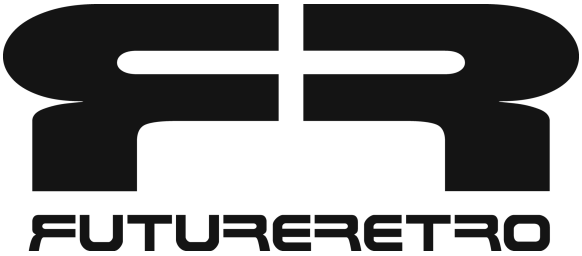
FUTURERETRO

semi-modular analog synthesizer

Operation Manual



Written and produced by Jered Flickinger

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INTRODUCTION

Welcome to the world of XS!
Thank you for choosing the XS semi-modular analog synthesizer. Please take time to read through the entire manual for a complete understanding of the operations and procedures needed to master this instrument.

Contents
Included with your XS synthesizer, you should find an external power supply, optional desktop ends, owner's manual, and warranty card. If any of these items are missing, please notify the dealer you purchased the unit from or contact Future Retro directly. Please keep the original box and all packaging material your unit came with, as this provides the best protection should you ever need to ship your unit.

Overview
The XS is a true semi-modular analog synthesizer with a universe of sonic possibilities just waiting to be discovered. The unit's versatile design allows it to be used as either a tabletop or rack-mounted instrument and its compact size makes it ideal for musicians on the go.
In its simplest form the XS is an extremely powerful monophonic synthesizer with internal signal routings pre-wired in a way that allows the unit to act similar to traditional synthesizers. The unit also provides numerous inputs and outputs that can be connected in various ways to override the pre-wired signal routings and interface the unit with other instruments in a modular fashion, and even process external audio.
The XS can be controlled by both MIDI and CV/Gate control signals in a variety of ways so that interfacing it with other instruments, old or new, is simple. The XS can also act as a MIDI to CV/Gate converter, allowing MIDI information received by the unit to be transmitted as CV/Gate signals for controlling other analog instruments.

Power
The power supply provided with your unit is designed specifically for this product. Do not substitute the use of other power supplies. If your power supply ever becomes lost or damaged, please contact us for a replacement.

Care
Avoid exposing the unit to smoke or damp, dusty, or extreme hot and cold environments. To clean the unit, use a soft damp cloth. Do not use any abrasive cleaners, as these may harm the surfaces and finish of the unit.

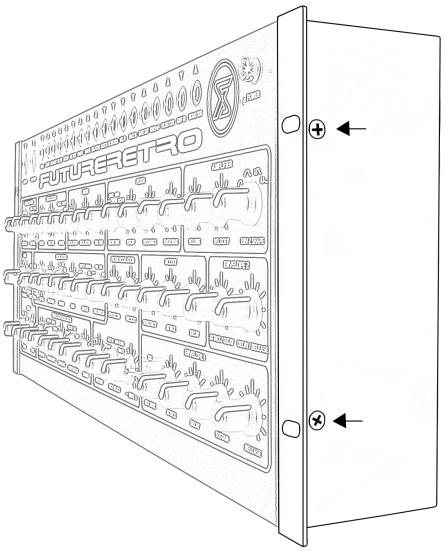
Product Warranty and Support
The XS comes with a 1 year limited warranty covering mechanical or electrical defects. To validate your warranty, fill out the warranty card included with your unit and mail it within one month of the original purchase date.
The warranty does not cover damage due to misuse or abuse of the product. Any modifications performed to the unit will automatically void the warranty. Future Retro will not be held liable for any accidents or damages caused to the user or their surroundings when using this product.
Should your unit become damaged within the warranty period, please email product support: support@future-retro.com
You will need to obtain authorization to return the unit to us for repairs.

