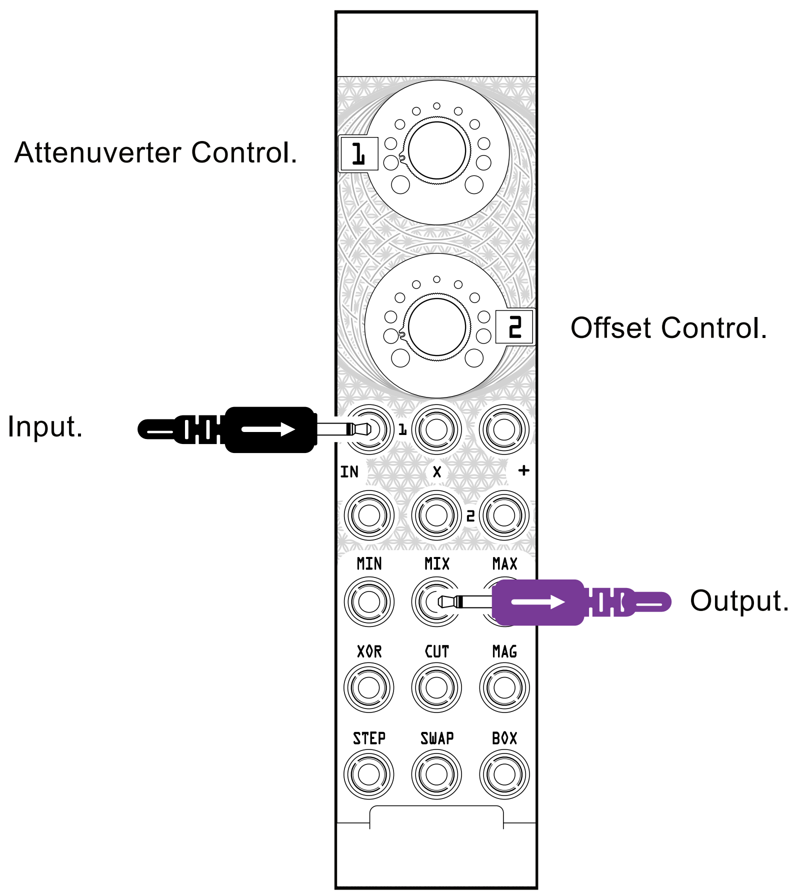
Output	Function
BOX	A window comparator that results in a three level square wave. To my ear the three level square wave (positive, negative or zero) sounds a lot more dynamic than just a simple on/ off square wave. Another benefit of the three level squarewave is that BOX can be used to pulse-width-modulate the positive and negative portions of a wave separately. This output is really the cornerstone of this module, not only is it used as the control signal for both the STEP and SWAP circuits but it also is the only output that always generates a gate. This can be really helpful for converting a fluctuating analog voltage into gates but is also amazing for extracting gate patterns out of voltage sequences. Another nifty feature of this output is that since it also generates a negative gate stream you can invert the voltage of the signal to get an extra gate pattern. Try using the multiply inputs for some pseudo-phase modulation on this output.



PATCHING WITH ANA

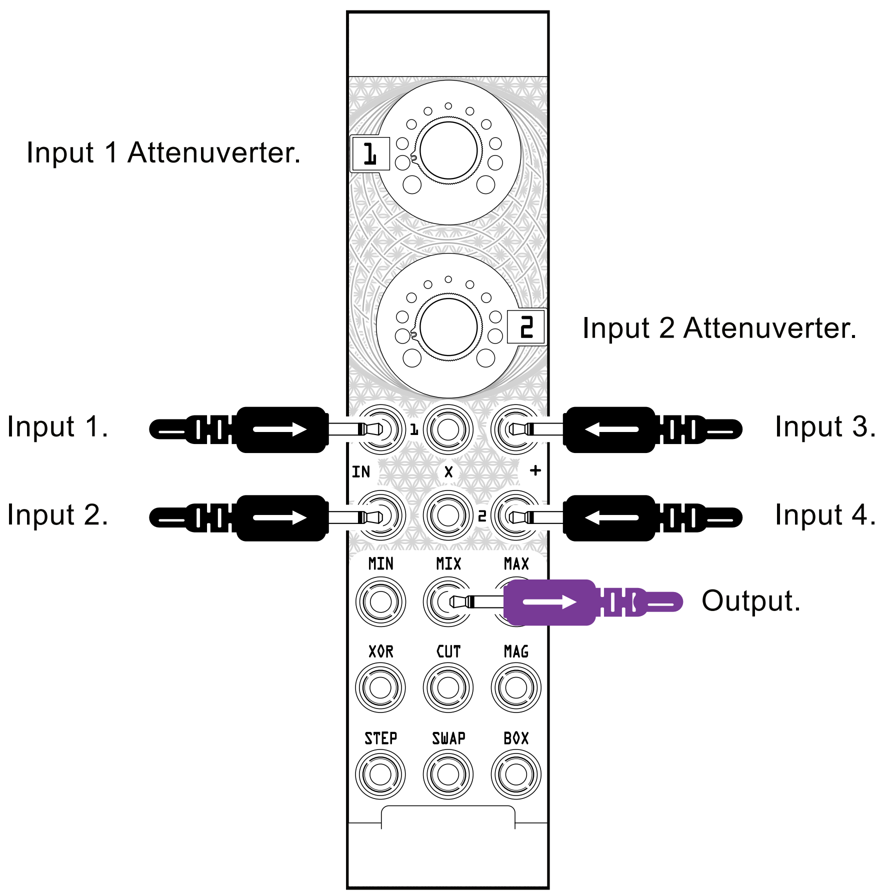
Patch Example 1: Normal Attenuvert Offset

It's wild how many times a patch needs just one more voltage processor, but add too many to a modular case and there won't have enough room for any of the fun modules. Fortunately Ana gives you a bit of both. This Attenuvert offset voltage processing patch is one of the main reasons that I decided to add the MIX output to Ana v2. It's an incredibly simple patch but when you need it you will be glad that Ana can do this.



