ANTS!



PLANKTON ELECTRONICS

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WARRANTY

Plankton Electronics warrants this product to be free of any defect in the manufacturing or materials for a period of one year from the date of purchase. This warranty does not cover any damage or malfunction caused by incorrect use – such as, but not limited to, power cables connected backwards, excessive voltage levels, or exposure to extreme temperature or moisture levels.

The warranty covers replacement or repair, as decided by Plankton Electronics. Please, contact our customer service for a return authorization before sending the module (support@planktonelectronics.com). The cost of sending a module back for servicing is paid for by the customer.

Plankton Electronics implies and accepts no responsibility for harm to person or apparatus caused through operation of this product.

As an open-source product, we encourage to mod and hack it, but we will not provide any assistance on how to do it. Any malfunction caused by a mod will not be covered by this warranty.

ABOUT THIS MANUAL

This manual has been written with the synth newbie in mind. It's a synth manual but at the same time a tutorial and a basic synthesis manual. We recommend to follow it step by step with the synth in front of you.

If you have any comments, write us to: support@planktonelectronics.com
We will be happy to receive them.

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OVERVIEW

ANTS! is an analog patchable synthesizer. It is designed to work as a modular synth, connecting patch cables to generate sounds, but at the same time it can work without the use of cables. These pre-patched connections (normalled connections) make the synth an (almost) ready to play 2-osc analog mono-synth. By plugging a patch cable into a normalled input, the normalled connection is broken so you can experiment with new and weird sounds, basses, leads, drums, pads, self-generative patches and happy accidents.

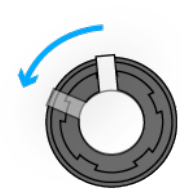
ANTS! is transparent: there are no layers, no double functions, no storing. Everything is in front of the user* and it is very simple to use: you just need to connect the outputs to the inputs. At the same time the 51 patch points and the 25 potentiometers give you the option to design complex patches and sounds. The possibilities are endless.

** The only hidden aspect is the internal routing of the machine, the normalled system. ANTS! is already prepatched inside to make it easy to use. If you want to know more about this feature jump to the NORMALLED SYSTEM chapter.*

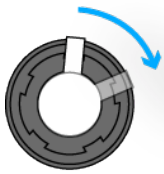
TERMINOLOGY

In this manual, we will use some words that may confuse you if you are a newbie in the synth world.

CW: Clockwise. --- *e.g. Turn the RATE potentiometer CW* ---
CCW: Counter clockwise. --- *e.g. Turn the FREQ potentiometer CCW* ---
Pot: potentiometer.
NS: 'Ninja Star'. It is a device used to split the signals. Often we want to send a signal to more than one destination. This is done by using a passive splitter like the 'Plankton Ninja Stars'. You are free to use other devices, like stackable cables, or other splitters. An ***ANTS!*** pack come with some Ninja Stars ready to use.



CCW



CW



NINJA STAR

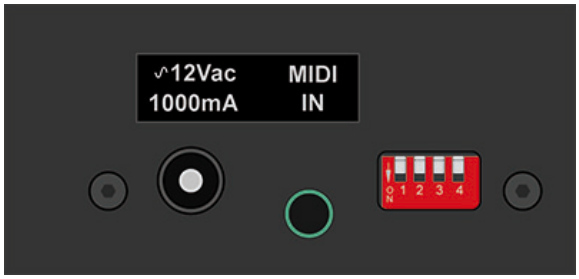
COMPATIBILITY

ANTS! uses 3.5mm mono jack connectors. All the voltages are compatible with the EURORACK standard. Oscillators offer +/-4V of signal output and work with 1V/Oct inputs to play it musically. We encourage exploring the possibilities offered by playing the synth together with other eurorack modules, controllers, sequencers and MIDI and analog keyboards.

A MIDI keyboard or controller connected through the **MIDI TO CV** converter can control the synth. At the same time any keyboard or step sequencer with analog CV and GATE outputs can be used to control the machine. You can use more than one controller, or just play the synth without any controller. Test all the possibilities!

POWER

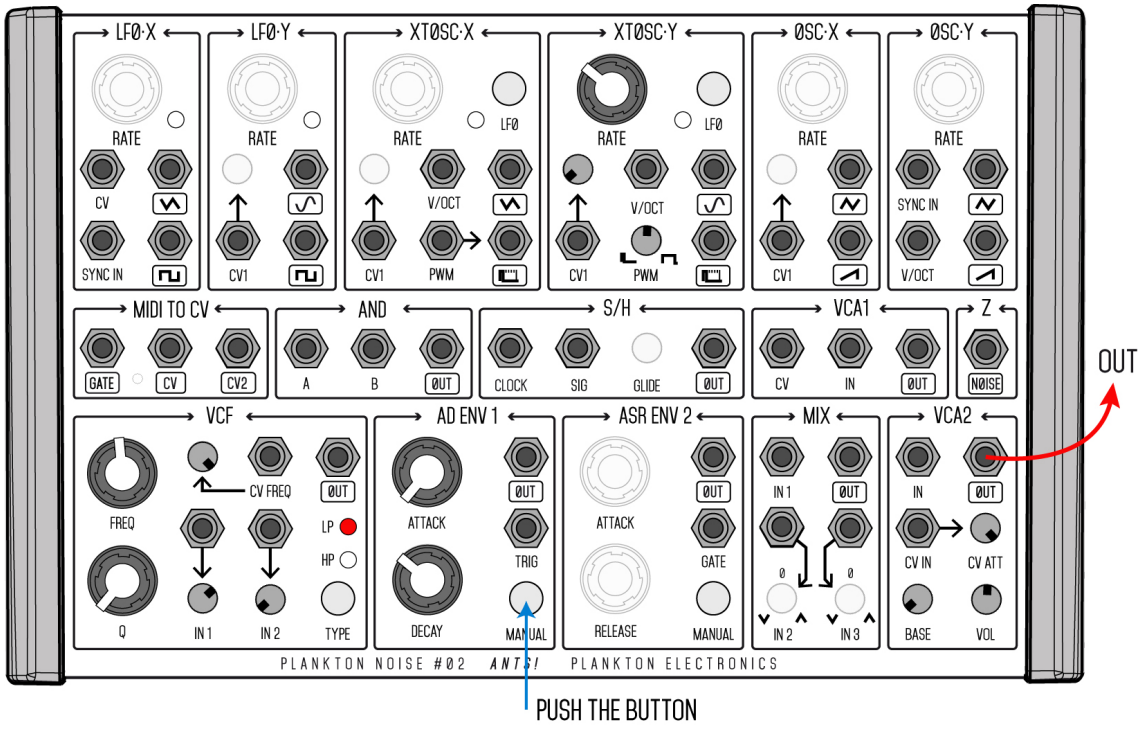
ANTS! is powered with 12Vac. A power supply is included with the synth. Please, use only the provided power supply. Using the wrong power supply can cause malfunction or even damage the unit.



Connect the power supply to the power connector of the left labelled as '12Vac'. Notice that the 3.5mm jack is for the MIDI cable.

FIRST STEPS

Before reading the manual , we think you'll want to start making sounds. Connect the power supply to the ***ANTS!*** and set the potentiometers as show below. Connect the **VCA2** *OUT* to your mixer, amp, or FX unit (be careful with the levels). Now push the **AD ENV1** *MANUAL* button. You should hear a bass like sound.



** Note: the transparent knobs are not used in this patch. Their position is not relevant.*

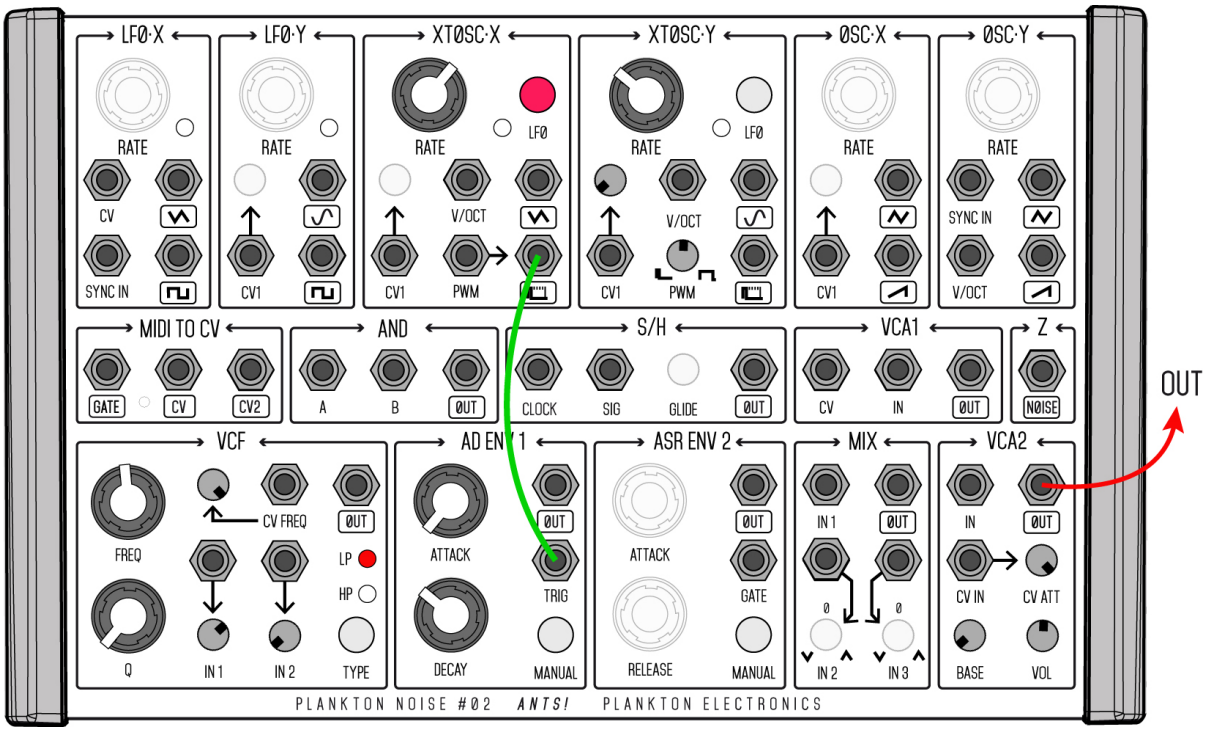
Now you are hearing the **XTOSC·Y** through the filter (**VCF**) and the **VCA.** Both**, VCF** and **VCA,** are controlled by the **AD ENV1.** We will see more about this routing later in this manual.

Change the *RATE* knob of the **XTOSC·Y** and play triggering the envelope. You should hear the tone changes. Play with the *FREQ*, *Q*, *ATTACK*, *RELEASE* and *PWM* controls.

Take your time to explore and play.

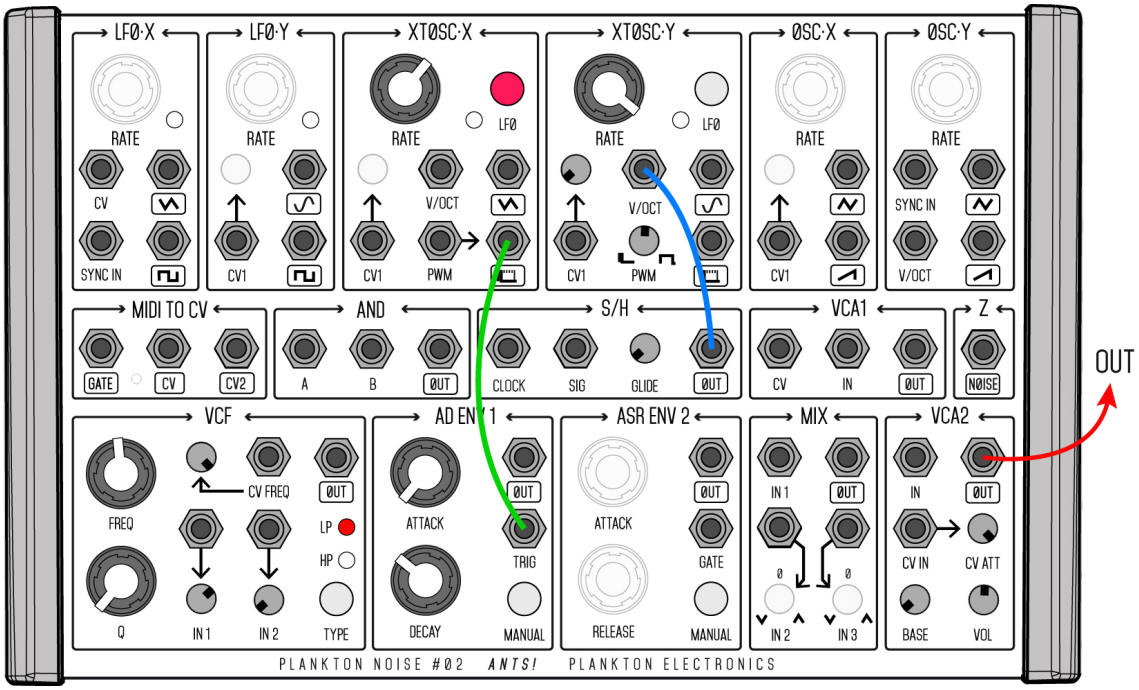
****

Connect the **XTOSC ·X** *SQUARE OUT* to the **AD ENV1** *TRIG* input like this:



Notice that the **XTOSC ·X** switch is activated (pressed). This activates the LFO mode. The LED must blinks ON and OFF. Now the synth should sound at a constant rate defined by the **XTOSC ·X** *RATE.* Play with it.

Connect a wire from **S/H** *OUT* to **XTOSC·Y** *V/OCT*. Look at the potentiometers position**:**



ou should hear how the tone changes at each step as a result of the random voltages generated by the **S/H** .

Play with all the activated parameters. Tips: Change the **VCF** mode to *HP*, move the **XTOSC·Y** *PWM* CCW and move *ATTACK, Q* and *GLIDE* CW. You will note that some small changes in knob position may affect the sound dramatically. If you find yourself in a place where there is no sound at all come back to the last picture configuration.