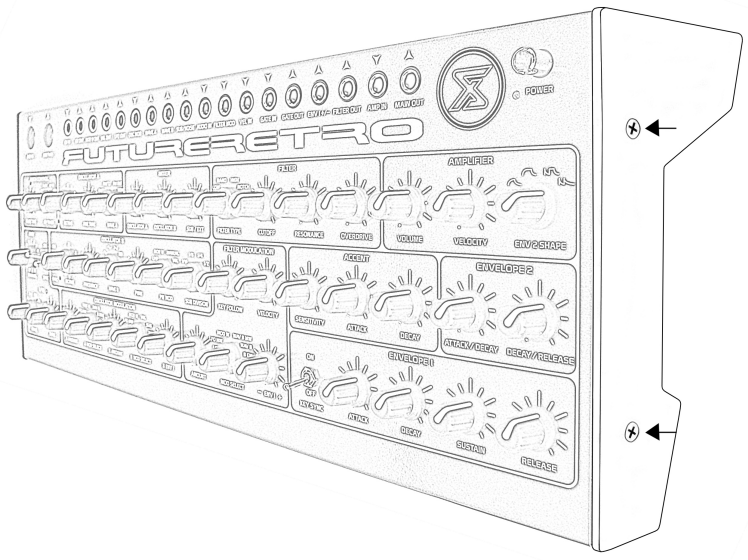
Please visit the Product and Support pages of our website for the latest information about this product, and any additional updates which may become available: www.future-retro.com

RACK-MOUNT OR DESKTOP

Have it your way
The XS can be used as either a rack-mount or desktop unit. All units come assembled with the rack ear option installed at the factory. If you prefer to place the XS on a desktop, the rack ears may be removed and these desktop pieces may installed in their place.

Remove the two Phillips screws on each of the rack ear end pieces, and install the desktop pieces as shown below. The Phillips screws that are used to fasten the rack ears can be reused for mounting the desktop pieces.





GETTING STARTED

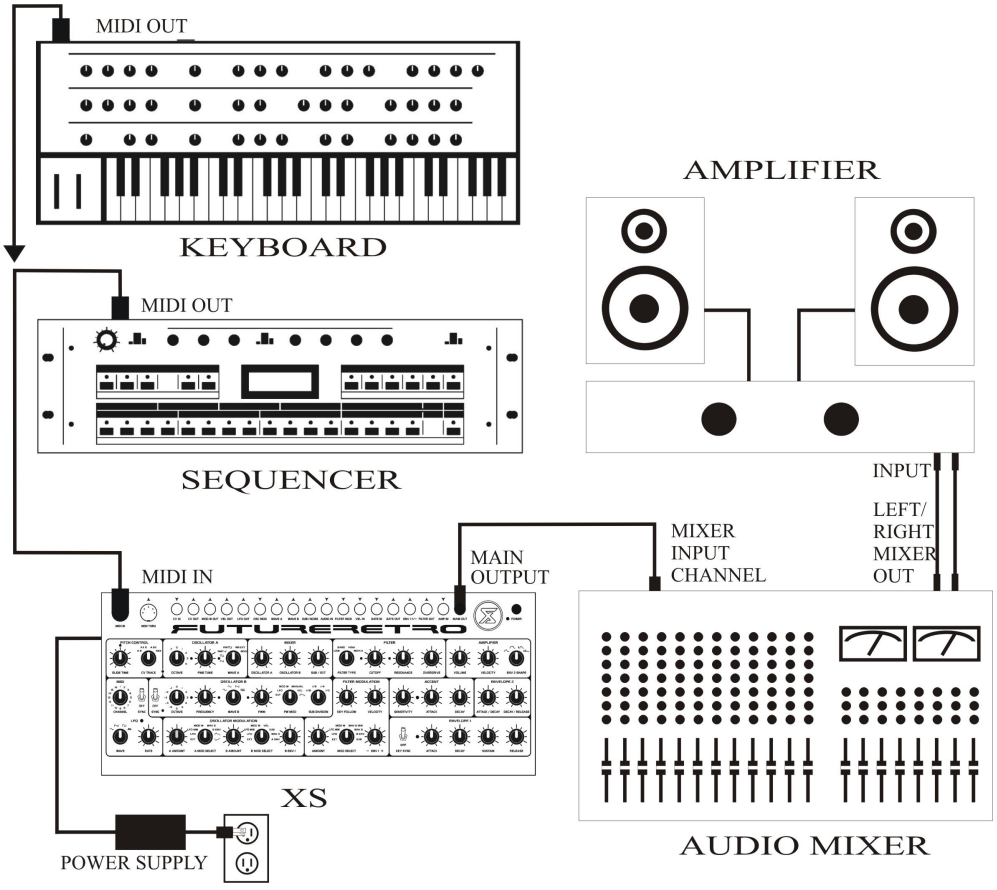
I want to play now!