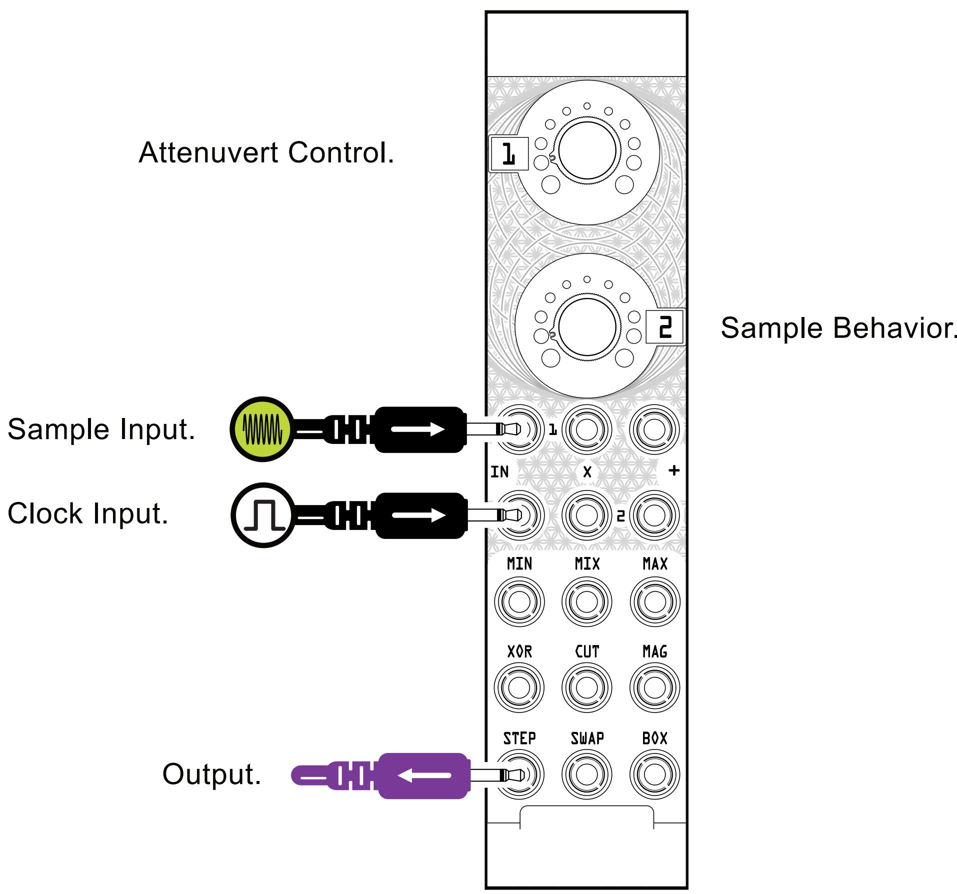
Patch Example 2: Four Input Mixer

Another great reason to add the mix input is the ability to use Ana as a rudimentary mixer now. Inputs 1 & 2 both have control over their gain and polarity through the attenuverters while Input 3 & 4 are added to the output at unity gain. Keep in mind that the attenuverters can actually boost the level of their input so they are ideal for quieter inputs. If you decide that you want to use some voltage control from something like an envelope or a gate into either of the multiply inputs keep in mind that there will be some bleed. I have had success with adding a small offset voltage to the multiply CV signals in order to manually remove some of the bleed when using control voltages that bottom out at zero volts but you will not be able to completely get rid of the bleed. If you would like a VCA with no bleed I suggest trying out 3DVCA.



