Khaos Ex Machina

Ananke

Please think of the environment,

and do NOT print out this document!

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Support

If you haven't found the answer to your question in the manual, please don't hesitate to contact me at

ton@khaosexmachina.com

The terms of warranty can be found at

https://www.khaosexmachina.com/support

Specifications

Module width			6 HP	
Module depth			25 mm (with connector)	
Power consumption			+12V	46 mA
			-12V	15 mA
Input	TRI		Range	+/- 10 V
			Threshold	0.5 V (rising diff.)*
			Impedance	100 K
	A(env), B(pot)		Range	+/- 10 V
			Impedance	100 K
Output	ATT, DEC, END, A>B, A<B		Range	0 V (low)
				8 V (high)
			Impedance	1 K
	ENV		Range	0-8 V
			Impedance	1 K
	TRI		Range	0-2 V
	(when FBK is enabled)		Length	0.1 ms
Pots		RNG sw.	Min.	Max.
	Attack	1s	0.5 ms	220 ms
Values in this table are only close approximations	0V-8V	10s	8 ms	3,45 s
		1m	140 ms	1 m
	Decay	1s	0.1 ms	750 ms
	8V-0.2V	10s	2 ms	10 s
		1m	30 ms	2 m 30 s
	Threshold		0.1 V	7.9 V

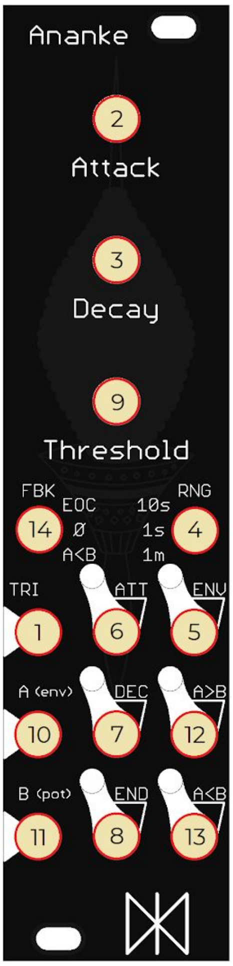
* The TRI (Trigger) input is connected to a differentiator, therefore it “looks” for a fast rising edge that has 0.5 volts of voltage difference.

Examples that work: -2.5V → +2.5V, -5V → +5V, 0V → +0.5V, -3V → -2V, +3V → +4V, etc.

Examples that don’t work: 0V → +0.1V, -3V → -4V, +3V → +2V, etc.

Overview

Ananke is a logarithmic AD envelope generator with a comparator, logic outputs and internal feedback options for oscillation.



1) **Trigger input** — Onsets the envelope when receiving a sudden rise in voltage of at least 0.5 V (rising edge triggered). Also functions as an auxiliary trigger output when the internal feedback is used. (see *TRI input / output* section below)

2) **Attack time** — Linear potentiometer that sets the time it takes the envelope to rise from 0V to 8V. It's range depends on the range switch (**4**).

3) **Decay time** — Linear potentiometer that sets the time it takes the envelope to fall from 8V to 0V. It's range depends on the range switch (**4**).

4) **Range switch** — Three way switch that sets the range of the Attack (**2**) and Decay (**3**) potentiometers. The numbers shown next to it roughly refer to the maximum attack times.

5) Envelope output — Yup… it is what you think.

6) Attack stage output — Gate output that is high as long as the envelope is in its attack phase.

7) Decay stage output — Gate output that is high as long as the envelope is in its decay phase. Goes low when the envelope drops below 0.2 V.

8) End output — Gate output that goes high when the envelope has finished it's decay phase. This happens when the envelope drops below 0.2 V.

9) Comparator threshold level — Linear potentiometer that sets the voltage that is compared to the envelope by default. Ultimately it functions as the comparator's B input.

10) Comparator A input — Non-inverting input of the comparator.
It is normalled to the envelope output (**5**).

11) Comparator B input — Inverting input of the comparator.
It is normalled to the threshold pot (**9**).

12) Comparator high output — Gate output that is high when the comparison is positive, so when input A is greater than input B.

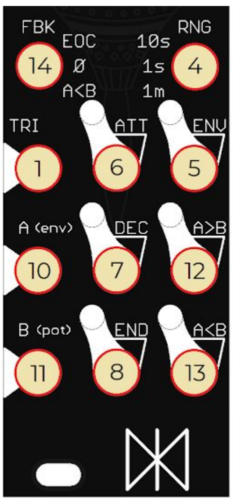
13) Comparator low output — Gate output that is high when the comparison is negative, so when input A is less than input B.

14) Feedback switch — Three way switch that lets you feed a logic output back into the trigger input (**1**).

EOC: The END output (**8**) is being fed back.

Ø: No feedback is conducted internally.

A<B: The comparator's low output (**13**) is fed back.



TRI input / output

The trigger input only accepts signals by default. The built-in differentiator converts gates into triggers as well. The envelope may only be retriggered in it’s decay phase, but even then, it will start to rise from it’s current voltage.