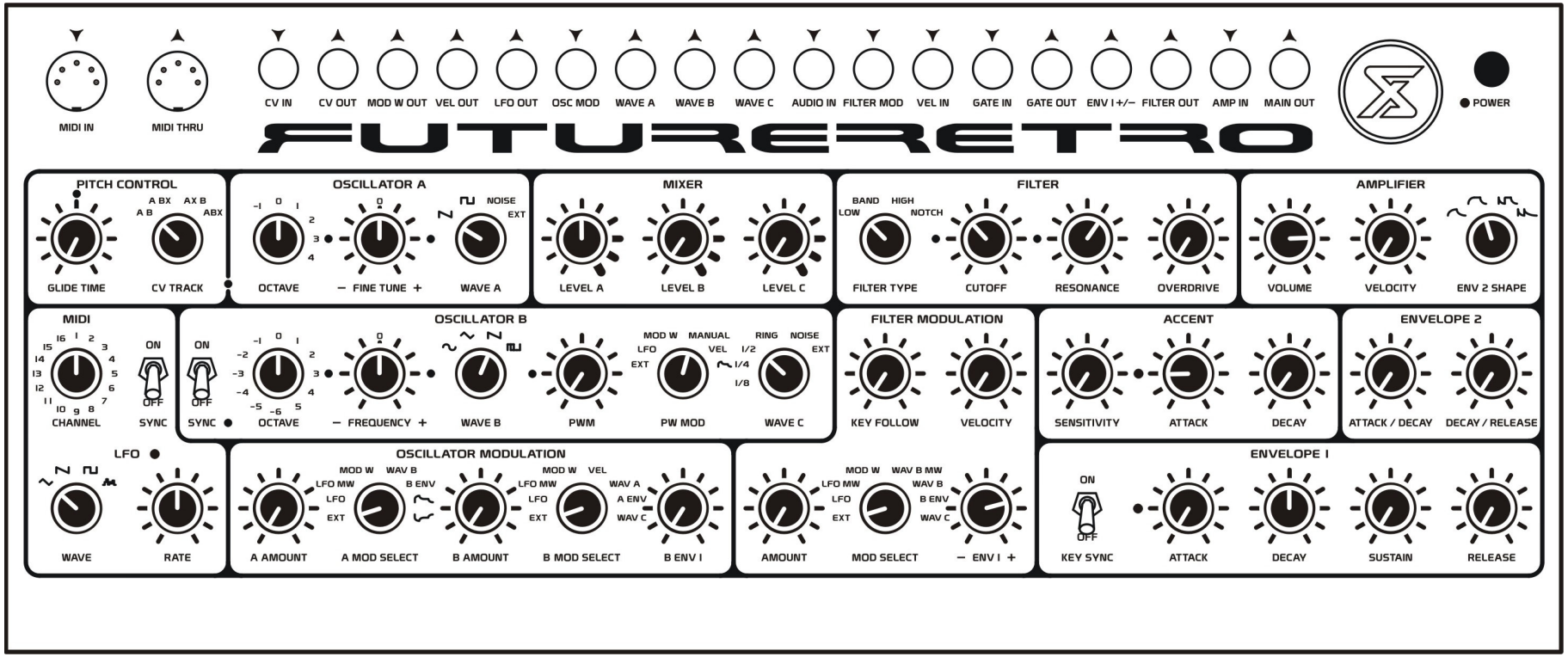
To play the XS, follow these directions in order.