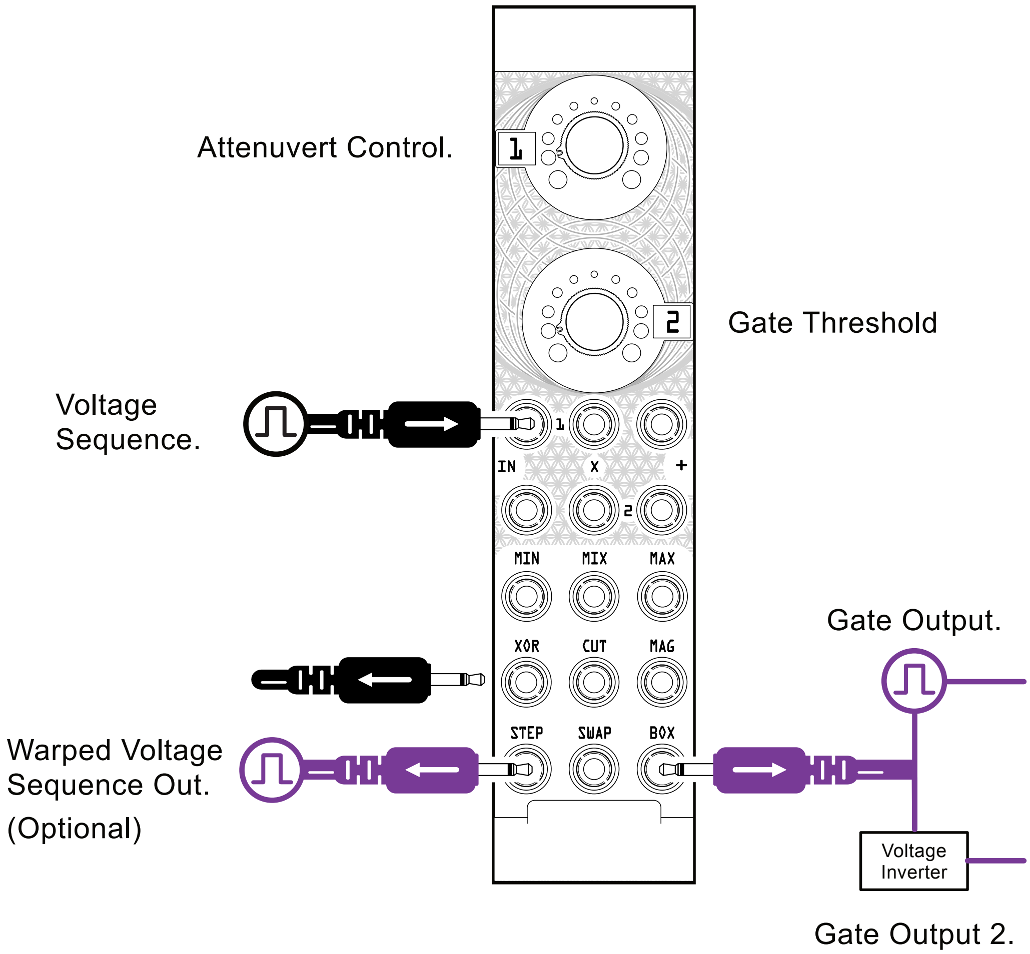
Patch Example 3: Sample N' Hold

This is not going to behave exactly like a normal sample and hold but it will get you pretty close. Adjusting the Sample behavior control can change not only how often the trigger input is sampled but also which portion of the normal sample input is held. This is an updated version of a patch found in the Ana v1 manual, in that case the BOX output was patched back into the clock channel's SUM input. This no longer works the same way since Channel 2 is also sampled and sent to the STEP output now, meaning that feeding BOX back will add lots of sudden jumps in voltage to your output. You might also have interesting results putting the clock input into the SUM 2 input but keep in mind that this will also shift the level of the STEP output.



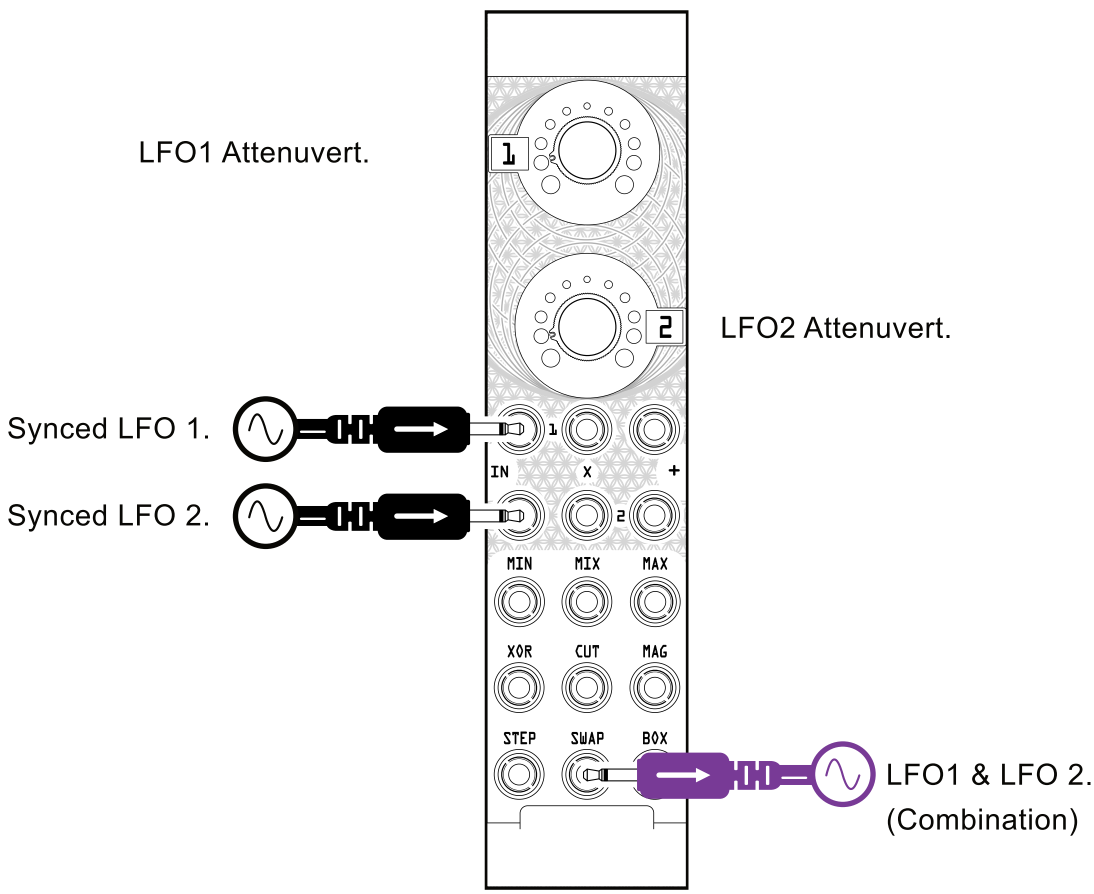
Patch Example 4: Gate Extractor

This is a go-to patch for me that uses a voltage sequence input to automatically generate up to two gate sequences. The threshold control will change which portions of the voltage sequence creates gates and also change which notes make it into the warped voltage sequence output. Similar to the previous patch, the threshold control will also shift the level of the STEP output. As mentioned in the BOX output description, because BOX creates both a positive and negative square wave with different patterns you can run the BOX output into a voltage inverter (not a logic inverter) in order to get a second gate sequence. This sequence will not overlap with the first sequence but it still behaves differently than a simple logic inverter that just gives a gate whenever the input is low.