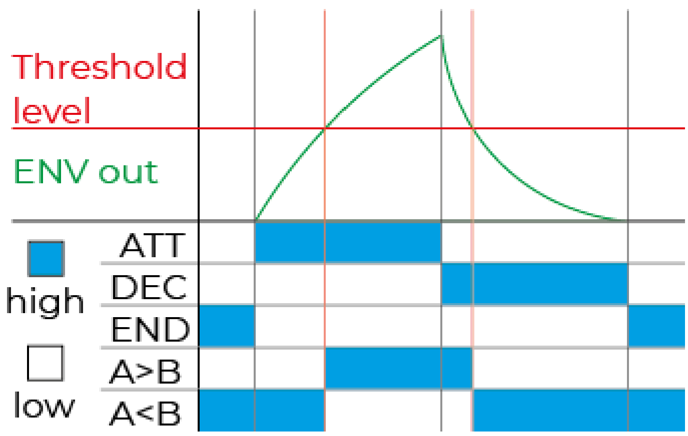
When there is an internal feedback path set up, the fed back signal is also present at the TRI input, but as an output. This means that whenever a logic output triggers the envelope via the feedback switch, a short trigger is also outputted at the TRI input (now output). The voltage of this pulse varies with the settings and is generally very low (<2V) to prevent possible damage. Most devices are well protected from reverse currents, so the input may still be used to retrigger the now cycling envelope.

WARNING: although the actual voltage and current that is outputted from the TRI input is very low, it is still present.

All this aside, this short and low voltage signal can still be used for sync purposes without the expense of a logic output, for example to trigger another Ananke.

Outputs

The envelope’s shape is best described as logarithmic, although this is only entirely true for the decay phase, the attack is slightly closer to linear, than fully log. The image below shows a very rough (handmade) approximation of the shape, and the behaviour of all outputs, corresponding to the envelope’s stages and the threshold level.



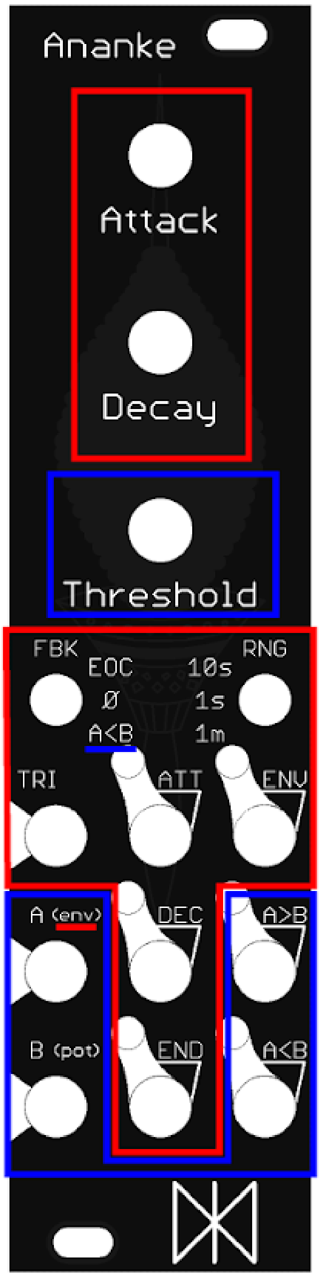
Guide for simple operation

The two "parts"

Ananke consists of two subassemblies that are different in function, yet work together flawlessly. These elements are wired to complement each other, but they also may function independently.

Envelope

The main part of Ananke is a two-stage envelope generator, that is highlighted with red outlines. The TRI input launches the envelope, the Attack and Decay pots set the times of the two stages and the ENV out provides the envelope. The RNG switch selects between three different time ranges and the FBK switch feeds outputs back to the trigger input, to allow oscillation and more. In addition there are three binary outputs corresponding to the 2+1 stages of the envelope, being attack, decay and when it's finished, the end.



Comparator

The other part that spices up Ananke is a very simple comparator, that expands the possibilities greatly, and is highlighted with blue outlines. The comparator is normalled to be used with the envelope, so without additional patching, it can be used to derive additional binary outputs from the envelope's voltage. In addition, both comparator inputs are open for external patching, so either the Threshold pot or the envelope can be replaced with any CV, or even both to operate the comparator separately.