1. Connect the XS to an audio system as shown in the illustration below.
2. Connect the MIDI IN of the XS to the MIDI OUT of your controller keyboard or sequencer.
3. Set the front panel controls of the XS as shown in the illustration on page 5.
4. You'll need to set the MIDI channel control on the XS to the same MIDI channel your keyboard or sequencer is sending MIDI information on.
5. Press the power switch of the XS to turn the unit on, and slowly increase the volume control on the XS to a suitable listening level (without overdriving the input of your mixer) while you play your keyboard or sequencer.
6. Now you can play around with the various analog parameter settings to adjust the sound that the XS is creating.
7. When you are finished playing, press the power switch again to turn its power off.

Remember, we're just getting started here. For a full understanding of this product and its features, please read through the entire manual.

Note: As a general rule, first turn on the XS, then your mixer, and then your amplifier. When turning your studio equipment off, you'll want to turn off the amplifier first, then proceed with turning off the rest of your equipment. This will prevent any power surges to your amplifier and speakers, which could damage them.




MIDI IN
MIDI THRU
CV IN
CV OUT
MOD W OUT
VEL OUT
LFO OUT
OSC MOD
WAVE A
WAVE B
WAVE C
AUDIO IN
FILTER MOD
VEL IN
GATE IN
GATE OUT
ENV I +/−
FILTER OUT
AMP IN
MAIN OUT
POWER
FUTURERETRO
PITCH CONTROL
GLIDE TIME
CV TRACK
OSCILLATOR A
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MIXER
LEVEL A
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SYNC
OSCILLATOR B
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WAVE B
PWM
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KEY FOLLOW
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ACCENT
SENSITIVITY
ATTACK
DECAY
ENVELOPE 2
ATTACK / DECAY
DECAY / RELEASE
LFO
WAVE
RATE
OSCILLATOR MODULATION
A AMOUNT
A MOD SELECT
B AMOUNT
B MOD SELECT
B ENV I
AMOUNT
MOD SELECT
ENV I
ENVELOPE I
KEY SYNC
ATTACK
DECAY
SUSTAIN
RELEASE

CONNECTIONS

MIDI IN: Information received at the MIDI IN jack can be used to play the sounds of the XS. Use a MIDI cable to connect this input to an external sequencer or keyboard's MIDI OUT.

MIDI THRU: All information received at the XS MIDI IN jack will be sent out the MIDI THRU jack. Use a MIDI cable to connect this output to another device's MIDI input for creating a daisy chain between multiple MIDI units.

CV IN: Connect this input to a 1V/Oct standard CV output of another device, in order to control the pitch of the oscillators in the XS.

CV OUT: MIDI note/pitch data received at the XS MIDI IN jack will be converted to a control voltage of the 1V/Oct standard. You can connect this CV output to the CV or modulation inputs of any device to control the pitch of its oscillators or other circuits.

MOD W OUT: Mod Wheel data received at the MIDI IN jack will be converted to an equivalent control voltage ranging from 0 to +10 volts. Connect this output to the CV or modulation inputs of any device you wish to control with the mod wheel.

VEL OUT: MIDI Note/Velocity data received at the XS MIDI IN jack will be converted to an equivalent control voltage ranging from 0 to +10 volts. Connect this output to the CV or modulation inputs of any device you wish to control with Note Velocity.

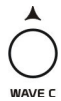
LFO OUT: The waveform currently selected in the LFO section will be available at this output. All LFO waveforms have a range of –5 to +5 volts. Connect this output to the CV or modulation inputs of any device you wish to control with the LFO.