At this point you can:

1. Continue reading the manual and learn how the synth works. Jump the 'BASICS' chapter if you're already familiarized with modular synths.

2. Experiment, tweak knobs, make connections and see what happens.

3. Go to http://ants.metapatch.com to explore and reproduce a large list of patches and sounds. (http://ants.constructingtowers.com/#/patch for the beta version).

ANTS! is a modular synth. This means that you must connect cables from the inputs to the outputs to create your patches. White symbol over black background represents inputs. Black symbol over a white box, outputs.

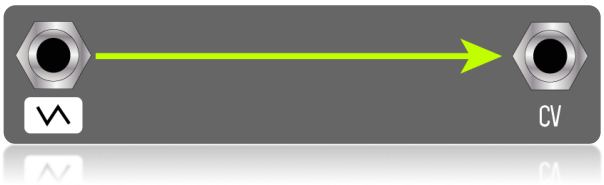


This is an input.



This is an output.

Patching is easy. You just need to connect a cable from an *out* to an *in*.



However, not all the connections will produce something coherent or useful. Synths work with two kinds of signals: ***sound*** and ***CV***. There are synth functions that accepts and generates CV, some sound and some both.

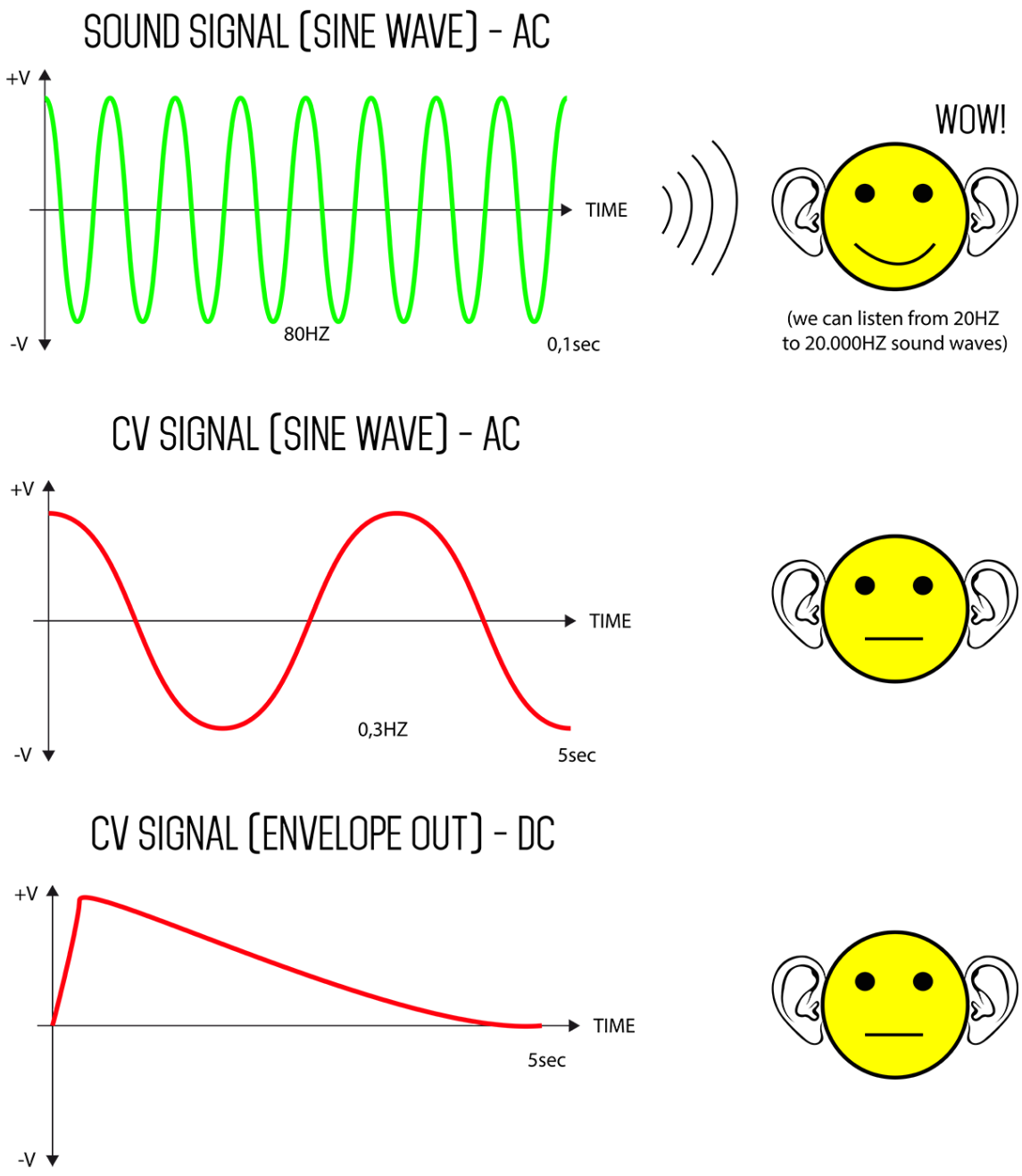
Sound signals are those audible by us. They are in the form of waves (AC signals) and oscillators are the main source of them. If you patch your mixer directly to an oscillator you will listen the different sound waves generated (sine, square, pulse, saw tooth, etc.).

Be careful with the levels if you plug your amp directly to an oscillator!

Technically, we should call these signals 'audio', but the 'sound' term will be easier to visualize for the newbie. The main purpose of this manual is to learn how to use the synth. From now on we will use both words interchangeably.

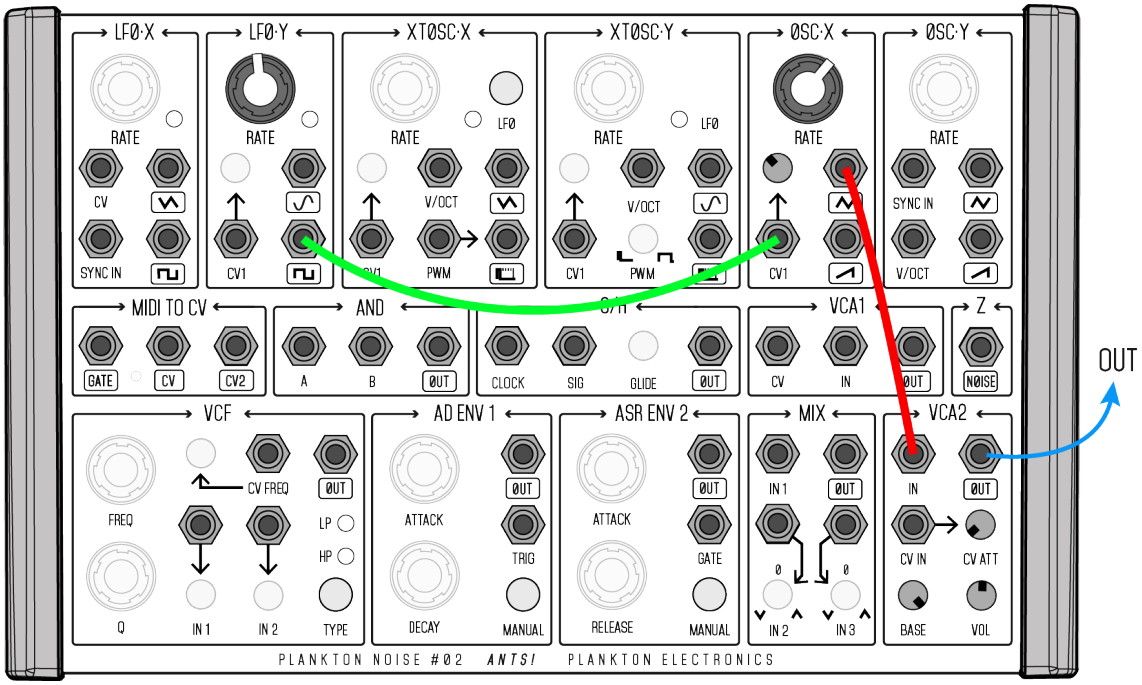
CV signals (control voltage) are the ones that we use to control and modify the parameters of the synth. They can be DC (direct current) like the signal generated by an envelope, or AC (alternate current) like the wave resulting of an LFO. In the second case, despite they are waves, they are below the audible limits (infrasounds), so we can't consider them as sound.

Here is an easy way to understand it:



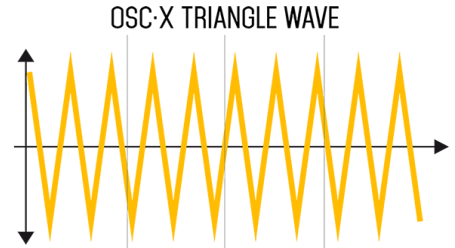
We can use CV signals to modulate some parameters. E.g., we can use an LFO to modulate the RATE of an oscillator. In addition, we can use the envelope to modulate the VCA (amplifier) in order to 'open and close' the sound. Let us see what happens when we modulate an oscillator tone with a square wave from an LFO.

Set this patch:

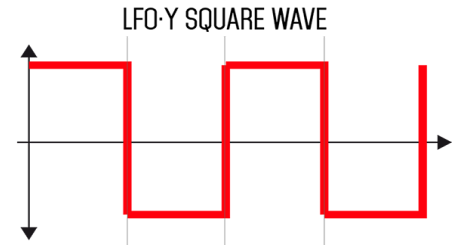


What we are doing here is modulating the tone of the **OSC·X** with a square wave. Listen how the tone of the oscillator changes with the **LFO·Y** *RATE.*

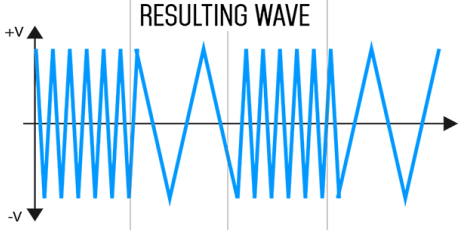
The attenuator potentiometer of the **OSC·X** *CV1* determines the amount of modulation that affects the oscillator tone. The **OSC·X** *RATE* sets the central tone. From this point, the tone will go up and down.



The result is the same as if we move the **OSC·X** *RATE* pot up and down at the LFO rate, with the only difference that we cannot recreate a square wave modulation by hand. This works like an automation.

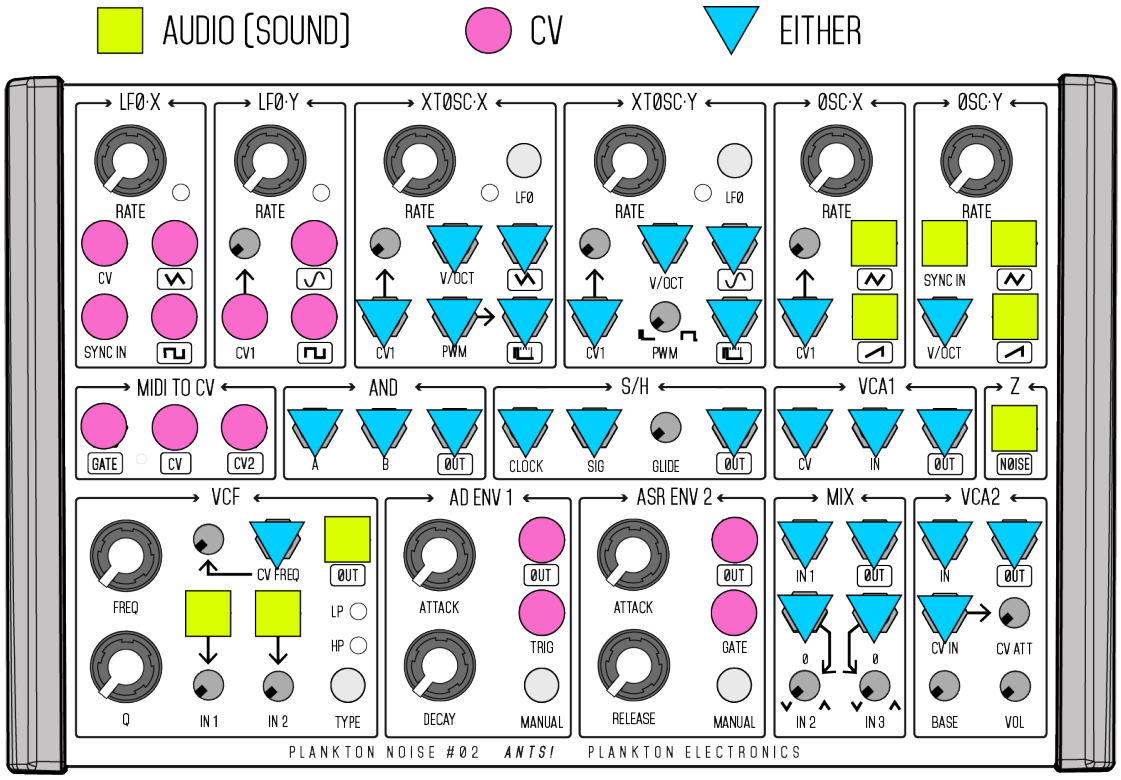


Play with the **LFO·Y** *RATE,* **OSC·X** *RATE* and *ATT* (the small potentiometer over the *CV1 IN*).



Imagine all the modulation possibilities that you have in your hand. They are endless. Try to modulate the LFO with another LFO wave and see how everything changes. Now modulate the last LFO with a third LFO and you will have complex patterns only with 3 cables. You have a whole world to explore. Don't be afraid to patch and experiment.