Oscillation using internal feedback

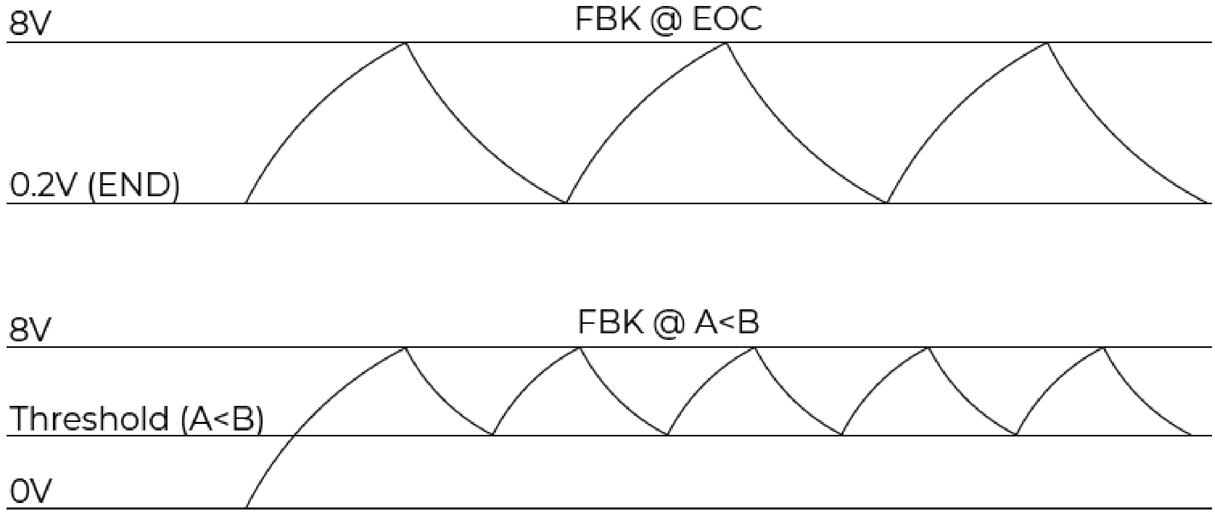
The FBK (feedback) switch lets you loop the envelope at different points, thus creating two different LFOs.

EOC

In this position, the END output is fed back to the trigger input, therefore the envelope is started again when it’s finished. This is when the envelope has fallen below 0.2V, meaning in this way of operation, the output voltage swings between 0.2V and 8V. Both the speed and the shape of the oscillation can be defined by the Attack and Decay times.

A<B

In this position, the A<B output of the comparator is fed back into the trigger input. This means that the envelope is triggered below a defined voltage, that is set by the Threshold pot. Same way as above, both speed and shape is set by Attack and Decay times, but now the Threshold level is also influencing the speed. Higher threshold levels push the bottom of the cycle higher, creating bigger DC offsets at the output, while leaving smaller room for the envelope, therefore speeding up the cycle.



Examples of operation

Envelope stage outputs

These binary outputs can be used to control other events in relation to the envelope. Since they output gates, they can be used to trigger other events, like other envelopes, or step forward sequences; but they are also useful as modulation sources, to modulate parameters, for example change the timbre of a sound at different stages of the envelope.

Using the comparator…

…to control external things

The threshold level can be set to a desired point of the envelope, to have an output go high whenever it's necessary. This may be useful to trigger events or modulate parameters based on time, not clock grid.

…to precisely trigger the envelope

An external signal may be patched into the comparator's A input (for example another envelope, or a voltage sequence), this way the threshold pot can set the point below which the envelope triggers if the FBK is set to A<B. (Triggering above the threshold level can be achieved by patching the A>B out to the TRI in) This way the envelope can act at a certain point of another envelope, or maybe at the highest or lowest note of a sequence.

…to delay triggers and clocks

The envelope can be triggered by the trigger that is about to be delayed. Two differently delayed signals can be derived this way, one is the DEC output, which goes high at the decay stage of the envelope. The time it takes for this output to go high can be set with the Attack parameter. The other is the comparator's A>B output, its delay time is set by both the Attack pot and the Threshold level.

...as a trigger to gate converter

The trigger to be converted should be used to trigger the envelope. This way a custom length gate can be made using a binary output. The most precise choice is the ATT output, because it offers negligible delay between the input and the output. A possibly more fun way of doing it is by using the A>B output, with the Attack time at minimum. This way the Decay is controlling the gate length together with the Threshold level, which can be replaced with an external CV, to modulate the gate length.

...to destroy audio

Patch a non-rectangular wave (like sine, triangle, saw) to the comparator's A input and use either output to get a pulse wave made with the pulse width controlled by the Threshold pot. An external CV can be patched into the B input for some sweet PWM action.

Patching complex audio signals into the A input will lead to some mad results at the outputs. The threshold level will change the timbre of the output.

Using the A>B for Left, and the A<B for Right audio leads to a messy stereo image, that will definitely mess with your head!

Patching a different audio signal to the B input leads to... well... just try it if you like noise.

Note regarding the normalized envelope

Normalization takes place before the final gain stage of the envelope, meaning it may not reach the threshold's maximum point from the comparator's perspective. This depends on the threshold pot, as they are 20% tolerance, so the actual maximum setting might be slightly less than 7.9 V. In some cases the maximum threshold will still be less than the pre-amplified envelope, in other cases it will be more, but this should not worry the user, as the values will be close enough to not lose any function, you may have to dial the pot slightly back to get the comparator to tip over, but that's all.

Thank you for purchasing Ananke and supporting Khaos Ex Machina!
I hope that this manual has helped you to get started with the module, but if you still have questions, don't be afraid to reach out to me at ton@khaosexmachina.com

This document is subject to change without notice.

Last updated: 2020.08.14.