OSC MOD: This is the external modulation input for the oscillators. Connect this input to the output of any CV or modulation source you wish to modulate the oscillators with.
The external signal can be used to modify each oscillator's pitch individually, as well as the pulse width modulation of Oscillator B's square/pulse waveform. Set the Mod Select controls to EXT for any of these three sections you wish to control with the external source.

WAVE A: This is a dual-function output of the waveform selected for Oscillator A. This is a stereo output, although mono cables can be used here without any problem. If using a mono cable, you can insert it all the way for the tip signal, or pull it out one notch for the ring signal. The tip of the jack provides a continuous output of Oscillator A's selected waveform. The ring of the jack provides the same waveform, but the amplitude of this waveform is controlled by Envelope 1.
Either output can be connected to the input of any other device, allowing the oscillator to act as an audio or modulation source. The waveform's output signal will have a range of –5 to +5 volts.

CONNECTIONS

WAVE B: This is a dual-function output of the waveform selected for Oscillator B. This is a stereo output, although mono cables can be used here without any problem. If using a mono cable, you can insert it all the way for the tip signal or pull it out one notch for the ring signal. The tip of the jack provides a continuous output of Oscillator B's selected waveform. The ring of the jack provides the same waveform, but the amplitude of this waveform is controlled by Envelope 1.
Either output can be connected to the input of any other device allowing the oscillator to act as an audio or modulation source. The waveform's output signal will have a range of –5 to +5 volts.



WAVE C: This is mono output of the waveform selected for the WAVE B control. The three sub oscillator waveforms will have a range of 0 to +15 volts, while the ring modulator and white noise source will have a range of –5 to +5 volts.
This output can be connected to the input of any other device allowing it to act as an audio or modulation source.

AUDIO IN: This is a mono audio input that can be connected to any line-level external audio source output. When a cable is plugged into this jack, you can use either the WAVE A or WAVE C control to select EXT which will select this external audio source as its waveform.

FILTER MOD: This is the external modulation input for the filter. Connect this input to the output of any CV or modulation source you wish to modulate the filter with.
Set the Mod Select control in the filter section to EXT if you wish to use the external source.

VEL IN: This is the external Velocity input, allowing external control voltages to override the Velocity control generated by the internal MIDI to CV converter. Generally, you will want to connect this input to any control voltage ranging from 0 to +10 volts.
This external signal will then control all Velocity-sensitive parameters throughout the analog section.

GATE IN: When nothing is plugged into the Gate In jack, the envelopes in the XS will be triggered by Note On messages received via MIDI. If you connect a positive polarity gate output of another device to the gate in of the XS, this external gate can then be used to trigger the envelopes in the XS. Once the external gate signal reaches +1.5 volts or higher, the envelopes will be triggered.

GATE OUT: All MIDI note message received by the XS will be converted to a positive polarity gate ranging from 0 to +15 volts. Connect this output to the Gate In of any other device you wish to control with gate signals.

CONNECTIONS

ENV 1+/-: This is a dual-function output of Envelope 1. This is a stereo output, although mono cables can be used here without any problem. If using a mono cable, you can insert it all the way for the tip signal or pull it out one notch for the ring signal.
The tip of the jack provides a positive polarity of Envelope 1 ranging from 0 to +10 volts. The ring of the jack provides a reverse polarity of Envelope 1 ranging from +10 to 0 volts.
Connect either of these outputs to any modulation input you wish to control with Envelope 1.

FILTER OUT: This is the output of the Filter and Overdrive section. You can connect this output to any audio or modulation input. The signal coming out of the filter can range from 0 volts (nothing) to +/- 15 volts, depending on the level settings in the mixer section.

AMP IN: This is the main input for the Amplifier section. When nothing is plugged into the Amp In jack, the output of the filter will be connected to the amplifier's input. Once a cable is inserted into the Amp In jack, audio coming from the filter's output is disconnected from the amplifier, and only the external signal will be routed through the amplifier.