However, as we have said before, not all the modules will work properly with all kind of signals. Some work better with sound, some with CV and some with both. Use this diagram as a reference:



Some notes about this picture:

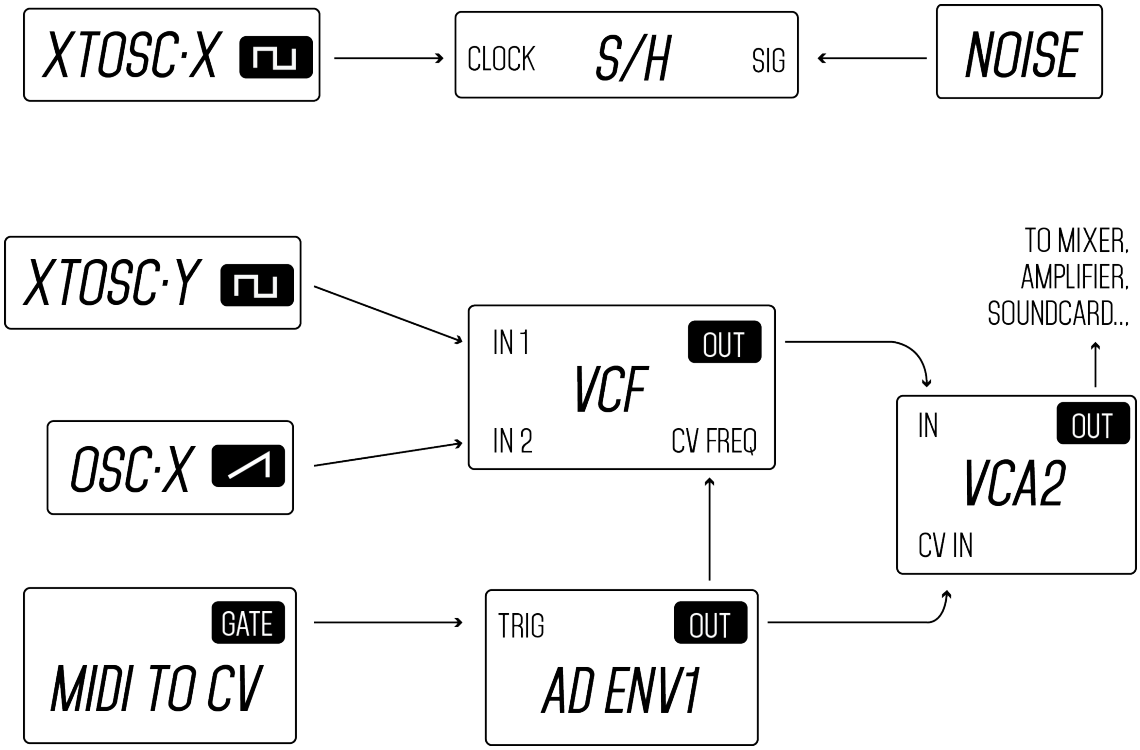
1. Inputs with the triangle accept audio and CV while outputs can send either.

2. This is a suggestion, not a 'must do'. This means, for example, that you can connect a square wave to the AD ENV 1 TRIG and shape it, accepting and generating audio, but it is not its main purpose.

3. Looking at it you can deduce that we can use sound waves as a CV to modulate other parameters. We will see this later.

ANTS! is pre-patched (normalled). This means some connections are already made in order to play it as a standard mono-synth.

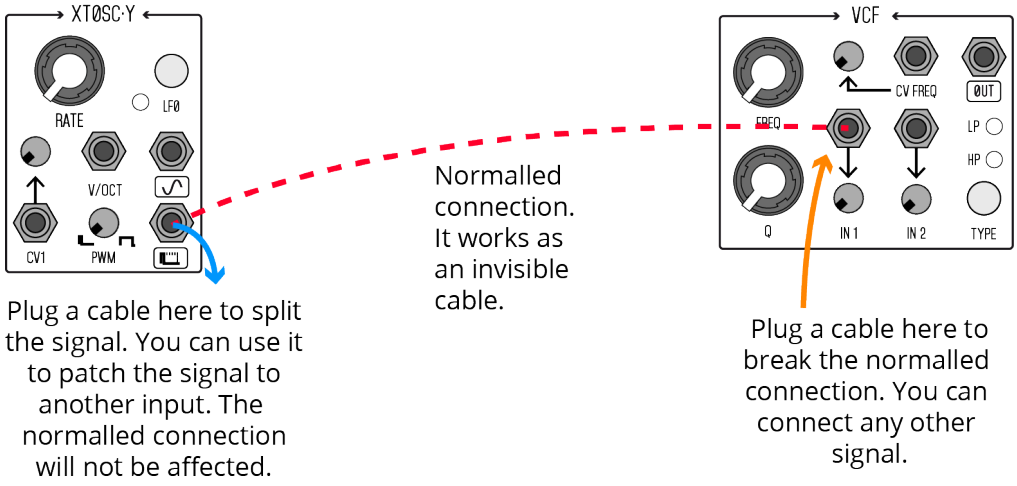
The pre-patched system is as follow:



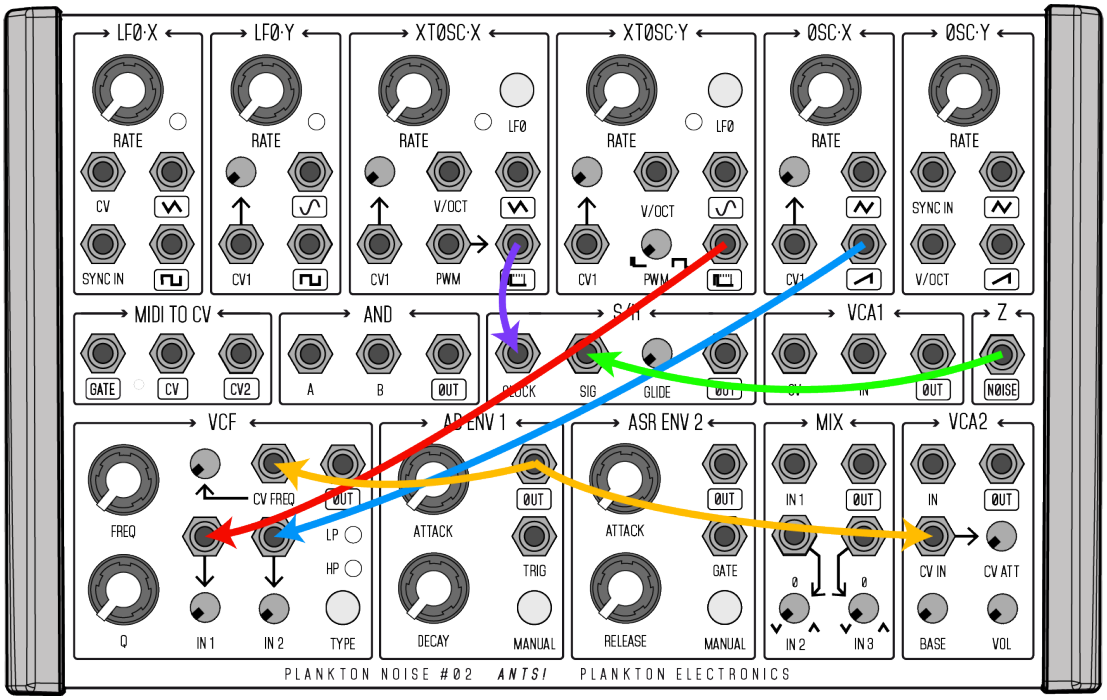
As you can see the **MIDI TO CV** outputs are not normalled to the oscillators CV inputs, so unless you connect a cable from the **MIDI TO CV** outputs to the oscillators CV inputs the pitch of the oscillators will not vary. This way you can choose different configurations, e.g.: CV to both oscillators to play octaved or unison sounds; CV to **XTOSC·Y** and CV2 to **OSC·X** to play different tones through the **VCF** and the **VCA** (paraphony); and a large etc.

You can break any of the normalled routes by connecting a cable at the input (destination) of the normalled connection. By connecting a cable at the output you are splitting the signal, so you can use it to another destination, but the normalled connection remains the same.

This is how a normalled connection works:



This is the normalled system viewed on the synth :



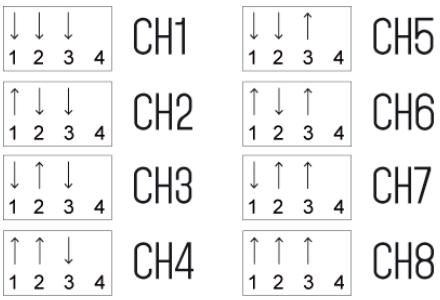
This is the normalled system in text mode:

XTOSC·Y square wave >> **VCF** in1
OSC·X saw wave >> **VCF** in 2
VCF out >> **VCA2** in
MIDI TO CV gate >> **AD ENV1** trig
AD ENV1 out >> **VCF** cv freq + **VCA2** cv in
Z noise >> **S/H** sig
XTOSC·X square wave >> **S/H** clock

ANTS! uses a 3.5mm MIDI input in the rear part. The package includes a cable which adapts the 3.5mm connector to the standard MIDI DIN connector.

The 4 DIP switch is used to control 2 functions: the MIDI channel and the CV2 mode. Switches 1, 2 & 3 are used to select available MIDI channels, from 1 to 8.

In order to select a specific MIDI input channel follow this guide (some MIDI keyboards and controllers use the MIDI ch1 as the default one) :



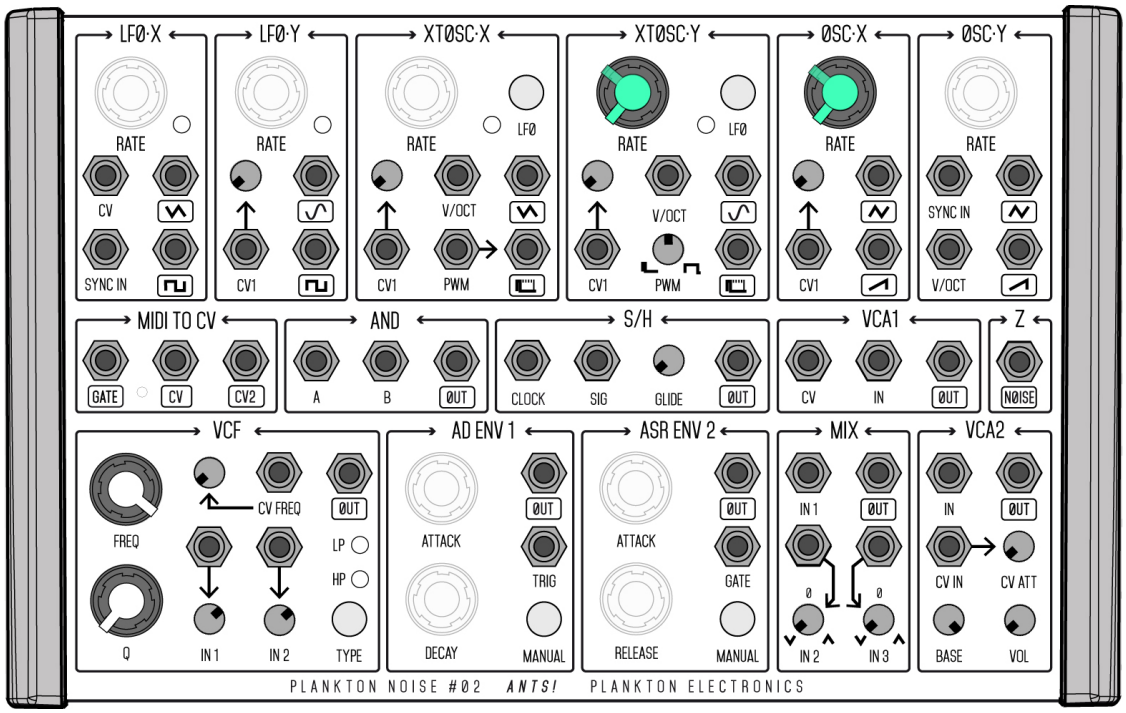
The switch 4 selects the CV2 mode. Switched down, the converter outputs the note **velocity** parameter to CV2. Switched up, it sends the **second note** (the value of the second note pressed while the first one is still pressed). This way you can play 2 note chords or phrases.

If you check the normalled system you will see that the **MIDI TO CV** *GATE* is pre-patched to the **AD ENV 1** *TRIG***.** This means that when you connect a MIDI keyboard and play a note, the **VCF** and the **VCA2** will be opened according to the **AD ENV1** settings (if any cable is breaking the prepatched system). You can also connect the *GATE* to the **ASR ENV 2,** or experiment with other options, for example, connecting it to the **AND** gate with an LFO and sending the mixed signal to the envelope.

The CV outs are not normalled anywhere. This means that if you want the MIDI notes to be used by the oscillators you must patch it before. You can connect the **MIDI TO CV** *CV* to one or more oscillators and play single osc patches, unison sounds, fifths, chords, etc. Or you can set the CV2 as a 2nd note mode with the DIP switch and connect it to a second oscillator.

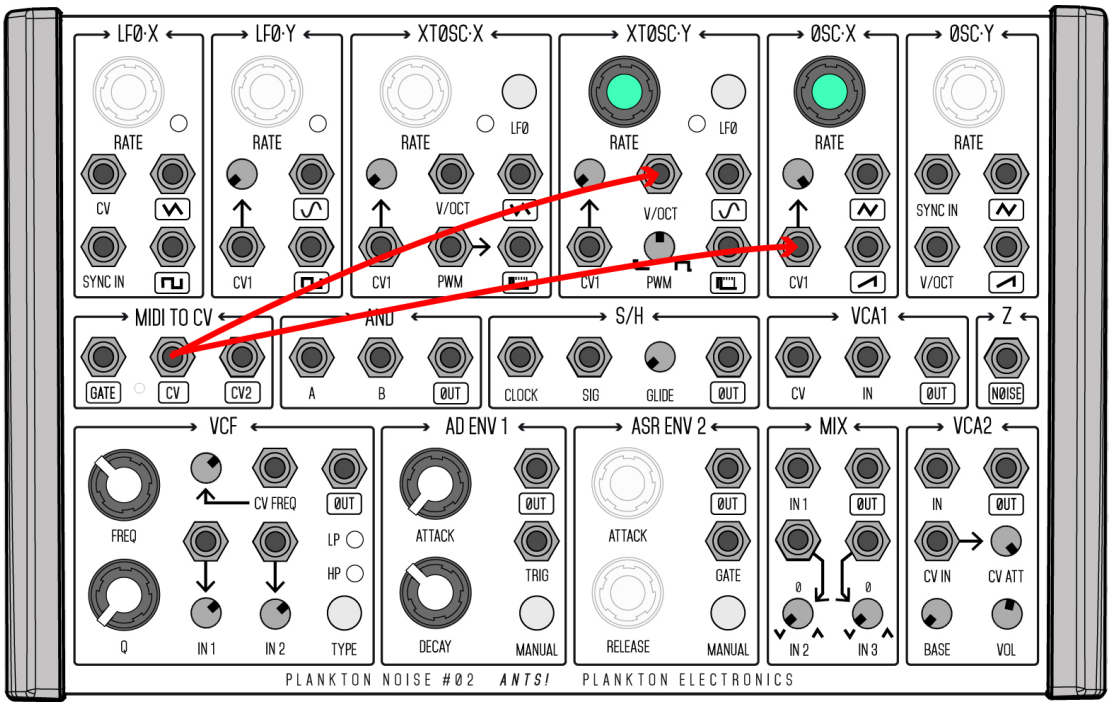
If you choose to use the velocity parameter, you can connect it directly to the **VCF** *CV FREQ* and open and close the filter depending on the velocity. Even better, you can use the mixer and mix both, **AD ENV1** *OUT* and *CV2* and send it to the **VCF** and the **VCA2**. Let's see some examples.