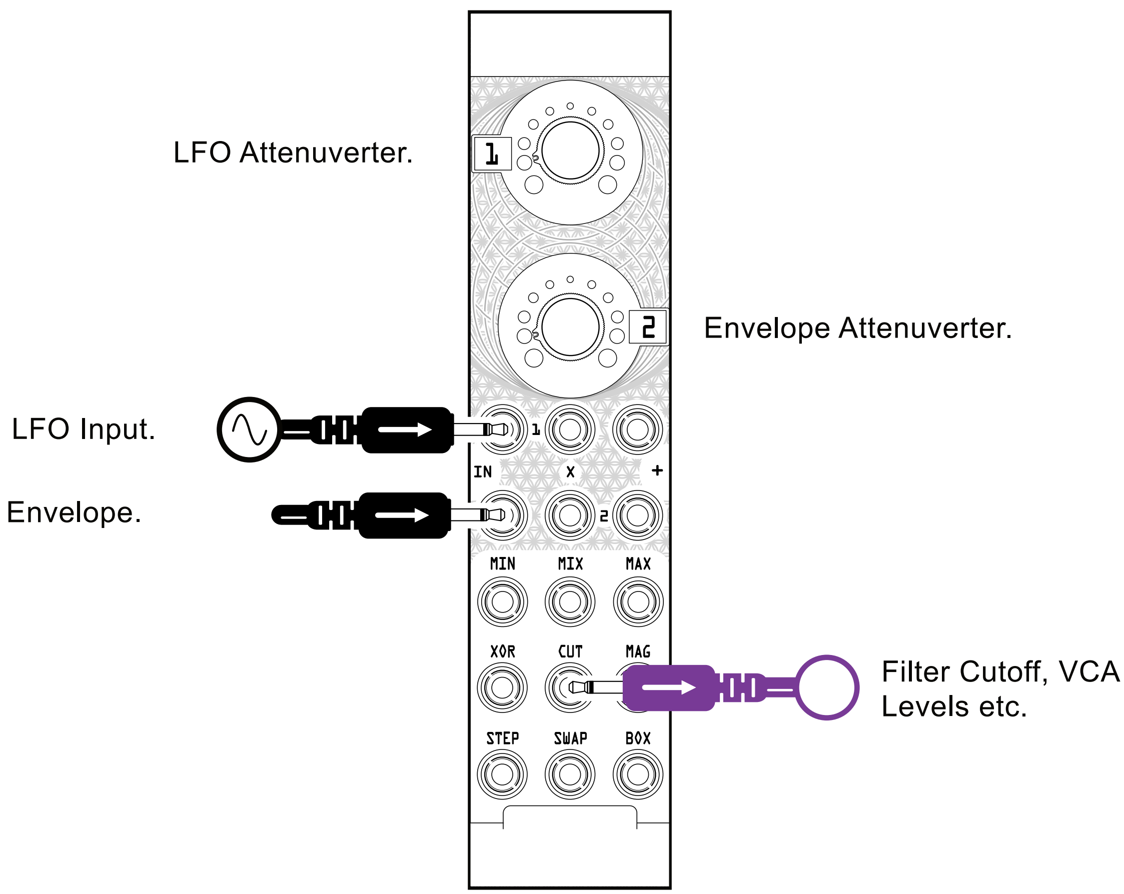
Patch Example 5: LFO Slicer

This has been my favorite patch for making interesting tempo synced LFOs with some dynamic waveshaping control. When tempo synchronized LFOs at different speeds are patched into both inputs of Ana, the SWAP output becomes a glitchy way to quickly transition between the LFOs. Using the attenuverters will not only change the level or polarity of each LFO but will also change the switching behavior of the SWAP output.