MAIN OUT: This is the main output of the Amplifier section. Typically, you will connect this output to the input of your mixing console or amplifier. This output is monophonic.

Note: All 1/4" connectors are monophonic unless specified as stereo in their description.

Note: In some of the stereo jack descriptions, we state that you can pull the cable out one notch. It may be more accurate, however, to say pull the cable out completely and then reinstall the cable so it is just touching the first contact of the jack. If the cable were actually pulled out one notch, it would end up shorting both tip and ring connections of the jack, which may cause operations other than described here in the manual, though not harmful to the unit.

POWER: Use only the factory-provided power supply that came with your XS. This is a special power supply that has multiple output voltages. Connect the mini-DIN connector of the power supply to the power jack, located on the bottom of the unit. Connect the power mains connector to your wall outlet. The power supply can operate on power main voltages ranging from 90—260 volts AC, which should be compatible with most power standards worldwide. The power cable which connects from the body of the power supply to your wall outlet can be changed out with standard IEC type cables, which can then support the various pin arrangements of each countries power main standards.

OVERVIEW OF ANALOG SYNTHESIS

The XS is a true analog synthesizer, which is capable of producing an infinite amount of sonic textures. All aspects of a sound can be changed instantly by the controls and switches located on the front panel. The settings of these controls are never digitized or stored in memory. Therefore, the sound the XS produces is always a direct representation of the actual control settings.

By keeping the controls of the XS completely analog you get infinite resolution of each parameter, whereas digital synthesizers typically provide only 128 defined steps for each parameter. We feel that digitizing the controls of an analog synthesizer will ultimately limit the precision that analog provides.

If you are new to synthesizers or analog synthesis, fear not. It's actually quite easy and rewarding, to say the least. No messy menus to fuss with, only hands-on manipulation of sound.
With a basic understanding of sound, you too can create an infinite pallette of sounds.

All sounds can be broken down into three basic elements, which are **Frequency** (pitch), **Harmonic Content** (tone), and **Amplitude** (volume).

Frequency is measured in Hertz (Hz). Hz is the number of times an oscillator repeats its periodic waveform within one second of time. For example, the range of human hearing is from approximately 20 Hz to 20,000 Hz (referred to as 20 kHz). The human ear perceives a low frequency as having a lower pitch, and a higher frequency as having a higher pitch. The XS is capable of producing frequencies covering the entire audible range of hearing as well as those above and below the 20 Hz to 20,000 Hz range. The frequency that the oscillators produce in the XS can be controlled in a variety of ways that will be discussed later in the Analog Controls section of this manual.

Harmonic Content refers to the amount of frequencies contained within a sound. The most dominant or perceived pitch in a sound is called the fundamental frequency. All other frequencies in the sound are harmonics of the fundamental frequency. Each harmonic is simply another sine wave at a reduced amplitude of the fundamental frequency. Harmonics are often referred to as the 2nd, 3rd, 4th, and so on. The number of the harmonic simply describes the number of cycles this harmonic produces for each single cycle of the fundamental frequency.

The shape of an oscillator's waveform is relative to its harmonic content, and there are four common waveshapes generated by a musical oscillator.
A sine wave (the one that looks like an S turned sideways), for instance, is the most basic waveform, having only a fundamental frequency and no additional harmonics. Sine waves sound very thin and are pure in sound.
A triangle waveform contains a fundamental frequency and all odd harmonics (3rd, 5th, 7th and so on) of that frequency. This causes it to sound slightly fuller than a sine wave.
A square wave also contains a fundamental frequency and all odd harmonics of that frequency. The difference between a square and a triangle waveform is that the harmonics are more pronounced in the square wave, giving it a somewhat hollow yet fuller sound than the triangle. In the XS, the duty cycle of this square wave can also be varied to create what is known as a pulse waveform. The width of this pulse alters the harmonic content of the waveform. Consider the true square wave whose pulse is 1/2 the period of the waveform. We know that the 2nd harmonic and its multiples have been eliminated, leaving only the odd harmonics. Let's say the pulse width is changed to 1/3 the period; this then eliminates the 3rd harmonic and its multiples such as the 6th, 9th, and 12th harmonics. A pulse width of 1/4 the period would then eliminate the 4th, 8th, and 12th harmonics.