First you need to tune the oscillators. Set this:



Connect the audio out at the **VCA2** and turn up the volume carefully. You will hear both oscillators, **XTOSC·Y** and **OSC·X**, at the same time. Tune them so they have the same pitch. Try to set it as CCW as possible.

Patch the MIDI cable to the *MIDI IN* and set the MIDI channel. When you press a note you should see the led next to the *GATE* label blinking along the note ON and OFF. Set this patch:



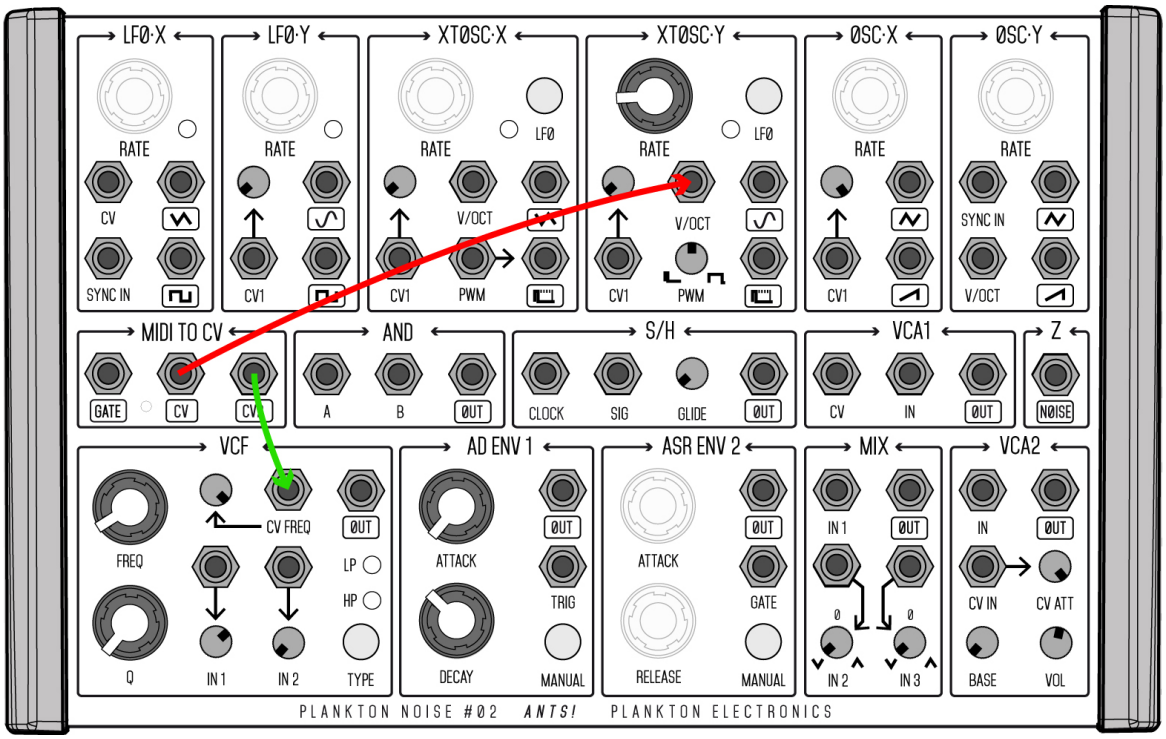
The oscillators pots should be at the same position that when you tuned it. When you play a note you should listen both oscillators in unison mode. In order to have both oscillators in tune, play low (bass) notes on the MIDI keyboard. Turn full CCW the **VCF** *IN1* pot and listen the difference between the single osc and two oscs in unison mode. Next, tune the oscillators so **OSC·X** is 1 octave over **XTOSC·Y** and play it. Repeat the process tuning it by fifths, thirds and other musical intervals. Take your time to play.

Now tune the oscillators to the same note again. Disconnect **MIDI TO CV** *CV* from **OSC·X** and connect **MIDI TO CV** *CV2* to **OSC·X** *CV1*. Set the MIDI switch 4 to its up position (2nd note). The patching should be:

MIDI TO CV *CV* >> **XTOSC·Y** *V/OCT ;* **MIDI TO CV** *CV2* >> **OSC·X** *CV1*

You will be able to play two notes. As you will see the gate will be only opened by the first note. When you press a second note while the first one is pressed, the 2nd note value will control the **OSC·X**. (You will make the most of this feature by connecting a MIDI sequencer instead of playing it manually and/or with complex patches.)

Now set the MIDI switch 4 to its down position (velocity). Patch this:



Play the MIDI keyboard. With this setup the velocity (the pressure that you make to each key) will control the filter opening. Set the **VCF** controls to your taste. You can also use the mixer **MIX** to the **AD ENV1** *OUT* with the **MIDI TO CV** *GATE* to play it with more expression. Experiment with different values.

NOTES ON THE MIDI TO CV

1. The GATE out works with logic values. 0 (off) or 5V (on).

2. The CV outs have a resolution of 7bit each and they work from 0 to 5V.

3. The CV outs work with the standard of **V/oct**. They will output 1V for each octave played (on CV2 out this is only when it is set the 2nd note mode). Nowadays, the V/oct is the standard used by the vast majority of oscillators.

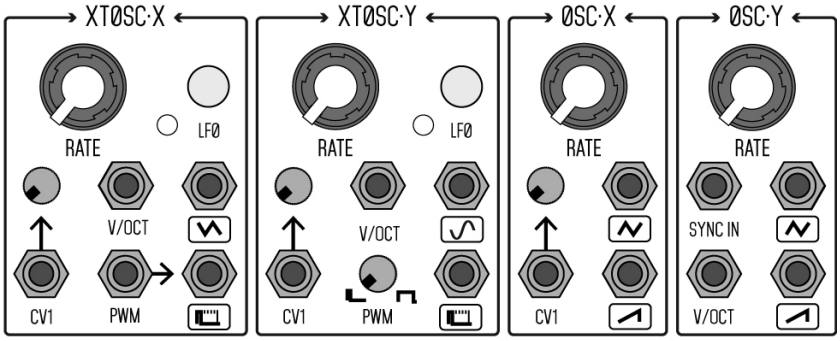
4. The MIDI note conversion goes from note 36 (0V) up to 96 (5V), giving a total of 5 octaves. Below note 36 the converter will output the last note played and no GATE signal at all, but the MIDITOCV led will blink to show that the right channel is selected.

5. The oscillators will respond fine on the low range. Playing the highest two MIDI octaves will result in a bad tracking (MIDI note to pitch). Use them to elevate the pitch out of its natural range, not for playing melodies.

6. The provided MIDI cable converts the MIDI DIN 5 to a 3.5mm MIDI connector. If the cable is too short you just need to connect it to a MIDI female-female adapter or a female-male extender cable. They are available at most of the music stores.

OSCILLATORS

Oscillators are the main functions of a synth. They are in charge to generate the sound waves. ***ANTS!*** Provides 4 analog triangle core oscillators (the term 'triangle core' refers to the electronic design of the electronic design of the oscillators). There are 4 analog oscillators: **XTOSC·X, XTOSC·Y, OSC·X** and **OSC·Y.**



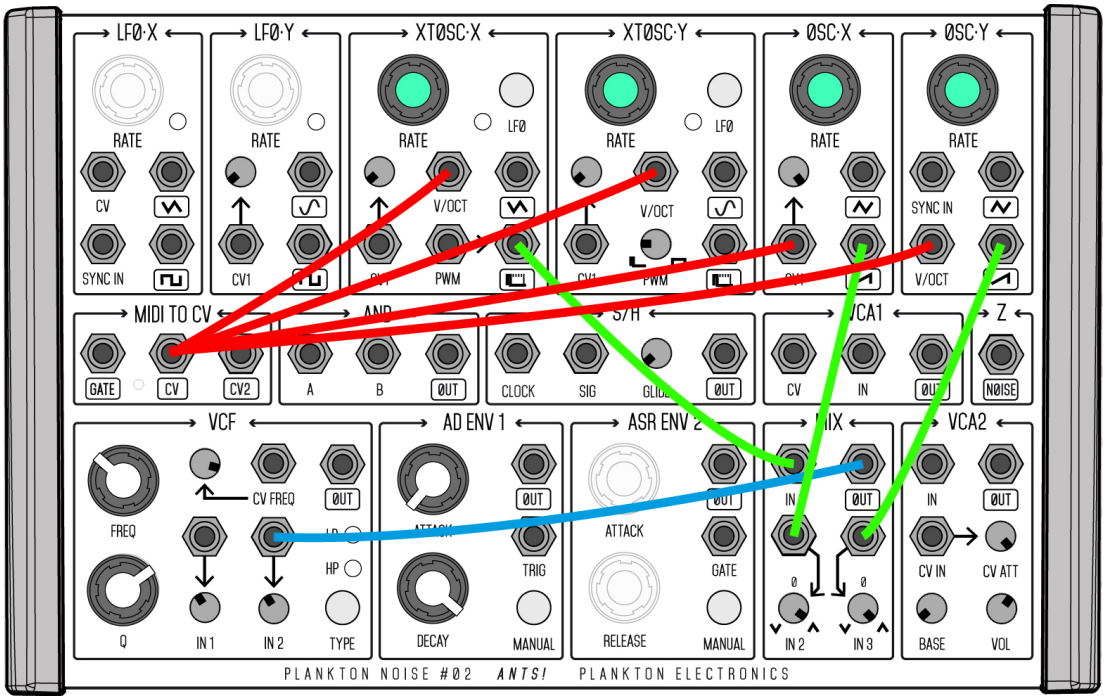
The 4 oscillators have V/oct inputs, so all 4 can be played musically if you connect the **MIDI TO CV** outputs to them.

XTOSC·X and **XTOSC·Y** have V/OCT inputs plus an extra CV input with an attenuator (*CV1*). Both inputs will affects the RATE parameter of the oscillator. The *CV1 IN* can be used in many ways. For example you can use an LFO to modulate up and down the tone. The attenuator will control the amount of modulation applied to the pitch. We have seen this in the "BASICS" section of this manual. The V/OCT inputs will transform each volt in one octave (twice the frequency) so you can connect the outs of the **MIDI TO CV** converter here and play the oscillators musically. Again, we have done it in the "MIDI" section.

OSC·X and **OSC·Y** only have 1 CV input. In **OSC·X** you will need to turn up the attenuator fully CW in order to use the V/OCT feature. In **OSC·Y Y** there is no attenuator. If for any reason you want to modulate this oscillator and attenuate the modulation signal, you always can use the mixer to do it. Just think that you have another 3 oscillators to do that.

XTOSC·Y and **OSC·X** are already prepatched to the **VCF**, but **XTOSC·X** and **OSC·Y** are not patched anywhere. If you want to play 4 osc patches (we encourage you to do it!) use the mixer. Set this patch and play:

*Before setting the patch, tune the 4 oscillators to your taste. For example **XTOSC·X**, **XTOSC·Y**, and **OSC·X** at the same tone and **OSC·Y** one octave over them.*



Notice that **XTOSC·Y** is normalled to the **VCF** IN1 so you do not need to patch it. If you have done it properly, you should be listening a fat bass sound.

You may have noticed that going too up on the MIDI keyboard the oscillators go out of tune between them. This is normal with these kind of oscillators. You can play them on tune over 2 (maybe 3) octaves, but when played all together the difference is more noticeable. Try to play over a short range and tune them close to this range. Best results are obtained playing the keyboard close to the MIDI note 36. At high pitches the tuning will be worst, if you want to play the synth with a MIDI keyboard do it on the bass range.

WAVES

The 4 oscillators have different waves at the output. These are sine wave, triangle wave, pulse (and square), and saw tooth.

Sine waves  have no harmonics. They only have the main frequency. They are best used to generate drums or mixed with other waves to create complex tones. They are also very useful to be modulated by other waves.

Triangle waves  are very close to the sine waves but they have some overtones. They are made up of odd number harmonics that decrease exponentially. They are useful for drone sounds and complex auto generative patches.

Square waves  are very rich in harmonics and have a "hollow" sound. Like the triangle they are made up of an odd number of harmonics but they decrease steadily. They are very good to filter with the **VCF**.

*You can obtain 2 square waves from the **XTOSC·X** and **XTOSC·Y**. **XTOSC·X** serves it directly when nothing is plugged in the PWM IN. On **XTOSC·Y** you can get it when the PWM pot is at its centre position.*

Pulse waves  are depend on the Pulse Width (PW). The PW is the period when the wave is "up" and it is expressed in %. In a square wave the pulse width is 50%. A Pulse Wave of 10% sounds the same than a 90% (they are the same wave, but inverted). As the Pulse Width deviates from 50%, it sounds increasingly brighter and richer; but as the Pulse Width becomes very narrow, it becomes more thin and nasal. They are made up of all harmonics, but they amplitude depends on the pulse width percentage.