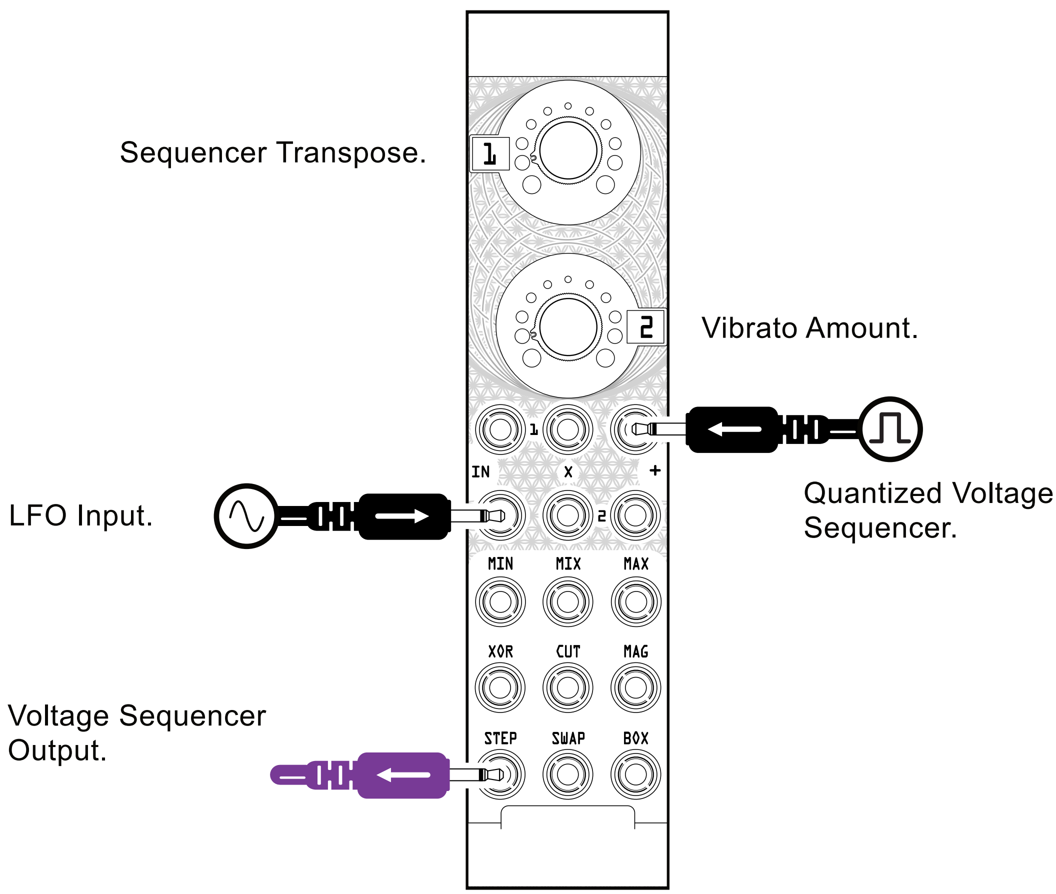
Patch Example 6: Best Modulation Mixer

Because CUT can behave a bit like a crossfader I have had a lot of success in using this output in order to mix different types of modulation sources. In this patch I am using an LFO and an envelope. The advantage of using the CUT output is that it will allow most of the behavior of both inputs to affect the output level without drastically changing the overall voltage level like the MIX or MAG outputs do. In contrast to the SWAP output, the transitions between both inputs happen without major jumps or sharp transitions except for the minor wave folding that happens around ground.



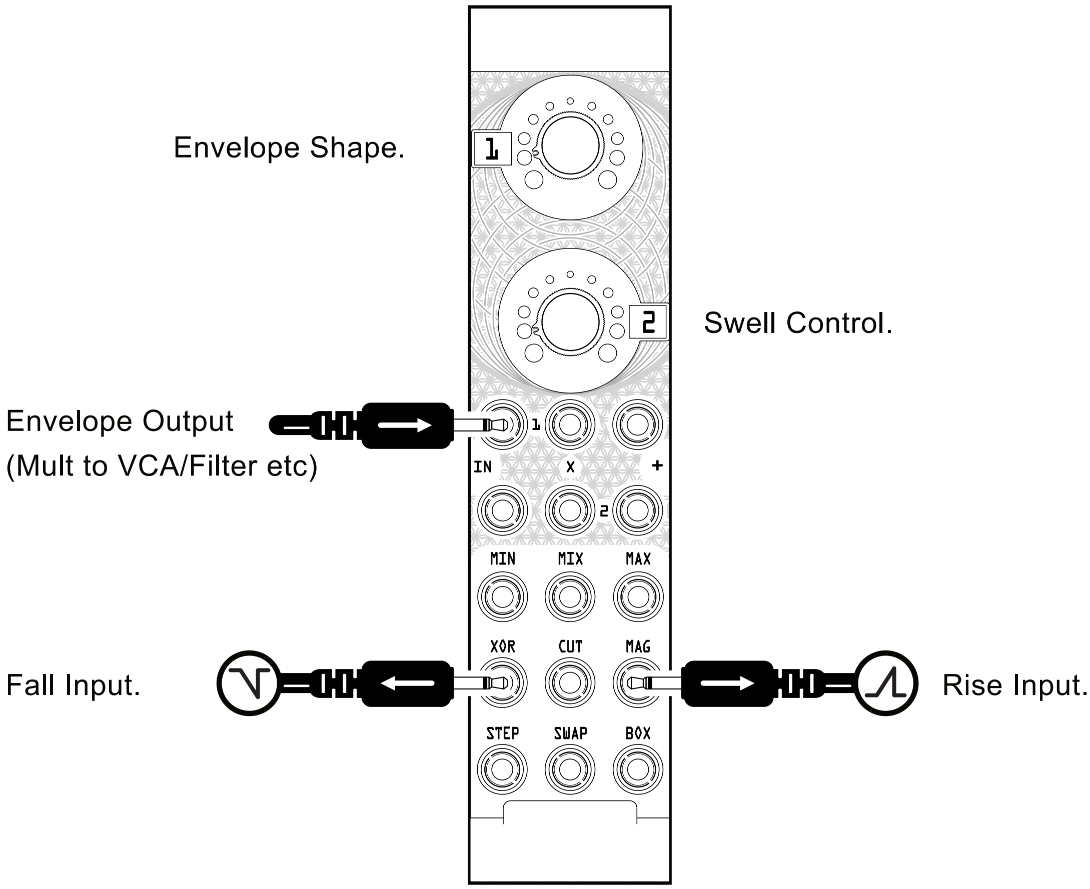
Patch Example 7: VibrAuto

If you want to make silly dance floor bangers with lots of swingy portamento sequences this is the perfect patch for you. I have had the best success using tempo synced LFOs or even envelopes but a free-running LFO will also work fine. Because you can't really use portamento before a quantizer it's advised to use an already quantized voltage sequence and patch it into the SUM input so that it will (mostly) preserve the quantization of the sequence. At this point the LFO input will both clock and shift the STEP output. I think that patching the LFO into the main input instead of the SUM input is important to be able to fine-tune the portamento behavior and avoid sea-sick pitch wobbles.