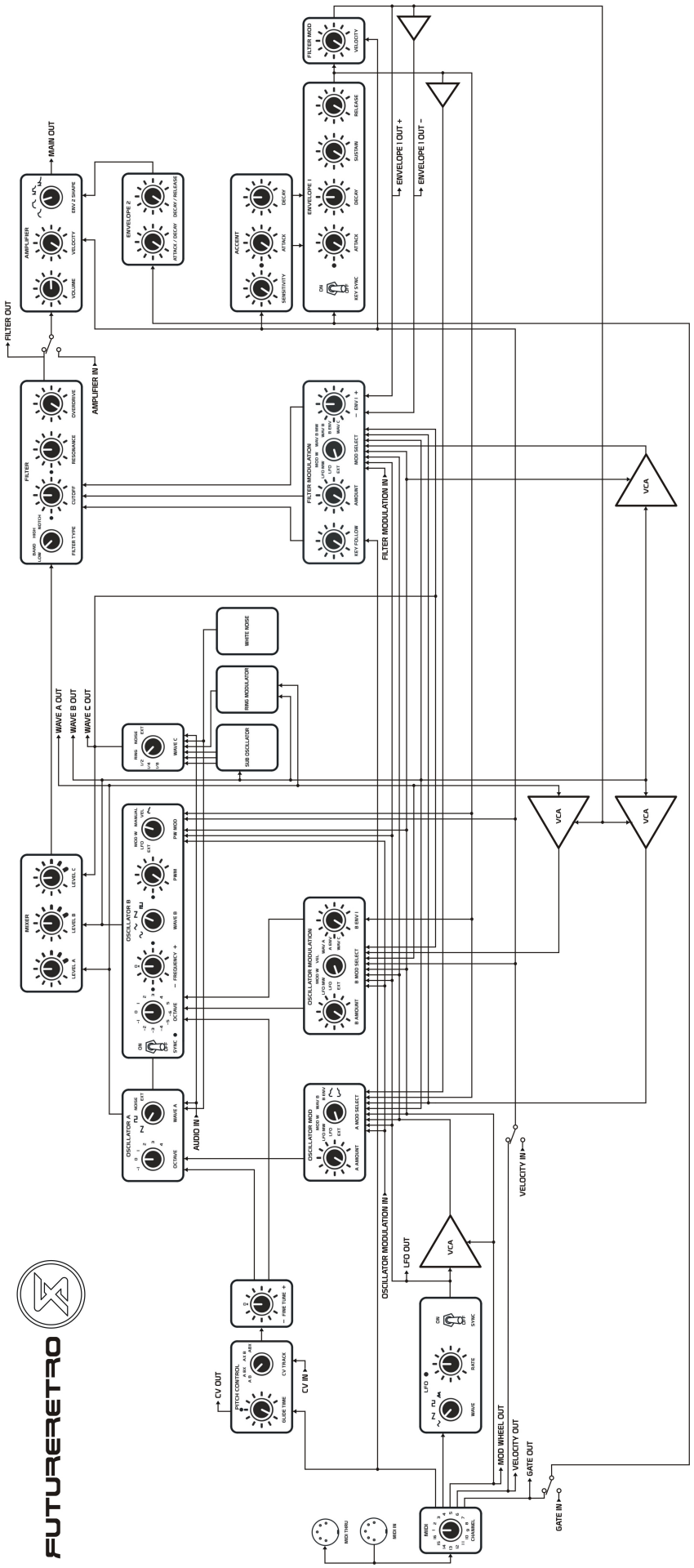
OVERVIEW OF ANALOG SYNTHESIS

A sawtooth waveform is one of the most complex shapes, since it contains a fundamental frequency and all harmonics of that frequency. Sawtooth waves are very full sounding and have a unique raspy quality to them.
In addition to these four common waveshapes, there are other items which can also be used as audio sources which will be described in more detail later on.
You can mix the waveforms of oscillators and other audio sources, together to create more complex tones. This method is often referred to as *additive synthesis*.