You can determine the pulse width of **XTOSC·Y** by turning the "PWM" (Pulse Width Modulation) pot. Fully CCW it will have a very narrow "up" state and thin sound. Fully CW it will go far to its limits and will only output a 4V DC

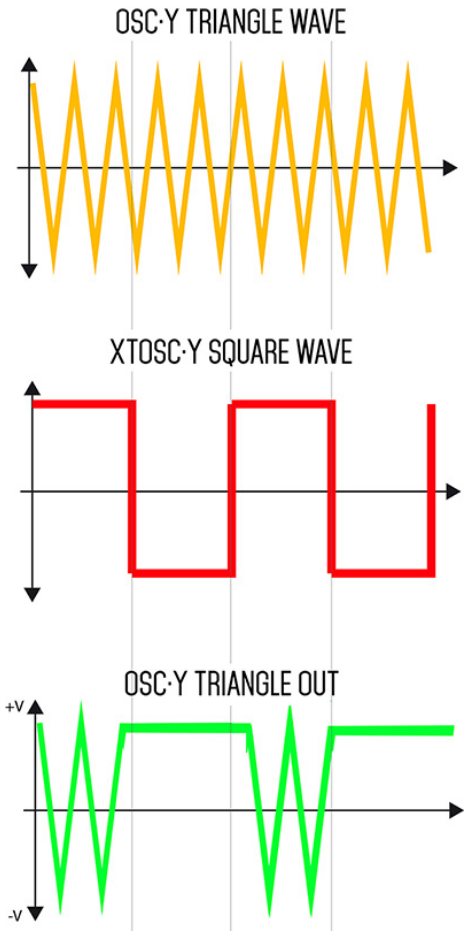
voltage (no sound at all). You can use this feature for some complex patching.

On **XTOSC·X,** you can modulate the PW by connecting a wave (or any other signal) to *PWM IN*. Experiment with LFOs, OSCs, envelopes, **S/H**, etc. The results can be very interesting. **Tip:** attenuate the modulation signal by inserting it to the mixer before going to the *PWM IN*.

Saw tooth waves  are very rich and bright. They have all the harmonics and they decrease steadily. They are very good to be filter with the **VCF** and produce all kind of sounds. Form classic basses and leads to complex patches.

OSC or LFO?

Both **XTOSC·X** and **XTOSC·Y** have a button which is named "LFO". When up the oscillators will work like a normal oscillator, starting at 20Hz. When down, they will work as an LFO (Low Frequency Oscillator). This means that instead of sound, they will output something that is below and only used to modulate other signals like oscs. The led will blink at each pulse "up". This way the synth can have 2 LFOs + 4 OSCS; 3 LFOs + 3 OSCS or 2 LFOs + 4 OSCS .



SYNC IN

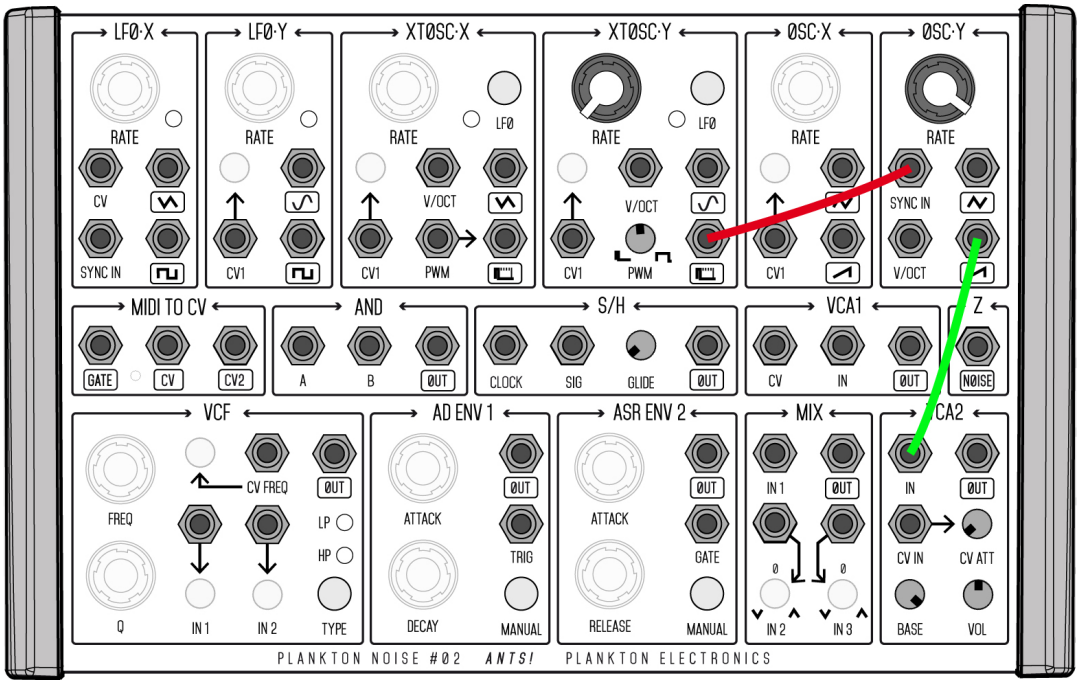
At **OSC·Y** there is an input labelled as *SYNC IN.* This refers to the osc synchronization. When another wave is connected here the triangle core of the **OSC·Y** will be reseted each time that the MASTER wave (the one that goes to the SYNC IN) is negative. This is a very rare kind of synchronisation offered by the ***ANTS!*** oscillators. You will see it more clearly here (this is an oversimplification of what happens inside the oscillator. Use an oscilloscope if you want to study it properly):

As you can see each time that the MASTER osc goes down, the SLAVE (synced) osc is blocked. When the MASTER oscillator goes up the triangle wave starts again (<u>always at the same starting point</u>).

The resulting wave has the period (main

tone) of the MASTER wave but with many added harmonics from the SLAVE (**OSC·Y**). This can be used in many ways. Creating a cool and very known resonance-like effect and another weird sounds and timbres. Let's see a basic patch where you can start to experiment with.

Set this patch. As usual, connect your mixer to the **VCA2** *OUT*:



Follow these steps:

1. Leave **XTOSC·Y** fully CCW and **OSC·Y** fully CW (as in the drawing). Now turn CCW **OSC·Y** and listen to.

2. Set **XTOSC·Y** *RATE* in another position and repeat step 1.

3. Leave **OSC·Y** at different fixed positions and move **XTOSC·Y**.

4. Change the **XTOSC·Y** *PW*.

5. Now connect your MIDI keyboard and patch **MIDI TO CV** *CV OUT* to **XTOSC·Y** *V/OCT* and play notes. Try different **OSC·Y** positions.

6. Now connect the **MIDI TO CV** to **OSC·Y** instead of **XTOSC·Y** and play. Listen to the difference.

7. Listen to the saw output.

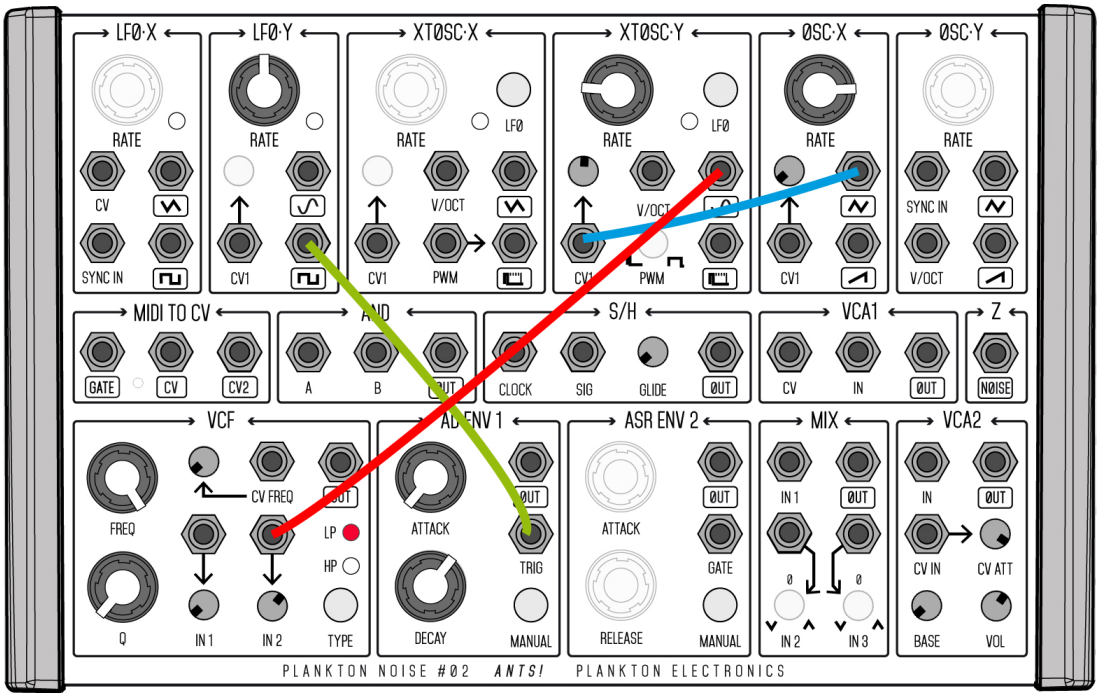
8. Modulate the oscillators with LFOs.

9. Patch the synced wave from **OSC·Y** to the **VCF** *IN1* and play the synth like in the normalled mode.

10. Think, try combinations and enjoy.

FREQUENCY MODULATION

Instead of modulating the oscillators with voltages we can modulate them with other sound waves. This is better known as frequency modulation or FM. With FM we use one or more sound waves to modulate an oscillator. The resulting wave is a resonant, usually metallic timbre. Set this patch:



LFO·Y should be triggering **AD ENV 1** and producing a rhythmic sound to the **VCA2** *OUT*. **OSC·X** modulates the frequency of **XTOSC·Y**. Now try different RATE positions from both oscillators. See how the **XTOSC·Y** *CV1* attenuator affects to the resulting sound. Experiment from here!

XMODULATION

Do you like chaos? Cross-Modulation is a term used when two or oscillators are modulated between them. If you have looked at the last patch of the "***ANTS!*** Demo Reel" on youtube that's is exactly how it sounds.

Starting from the last patch, connect the **XTOSC·Y** *PULSE OUT* to the **OSC·X** *CV1*. Turn both attenuators fully CW . Now each oscillator modulates each other. Do you like it? Then try adding another oscillator to the chain. Instead of A to B and B to A try: A to B, B to C and C to A. Do you want to try it with 4 oscillators? And adding an LFO? Filtering it? Enjoy.

NOTES ON OSCILLATORS

1. The outputs of the oscillators range between +/-4V to +/-5V.

2. You do not need to use the **MIDI TO CV** converter if you want to play it musically. Some keyboards and sequencers already have CV outputs. Connect the CV outs of these machines to the V/OCT inputs.

3. ***ANTS!*** has 4 analog V/OCT oscillators in a very compact package. This means that there have been some compromises. The most evident is that the tune will be OK over 2 octaves. On the high pitch range the tune will be worst. **Do not expect more on this machine**. If you want to play a Bach suite over a 7 octave keyboard this is not your synth!

4. 4 oscillators give you a whole palette of sounds and possibilities. However, we think that the synth sounds very nice also with a single osc over the filter. You have a whole world in this machine. And we will say once again: explore it!

5. You can combine waves from the same oscillator in the **VCF** mixer. Look at the wave drawings at the synth panel for reference. Note that the position of the wave will determine the resulting mixed wave. For example: if you mix the 2 waves of the **XTOSC·Y** the sine wave will not be added to the square. As it is inverted the resulting wave will be the square wave without the fundamental. An interesting kind of high pass filtered square wave. Try different combinations.

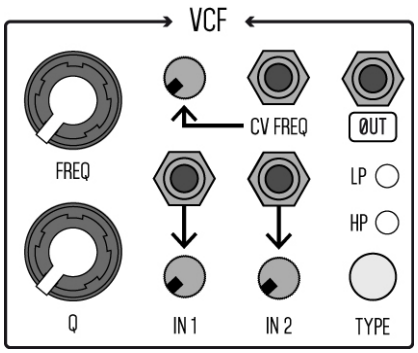
LFOS

LFOS (Low Frequency Oscillators) work exactly the same as standard oscillators, but below the audible range. Both offer Square waves (50% of PW), **LFO·X** have tri wave and **LFO·Y** sine wave. Instead of an attenuator **LFO·X** has a *SYNC IN* which works exactly the same way as **OSC·Y**.

We will not stop here. If you have understood the oscillators you should not have any problem with this 2 (2 to 4) functions. Don't disregard them. They are very useful and can be powerful tools. Some tips:

Use the square wave to trigger the **AD ENV 1** (we have done it before); modulate between them (xmodulation) and use the output to modulate an oscillator, modulate them with the envelope outputs; use the triangle and sine waves to modulate slightly the oscillators and detune them, use them to modulate the VCAs and the **VCF** to create movement, …

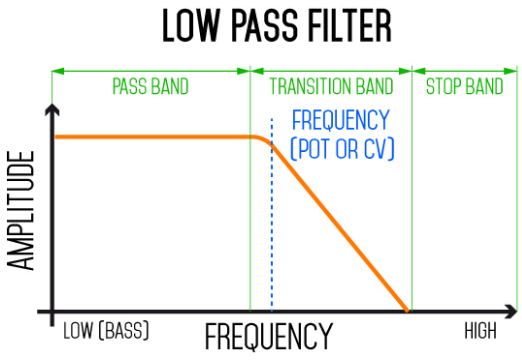
VCF

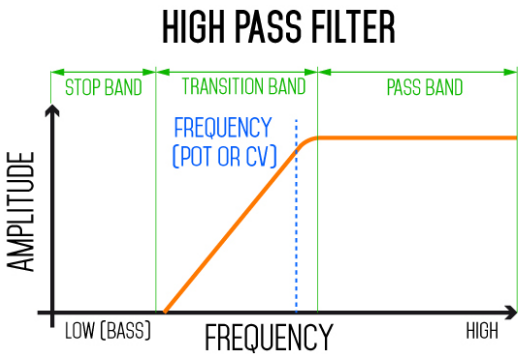


Many people say that the **VCF** (Voltage Controlled Filter) is the soul of a synth. It may be excessive, but not without a reason. Each filter have its own character and shapes the waves in very different ways. The ***ANTS!* VCF** is a not an exception: Analog, resonant, modular, low pass and high pass, with overdrive and a built-in mixer.