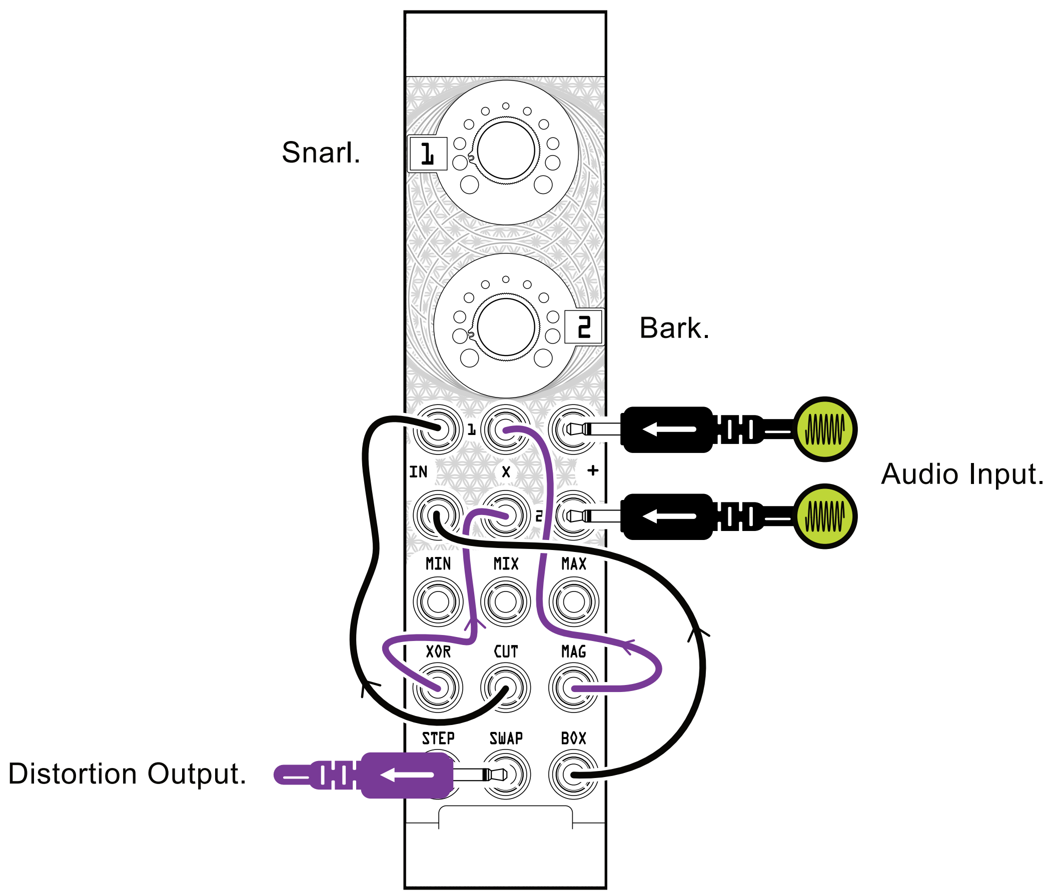
Patch Example 8: Envelope Shaper

This patch will ideally be used with a Rise/ Fall generator or an envelope that has voltage control over both the attack and decay/ release but it will work fine with simple decay envelopes as well. You have to mult the output of the envelope before patching it into the main input and then feedback the XOR and MAG outputs to the FALL and RISE CV inputs respectively. Most Rise/ Fall generators have an internal feedback control that in effect changes the envelope shape from exponential to logarithmic depending on how much gain the feedback has as well as whether the feedback is inverted. This patch mimics that behavior but also gives you a way to voltage control this function as well as creating some other interesting shapes with a large amount of tweakability.



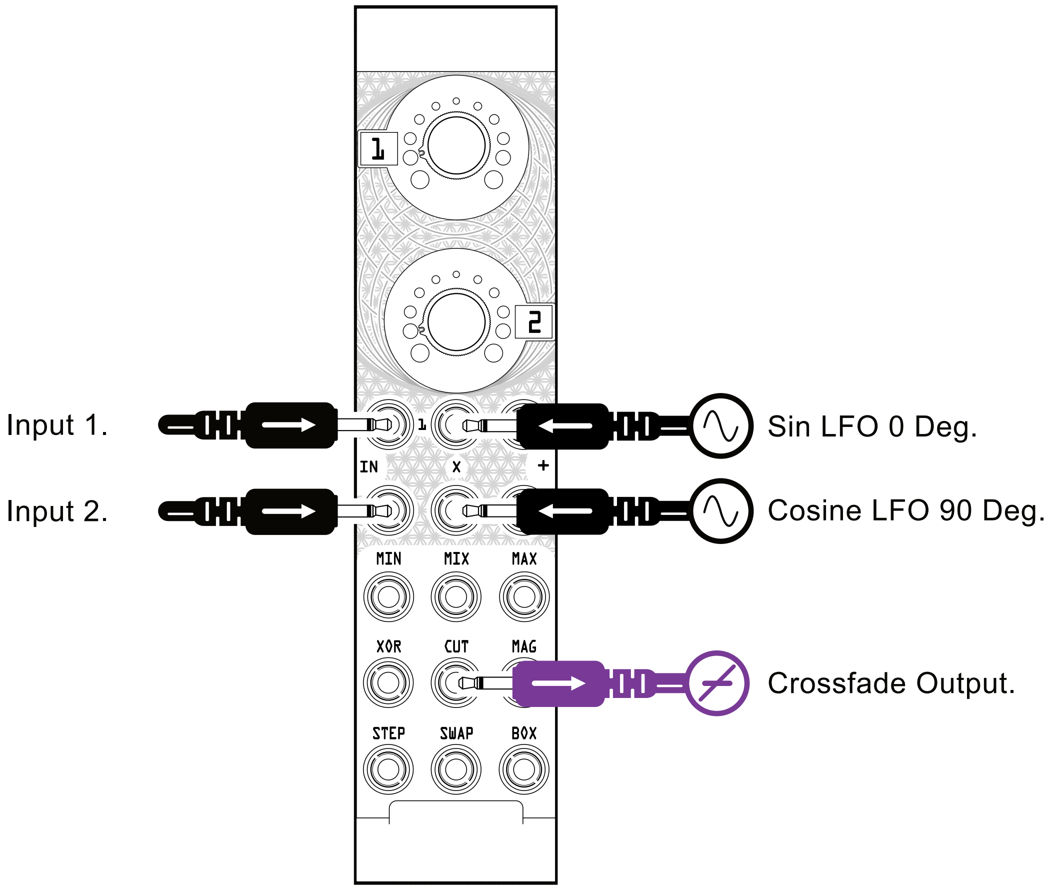
<u>Patch Example 9: Snarles Barkley (Gnarly Distortion)</u>