FILTER BASICS

A filter is used to remove frequencies. The *FREQ* (frequency or CUT-OFF) determines the position in the harmonic spectrum where the filter will begin to filter. A Low Pass Filter will filter (block) the high frequencies while a High Pass Filter will block the low frequencies. In a **VCF** we can control the frequency with an external voltage, hence the name "Voltage Controlled Filter".

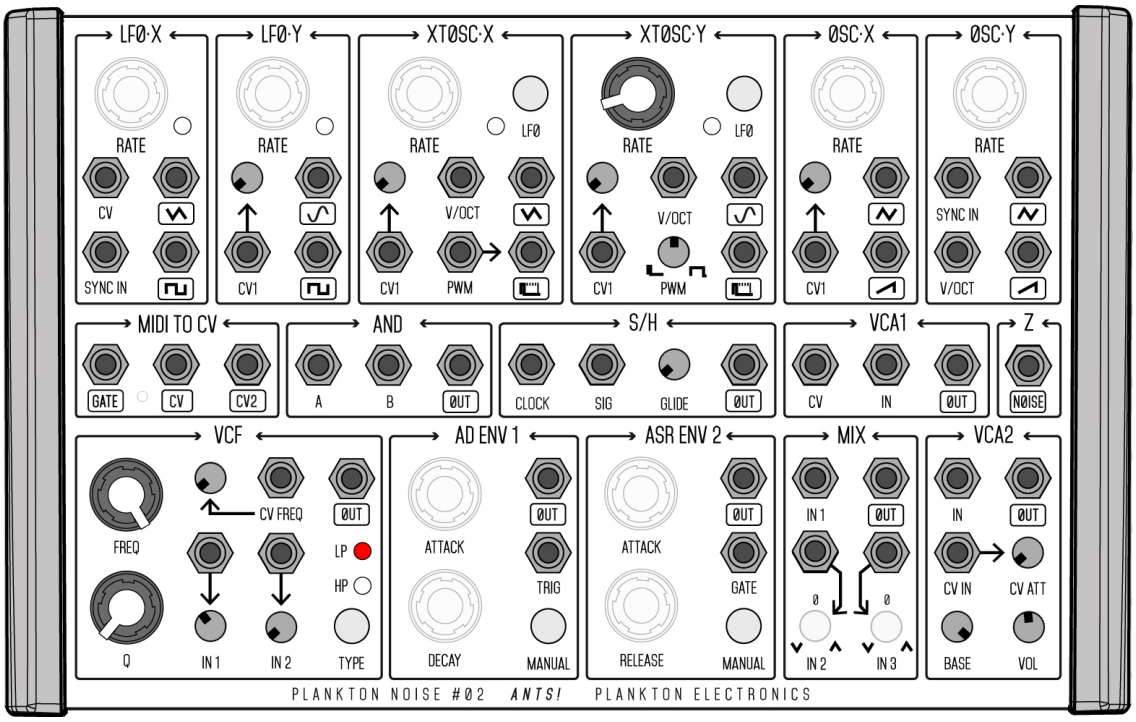




As you can see in the drawing the filter start to filter the frequencies starting from the FREQUENCY or CUT-OFF point. Before it there is the *Pass Band*, where all the frequencies are sounding. The *Transition Band* is the zone where the frequencies are removed gradually. This rate is called the slope, which is measured in decibels per octave. The **VCF** has 12db/oct in

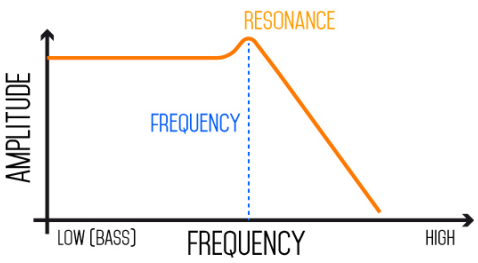
the LPF and a 6db/oct in the HPF. This means that in the HPF the frequencies are reduced more gradually. The *Stop Band* is the zone where all the frequencies have been removed.

Using waves rich in harmonics is the best way to use the filters as we will remove harmonics and shape the waveforms. Let's see it. Set the next patch:



Connect the mixer to the **VCA2** *OUT* as usual. Note that **XTOSC·Y** is prepatched the **VCF** *IN1* so you should be listening an unfiltered square wave. Turn the *FREQ* pot CCW and listen how the harmonics are removed. Now press the *TYPE* button and switch it to HPF. Turn the *FREQ* pot CW and listen.

Now turn the *Q* pot fully CW. Move the FREQ pot and hear how it affects the sound. This *Q* is the *RESONANCE*. Turn the *IN1* pot at different positions and hear how the resonance has a different behaviour. Experiment with different values and waves. Repeat the process connecting the *NOISE* output to the *IN1*. Noise has all the frequencies sounding randomly, and it is a good reference to listen a **VCF**.



Resonance occurs when sound in the pass band near the cut-off frequency is sent back into the filter as it comes out, creating feedback. The amount of feedback affects the volume of these

frequencies, as well as the timbre of the sound.

The 'classic' way of modulating a filter is using an envelope to open and close it, creating the effect of a sound rich in harmonics at the beginning which fade out at the same as the envelope goes down. The **AD ENV 1** is already patched to the **VCF** *CV FREQ IN*.

Now set the first patch of this manual. You can find it in the ***FIRST STEPS*** section. If you like you can connect an square wave from an LFO to the AD ENV 1 to play it automatically. Trigger the **AD ENV 1** and see how the **VCF** is affected by the modulation and how it shapes the sound.

Change all the filter parameters and experiment. Try first with the FREQ pot and the CV FREQ attenuator. Small changes in these two potentiometers will affect the shape of the sound a lot . Try middle and extreme settings. Change the values of the AD ENV 1 potentiometers also. Make the sound longer and turn the ATTACK pot CW.

Now experiment with the **VCF** built in mixer. Turning the IN 1 pot fully CW will be overdrive the input. This kind of saturation will be more evident depending on the wave used. Try different parameters. If you want a clean sound leave the mixer pots in the half position. The resonance will be also affected by the amount of signal in the input section. If the mixer potentiometers are fully CW the resonance will have a little effect. By the other side if the potentiometers are fully CCW the **VCF** will self-oscillate at maximum *Q*, creating a pure sine wave.

*Note that the AD ENV 1 will affect the **VCA2** also. If you want to listen how the envelope only affects the **VCF**, in the **VCA2** turn the BASE pot fully CW and the CV ATT fully CCW.*

Some tips and exercises to experiment with the filter:

1. Try different waves at the input. Note that the inputs are prepatched to **XTOSC·Y** and **OSC·X** square and saw tooth waves respectively.

2. Modulate the *FREQ* with different signals. Try LFOs, sound, noise, **S/H**.

3. Connect the output of the **VCF** to one of its own inputs.

4. Connect the output of the **VCF** to the *CV* input.

NOTES ON THE VCF

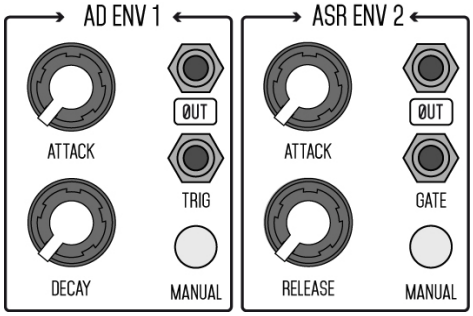
1. LPF is 12db/oct and HPF is 6db/oct.

2. Hot signals in the input will overdrive the input.

3. The **VCF** is in the middle of the normalled system path. All its connections are already prepatched. Check the normalled schematic and remember that you always can break these connections.

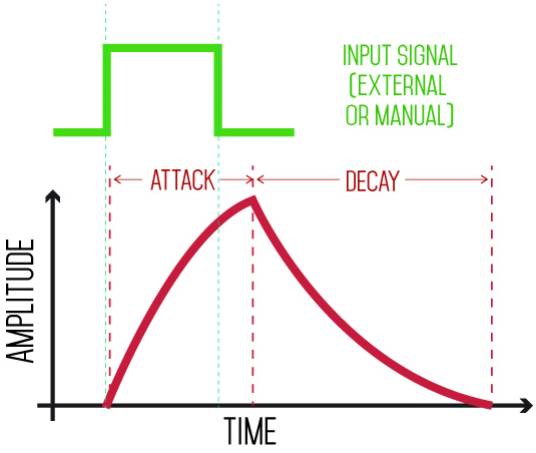
4. It has a lot of character. Small changes on its settings can affect the sound in a big way. Experiment and be familiarized with it.

ENVELOPES



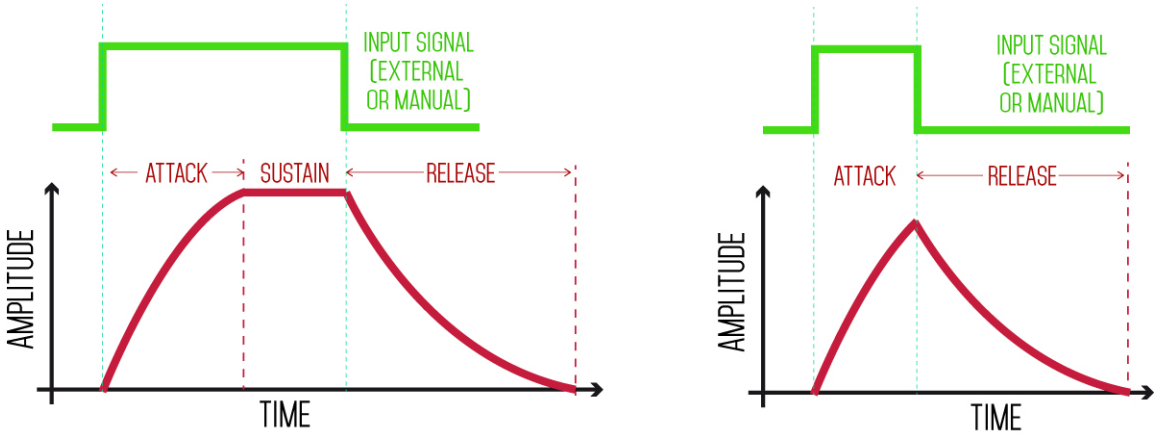
Envelopes are one of the main modules that any synth must have. They are used to modulate the **VCF** and VCA and shape the sounds. ***ANTS!*** Offers two envelopes: **AD ENV 1** is a triggered ATTACK - DECAY envelope and **ASR ENV 2** is a gated ATTACK - SUSTAIN - RELEASE env.

Envelopes generates a raising and falling voltage. In the **AD ENV 1** the sequence is triggered. This means that when it receives a positive signal (+3V) at the *TRIG IN* the voltage will raise up until its top (9V) and then it will go down until the 0 point (somewhere below but close to 0V). The raising time is set by the *ATTACK* pot. The falling time is set by the *DECAY* pot. **The time of the sequence is not dependant of the triggering signal. The envelope will start when the input signal goes from 0 to any value over 3V.** (In practice this '3V' means that most of the modules can trigger the envelope).

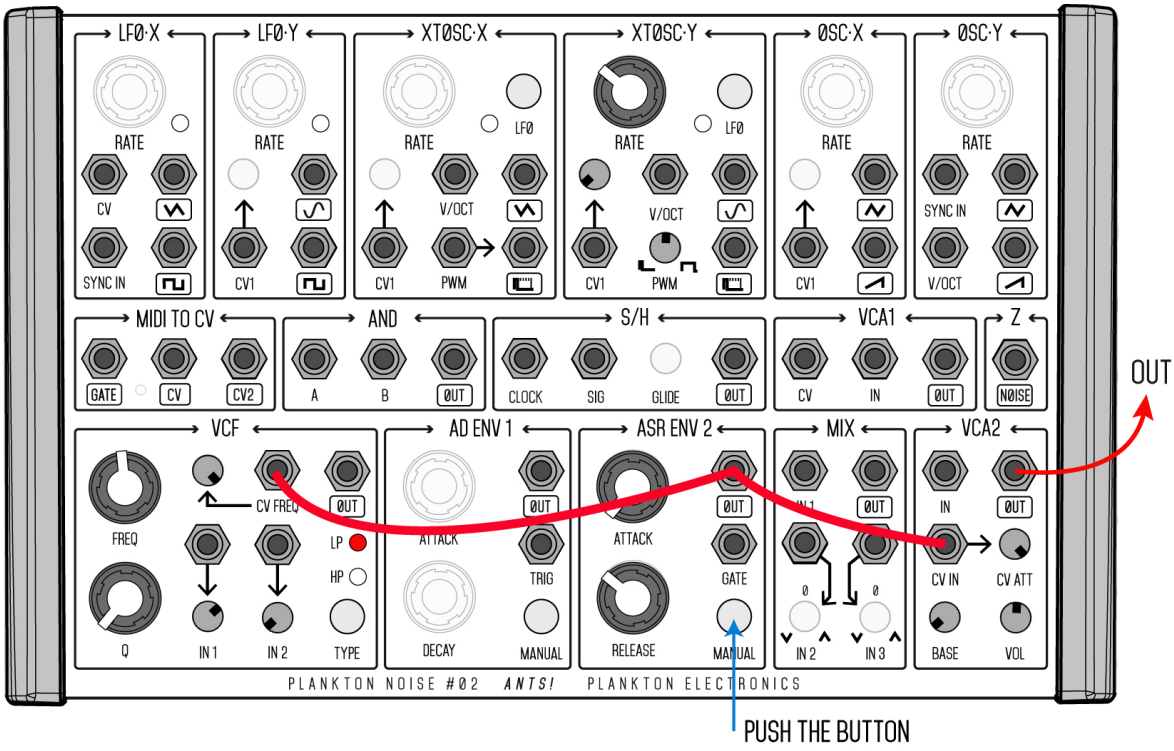


In the **ASR ENV 2** the sequence is gated. This means that the attack will go up **while the input signal is positive** (+2V). When it arrives to its maximum it will hold (SUSTAIN) until the *GATE* signal is 0 again. At this point the RELEASE will do its job. Note that if the *GATE* signal is shorter than the *ATTACK* time it will not develop until to its maximum value and the release will start from that point.

See the 2 situations:



By default ***ANTS!*** will use **AD ENV 1** as a main envelope. If you have followed the manual until here, you will have used the **AD ENV 1** a lot. If you want to experiment a bit more set the first patch of the manual and play it with different values. The envelope will affect the **VCF** and the **VCA2** at the same time. The attenuators of the CV inputs will determine the amount of modulation applied to each module. To test the **ASR ENV 2** patch this:



As you may have deduced this is the same patch as the first one, but we have connected **ASR ENV 2** in place of **AD ENV 1** breaking the normalled connections of the AD ENV 1. Experiment with the behaviour of this

envelope. Set the 2 pots at its minimum position and press the button. While you have the button pressed the sound is 'ON'. When you release the button the sound is 'OFF'. You're using a fast *ATTACK* and *RELEASE* times and the SUSTAIN is the main player here. No turn the *RELEASE* CW and listen. Do the same with the *ATTACK* pot.

There are many ways to use the envelopes on ***ANTS!***, not only in the **VCF** and VCAs. Some tips:

1. **MIX** both in the mixer and get a full ADSR envelope.

2. **MIX** it but invert the ASR in order to create rhythmic patterns. Trigger them at the same time.

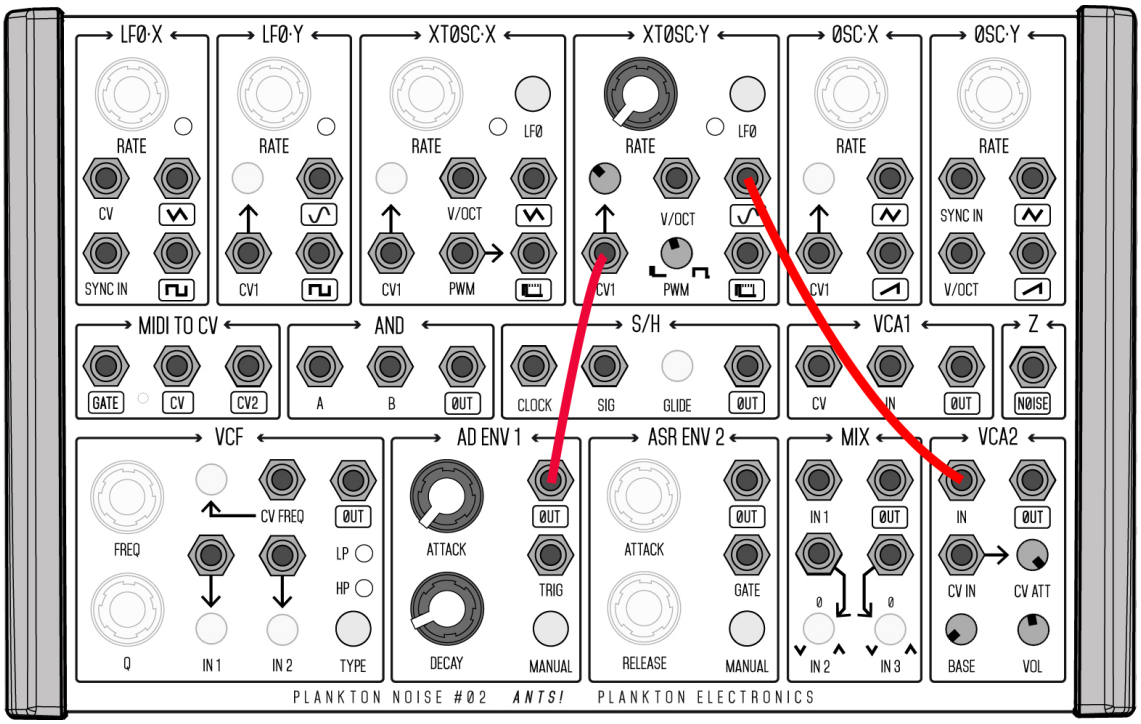
3. Use the **AD ENV 1** for the **VCF** and the **ASR ENV 2** for the **VCA2** in order to design more detailed sounds.

4. Use them to modulate the LFOs.

5. Use them to modulate the oscillators.

6. Use one of them with the **VCA1** with an oscillator and send the resulting signal to the **VCF**.

Create a bass drum with this simple patch:



The AD ENV 1 is modulating the **XTOSC·Y** tone and the **VCA2**. The tone of the oscillators starts up with a very short ATTACK and then goes down,

recreating the classical electronic bass drum. There are 3 main parameters that will affect the drum sound: *RATE*, *CV1 Atten* and *DECAY*. Small changes here will change the drum sound completely. Try to use different waves and the **VCF**. See what happens when you turn the *ATTACK* pot CW.

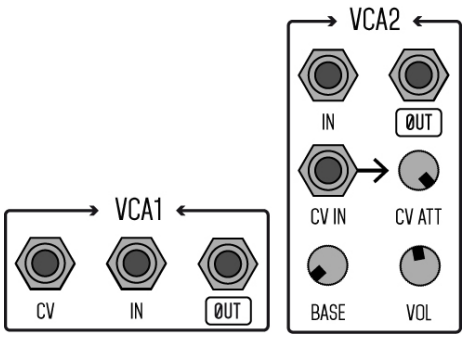
NOTES ON THE ENVELOPES

1. **AD ENV 1** is a fast envelope. Very useful to create clicked and aggressive sounds like basses and drums when a short *ATTACK* is needed. **ASR ENV 2** is slower. Best used for softer and long attack sounds

2. **AD ENV 1** goes slightly below 0V when it is relaxed. You may notice it when you connect it to some modules.

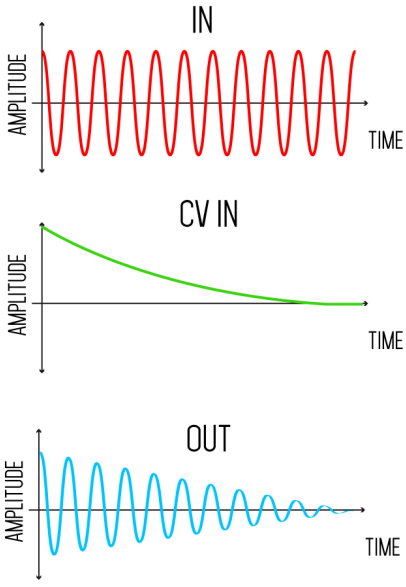
3. You can shape a sound wave by plugging it to the *TRIG* or *GATE* ins. Turn completely CCW all the pots. Now turn one of them slightly CW and see the result. You can listen the envelope.

VCAS



The VCAs (Voltage Controlled Amplifiers) are usually used at the final stage of a synth and they are in charge of control the amplitude (volume, level) of the sound. ***ANTS!*** has 2 VCAs and both can manage audio and CV signals. **VCA2** is more complete and more often used as the output module of the synth.

The VCAs receive an input signal which is processed according to the control voltage (*CV IN*). In the next drawing you can see how a sine wave is processed by the VCA with a short *ATTACK* and long *RELEASE* envelope. We have seen it many times with the examples. If you want to try it again set the first patch of the manual and play the sound. The **AD ENV 1** is in charge of controlling the VCA. The sound will fade in and fade out depending on the **AD ENV 1** settings.

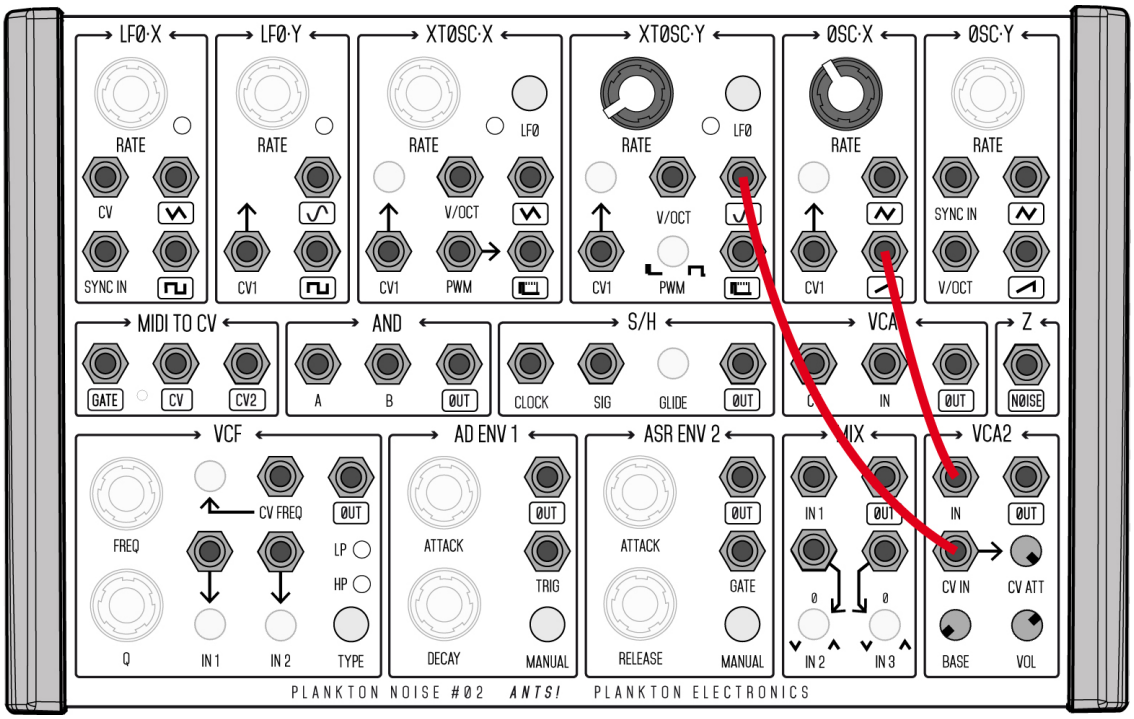


The **VCA1** has only 2 inputs and 1 output. The IN is for the signal to be processed, the CV is for the controlling signal. The **VCA2** has 3 extra potentiometers: like in other modules, *CV ATT* is in charge of controlling the amount of modulation that controls the function; *BASE* is a constant

voltage that is summed to the *CV IN*. It is used to open the sound constantly. Turn it CW to see how it affects the sound. *VOL* is used like a volume control at the final stage. As **VCA2** is usually used as the final module in the synth this control helps to set a proper volume to feed the mixer, the FX unit or the processor that will follow the synth.

AMPLITUDE MODULATION

Like in the FM, instead of modulating the VCAs with voltages we can modulate them with another sound waves. This is better known as amplitude modulation or AM. With AM we use one or more sound waves to modulate the VCA. The resulting sound wave is something similar to the FM waves. Set this patch:



XTOSC·Y is modulating the **VCA2** ON and OFF at audio rates. The saw wave from **OSC·X** is being modulated by the **VCA2**. Try different *RATE* settings on the oscillators, try different waves, try to open the *BASE* knob and listen to the result. Switch the **XTOSC·Y** to *LFO mode* and see how the **VCA2** is modulated by CV signal.

Tips / exercises for the VCAs:

1. Use the **VCA1** to produce an AM sound. Then patch it to the **VCF** and play it like a common oscillator.

2. Connect an LFO to the **VCA1** *IN* and the **AD ENV 1** to *CV*. Use the resulting signal to modulate one of the normalled oscillators and play it.

3. Do the same as in '2' but connect an audio wave instead of an LFO.

4. Connect a **AD ENV 1** with short *ATTACK* and *RELEASE* to the **VCA1** and trigger it with medium rated LFO. Connect the **ASR ENV 2** to the **VCA1** *CV* with a short **ATTACK** and a long **RELEASE**. Connect the output to the **VCA2** *CV*. Play the sound gating manually the **ASR ENV 2**.

NOISE

ANTS! has a transistor based analog white noise generator. It's labelled as '**Z**' and it has only one patch point, the *NOISE* OUT. This is a +/-5V noise source. Noise is random, chaos. Its output is normalled to the **S/H** *SIG* IN. You can use it to mix it in many ways. Some tips:

- Mix it with the bass drum patch (on the *ENVELOPES* section of the manual) to create a Snare Drum sound.

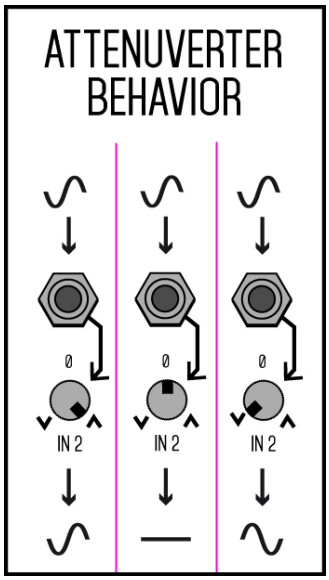
- Mix it with an oscillator in the **VCF** mixer to add some dirt to the sound.

- Connect it to the VCA or the **VCF** *CV* inputs to 'noise modulate' the sound.

- Modulate an oscillator with it to create a 'tuned noise' sound.

MIXER

There is simple 3 input mixer, **MIX**, incorporated in the synth. IN1 is goes directly to the mixing section. *IN2* and *IN3* goes through an attenuverter and then to the mixing section. Despite the fancy name an attenuverter is simple device. When it is in the centre position the signal is 0. If you turn it CW the signal will be added to the mixing section normally. But if you turn it CCW the signal will be inverted. The positive voltage will be the negative and vice versa. This way you can mix sound waves and CV signals in many ways. You can also use it as a simple attenuator by using only 1 of the inputs (for example to attenuate the signal that will modulate the **XTOSC·X** PWM IN). mix different waves and control voltages in to it to see the results yourself.