This patch creates some nasty spitting distortion with lots of sweet spots and as far as I could tell no dead zones. It starts with a premise that I use in a lot of distortion patches: plugging the same signal into both SUM inputs and then using the SWAP output to make all kinds of nasty waveforms based on the knob settings. In this case we are also feeding back various outputs into the other inputs to add some extra chaos and non-linearity to the system. I tried out many of the other output/ input combinations and all of them had their charm but I found that a lot of combinations (particularly using the STEP output) would result in dead zones where the output would be quiet until some of the controls were moved. Based on my experiments this particular setup would never feedback so much that it becomes silent but feel free to experiment with other feedback paths.



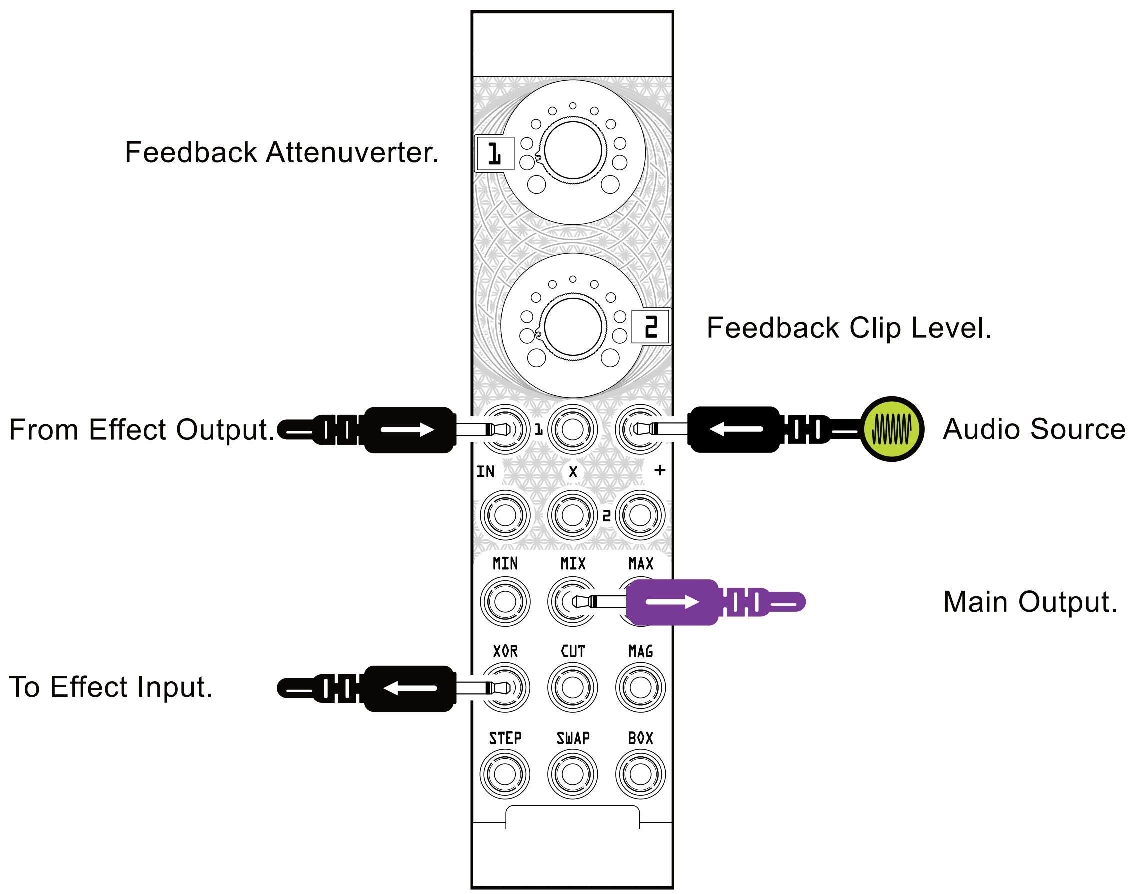
Patch Example 10: Cut Crossfader

It has been mentioned several times that the CUT output behaves similarly to a crossfader, this patch will give you the closest behavior to a normal crossfader while maintaining all of the fun and bizarre waveshaping that CUT can offer. This patch requires a modulation signal with two outputs that are 90 degrees out of phase with each other, the most likely candidates are either a quadrature LFO, an oscillator with a sine and cosine output, or a self-oscillating state-variable filter. Patching both signals into the multiply inputs will gradually shift the CUT output between both of the main inputs, slowly morphing into an un-altered version of each input at specific points in the LFO cycle. But in between those points all kinds of wobbly, nasty, cross modulated signals result. If you want to use an arbitrary voltage in order to control this crossfader you might have luck by running the voltage into a wavefolder and using the bias control to offset it by roughly 90 degrees. This method is not perfect but will work in a lot of cases and yield interesting results even when not working perfectly.