TIPS:

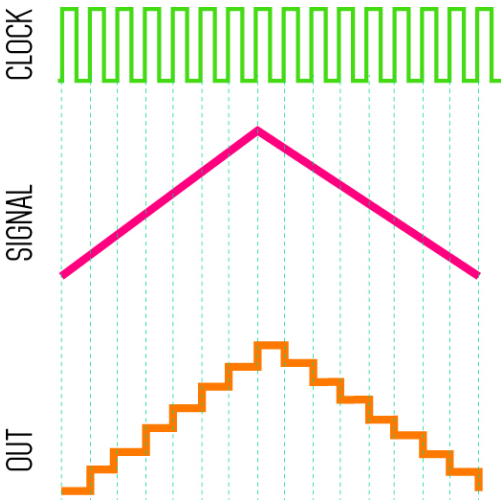
1. Use the **MIDI TO CV** *CV2* with the velocity mode. Mix the *CV2* and the **AD ENV 1** here and send the

resulting signal to the **VCF** and the **VCA2** *CV* inputs. You will be able to play expressive sounds while maintaining the curve of the envelope.

2. Some waves of the oscillators are inverted. If you mix directly in the **VCF** mixer you will subtract one from another. Inverting one of them here will have the contrary effect. So you can add the main tone to an square wave by mixing the inverted sine wave with the square here.

SAMPLE AND HOLD

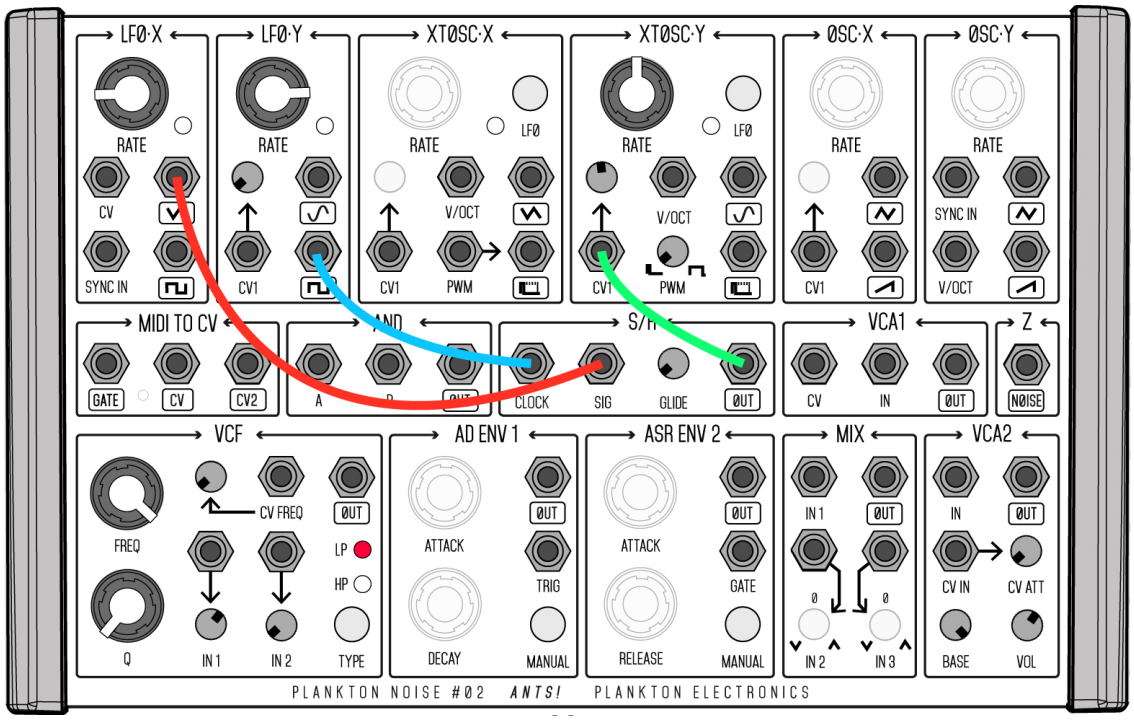
This is probably one of the most enigmatic functions to the synth newbie. But the Sample and Hold, **S/H**, is not that complex to understand. As it names says the **S/H** samples a signal and holds it.



The *CLOCK* input determines the rate at which the **S/H** will sample the signal. The *SIGNAL* input is the signal that will be sampled. At each clock pulse the **S/H** retains the value (an analog voltage) and sends it to the output until the next pulse comes in. The **S/H** can work at audio or CV rates.

The *GLIDE* will add a slope between each step at the output.

Set this patch:



You should listen how the **XTOSC·Y** tone goes up and down in a stepped pattern. The **S/H** is clocked by the **LFO·Y** and the **LFO·X** triangle wave is the signal to be sampled. At each **LFO·Y** step the **S/H** takes the current voltage of the **LFO·X** and sends it to the **XTOSC·Y**. Now change the *RATE* of the **LFO·Y** an see how each step is shorter or longer. Change also the **LFO·X** RATE. Turn the *GLIDE* CW and listen how each step is smoothed with a slope.

Now switch the **XTOSC·X** to the LFO mode and disconnect **LFO·X** and **LFO·Y** from the patch. You should be listen **XTOSC·Y** being modulated by random voltages. This is because the *NOISE* is normalled to the **S/H** SIG and the **XTOSC·X** square wave to the **S/H** *CLOCK*. This generates random stepped voltages. Change the clock rate and experiment with different values.

But the **S/H** can also work at audio rates. Switch the **XTOSC·X** to oscillator mode and connect the **S/H** *OUT* to the **VCF** *IN 1*. Now turn up and down the **XTOSC·X** *RATE*. You should listen a dithering effect in the noise, like a digital sound. This is very close to a low resolution digitalization. The clock rate is lower than the processed signal so we listen a lot of (great) artefacts.

Tips:

1. Experiment with different oscillator waves. **MIX** them through the **S/H**.

2. Connect a microphone to a preamp and connect it to **S/H** *SIGNAL*. Use an oscillator as a clock source and play it with the MIDI keyboard.

3. Process envelopes, LFOs and any kind of signal with the **S/H.**

NOTES ON THE S/H

1. The **S/H** can work at CV and audio rates. At a very slow clock rates you may feel how the CV falls down. This is a compromise in order to be able to use it at audio rates.

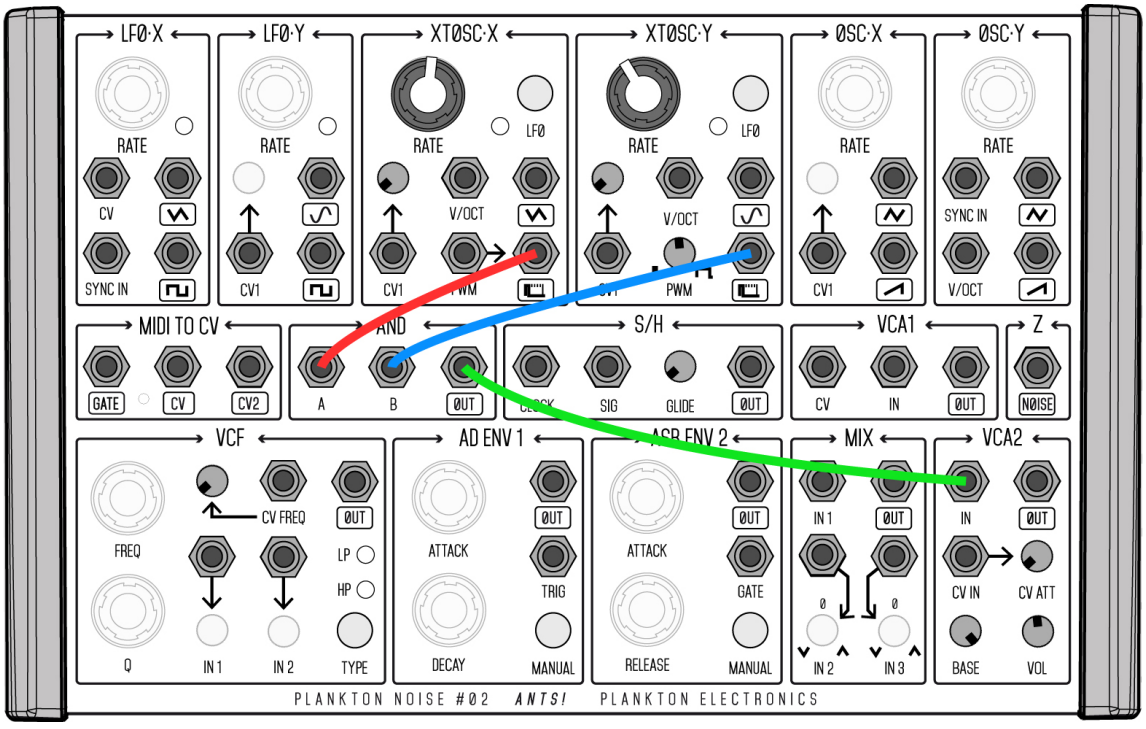
2. The clock input will accept any kind of signal. It will ignore the negative part of the signal an will take only the positive one. It will start to work over 3V.

3. If you use the *GLIDE* function at audio rates you will notice how it filters the sound like in a LPF.

The **AND** gate function is a basic digital logic gate . It works with logic or digital values: HIGH and LOW (or ‘0’ and ‘1’). Anything below 3V will be considered a ‘0’ while anything over it, a ‘1’. In practice the output is HIGH only when the 2 inputs are HIGH:

A	B	OUT
LOW	LOW	LOW
LOW	HIGH	LOW
HIGH	LOW	LOW
HIGH	HIGH	HIGH

The **AND** function have many uses. It can work with audio or CV signals. You can combine both. Set this patch:



Now you should be listening a digital like sound. Both oscillators are being mixed through the **AND** gate. Try with different values and see how the sound changes.

Tips:

1. Combine LFOs instead of oscillators to create rhythmic patterns.

2. Combine an LFO and an oscillator to create gated effects.

3. Combine the 2 envelopes. Being **AD ENV 1** short and triggered by an LFO and **ASR ENV 2** being gated manually.

4. Connect the **MIDI TO CV** *GATE* and an LFO. Connect the output to the **AD ENV 1** *TRIG*.

5. Pair it with the **S/H** to create complex patterns.

HACKING

ANTS! Is an open-source machine. We provide the schematics and the MIDI software for free. You can hack the machine if you like. Inside the synth you will find an ISP port to update the MIDI firmware and 4 potentiometers to tune the oscillators.

IF YOU OPEN THE SYNTH DON'T TOUCH ANYTHING IF YOU DON'T KNOW WHAT ARE YOU DOING. SOME COMPONENTS ARE EASY TO DAMAGE. ANY MALFUCTION CAUSED BY OPENING THE SYNTH WILL NOT BE COVERED BY THE WARRANTY.

If you want to open the synth follow these steps:

1. Turn-off the machine. Disconnect the power cable.

2. Remove the side covers. Each cover uses 2 T10 torx screws. When reassembling the machine don't over torque these screws. Tighten them gently until the covers are in place. The screws don't have an stop point.

3. Remove the 2 front screws. Do the same with the 3 back top screws (these 3 screws are close to the front panel in the back part). Use a 1/16 Allen key (hex).

4. Separate the panel from the metal case. Be careful here. There are some 2 flat cables inside the unit.

5. Remove the flat cables. Before doing it take a look on its orientation. Reversing the power cable and powering the unit will damage it instantly.

Now you have access inside the unit. Once again: be careful here! The most important parts are the ISP port to update the MIDI software and the 4 blue tuning potentiometers.

We will not provide any support on how to hack the unit. Continue at your own risk. Check the schematics for reference.

THE END

Now it's time to explore the synth yourself and make your sounds and music with it. We will be happy if you upload your own sounds to the online patch browser and share it with the community. We will like to see your own videos playing the synth.

We hope that you have enjoyed this manual. If you have any comments, remember to send them to support@planktonelectronics.com

Enjoy ***ANTS!*** and happy patching!

MAIN
27 INPUTS, 24 OUTPUTS
ANALOG CIRCUITRY
EURORACK FRIENDLY (VOLTAGE)

MODULES
2 LFOs
4 OSCs (2 switchable to LFO)
MIDI TO CV
AND LOGIC GATE
SAMPLE AND HOLD
2 VCAs
WHITE NOISE GENERATOR
LP/HP VOLTAGE CONTROLLED FILTER
1 TRIGGERED A/D ENVELOPE
1 GATED A/S/R ENVELOPE
1 MIXER WITH ATTENUVERTERS

MATERIALS
ROLLED STEEL CASE
PLASTIC SIDE COVERS
FR4 PANEL
SOFT-TOUCH KNOBS

LFOS
+/-4V OUTPUTS
TRIANGLE CORE
TRIANGLE, SINE AND SQUARE WAVES
RANGE: 19SEC – 30HZ
'SYNC IN' ON LFO·X

OSCILLATORS
V/OCT INPUTS
+/-4V OUTPUTS
TRIANGLE CORE
TRIANGLE, SINE, SQUARE, SAWTOOTH AND PW WAVES
'SYNC IN' OSC·Y
2 SWITCHABLE TO LFO
PWM IN ON XTOSC·X
PWM KNOB ON XTOSC·Y

MIXER
3 INPUT
2 ATTENUVERTERS

AD ENV1
TRIGGERED ENVELOPE
MANUAL CONTROL
'TRIG IN'
ATTACK: 0.9msec – 1sec
DECAY: 3msec – 5ec

ASR ENV2
GATED ENVELOPE
MANUAL CONTROL
'GATE IN'
ATTACK: 5msec – 10sec
RELEASE: 1msec – 4Sec

MIDI TO CV
1-8 CHANNEL SELECT
GATE OUT (NOTE ON)
CV (NOTE) OUT
CV2 OUT (2nd NOTE OR VELOCITY)

VCF
RESONANT ANALOG FILTER
HIGH PASS / LOW PASS
2 INPUT MIXER WITH DISTORTION
VOLTAGE CONTROLLED FREQUENCY

VCAS
2 Voltage Controlled Amplifiers
'BASE' and 'VOLUME' ON VCA1
AND GATE
2 INPUT LOGIC GATE
0 TO 5V

POWER
12Vac 1A
INCLUDED POWER SUPPLY