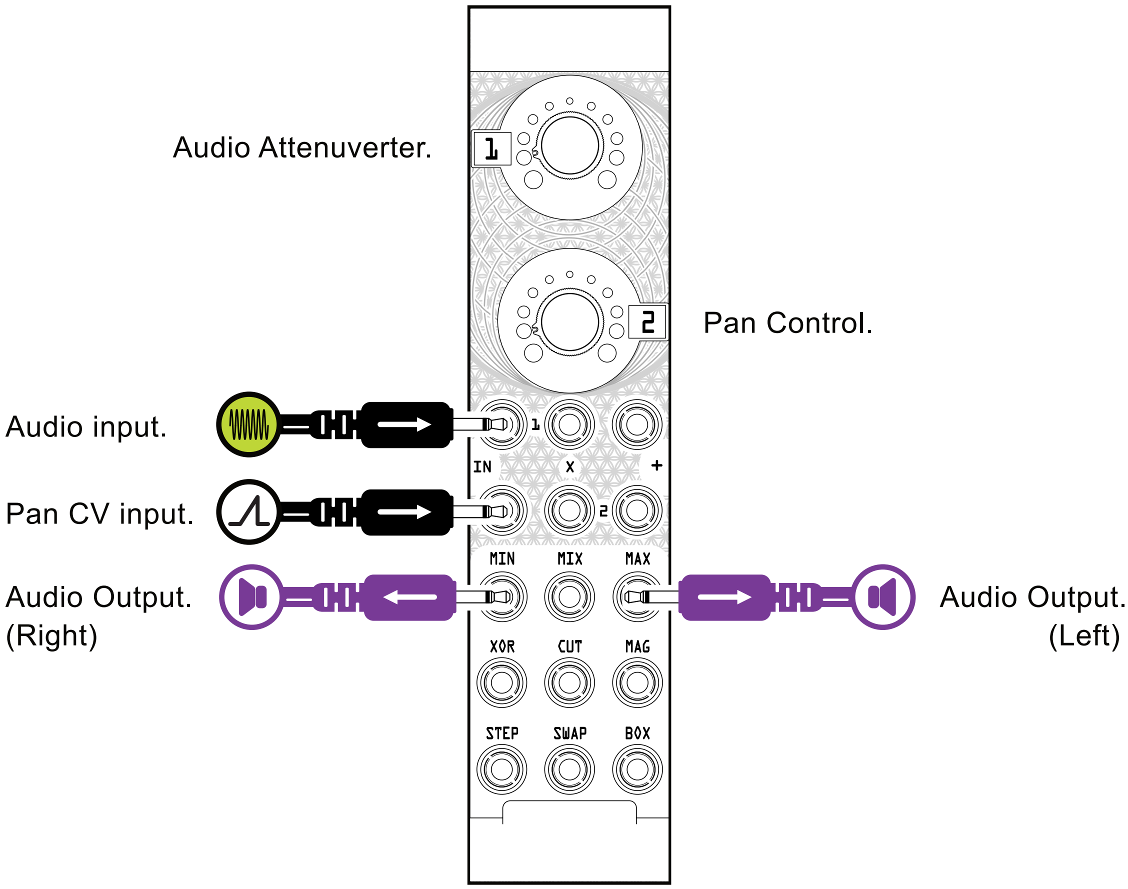
Patch Example 11: Effect Feedback Tamer

This patch takes full advantage of the new MIX output to control the feedback of an external effect using what is commonly known as a "soft clipper". This allows for the aggressive and harsh tones that we all love about feedback while preventing abrupt changes in level or unwanted clipping. We accomplish this by simultaneously amplifying the effect output using the main input attenuverter while also clipping the output level using the bipolar clipping circuit of the XOR output. We get to add an input signal using the normal SUM input and get an automatic mix of that input and the effect feedback by taking our output from the MIX output. This patch allows us to voltage control the amount of feedback, the level of clipping, or invert the feedback for a different set of sounds. I find this patch works especially well with reverbs or delays, allowing for the classic "bloom" feedback that grows in amplitude without having that feedback turn into garbage.



Patch Example 12: Glitchy Panner

As mentioned before, the MIN and MAX outputs are both complementary and inverse to each other. When one output is passing through channel 1, the other output is passing channel 2 and vice versa. In this patch we take advantage of having one of our input channels just be fed by a static voltage, when one output is passing the unaltered input the other is just passing a silent DC voltage. When transitioning between the two outputs, each output will clip the input signal instead of attenuating it like a normal panner, resulting in pleasing distortion that still affects the output level at each output. Keep in mind that when a signal is "silent", that is actually because that output is passing a DC voltage which might make some audio inputs freak out if there is no high-pass filtering on them



Notes

Limited Warranty

Mystic Circuits warrants all products to be free of manufacturing defects related to materials and/or construction for a period of one (1) year following the product's purchase date by the original owner as certified by proof of purchase (i.e. receipt or invoice). This non-transferrable warranty does not cover any damage caused by misuse of the product, including incorrect connection of the power and / or expansion cables, or any unauthorized modification of the product's hardware or firmware.
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Waste electrical products should not be disposed of with household waste. Please recycle where facilities exist. Check with your local authority or retailer for recycling advice.

Version 1.0 March 2024

Manual Update v1

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