The most common way to alter the harmonic content of a waveform, however, is by using a filter. This is referred to as *subtractive synthesis,* where instead of adding more harmonics, we are actually taking away or modifying the harmonic content of the oscillator waveforms and other audio sources.
The filter in the XS provides four filter types: lowpass, highpass, bandpass, and notch.
Each filter does just what it sounds like. With the lowpass filter, low frequencies are allowed to pass through the filter while higher frequencies are attenuated. A highpass, on the other hand, allows the high frequencies to pass through the filter while the lower frequencies are attenuated. The point at which frequencies pass or are attenuated by the filter is determined by the filter's cutoff frequency, which is variable over the entire audio range. A bandpass filter allows only the frequencies closest to the filter's cutoff frequency to pass through, while attenuating all frequencies higher and lower than the cutoff frequency. A notch filter has the opposite effect of a bandpass filter, where the harmonics closest to the cutoff frequency are attenuated while all other harmonics are allowed to pass through the filter.
Each filter type also provides resonance, which boosts the amplitude of the frequencies closest to the cutoff frequency of the filter. The cutoff frequency can be manually adjusted or animated by the use of modulation sources. Modifying the harmonic content of your audio sources are key to breathing life into your sounds and making them interesting.

Amplitude is a term used to describe the level of a waveform, or a sound's overall volume. The volume of traditional instruments is usually determined by how hard a surface is struck, a string is plucked, or the force of air blown through a wind instrument. Synthesizers use amplifiers to boost and attenuate a sound's amplitude in a similar fashion to increasing and decreasing the volume on your stereo. All sounds have their own unique shape of volume. This shape can be described as the envelope. The XS provides four envelope types to help shape the amplitude of a sound. In essence, envelopes are a way of automating the volume. The controlling envelope can be defined as having attack, decay, sustain, and release.
When a note is played, the attack parameter determines the amount of time it takes to go from silence to the loudest possible volume. Once the loudest volume level is reached, the decay parameter then determines the time it takes to go from the loudest level back to silence or some other defined level. This defined level is referred to as sustain. Once the sustain level is reached, the sound will remain at this volume until the note is released, at which point, the release parameter will determine how long it takes for the volume to return to silence.
The XS also uses Velocity information, which determines how soft or hard a note is played, to control the amplitude of sounds. So when a note is played softly, the sound is quieter. And as you play harder, the sound gets proportionally louder.
And finally, the main volume control is also used to set the overall output level for all sounds.

Pay attention to the everyday sounds all around you and consider the frequencies, harmonic content, and amplitude it takes to create them. And before long, you too will be able to create any sound imaginable.


FUTURERETRO
MAIN OUT
AMPLIFIER
VOLUME
VELOCITY
ENV 2 SHAPE
ENVELOPE 2
ATTACK / DECAY
DECAY / RELEASE
ACCENT
SENSITIVITY
ATTACK
DECAY
ENVELOPE I
KEY SYNC
ON
ATTACK
DECAY
SUSTAIN
RELEASE
FILTER MOD
VELOCITY
ENVELOPE I OUT +
ENVELOPE I OUT –
FILTER OUT
AMPLIFIER IN
FILTER
FILTER TYPE
CUTOFF
RESONANCE
POSITIVE
FILTER MODULATION
KEY FOLLOW
AMOUNT
MOD SELECT
– ENV I +
FILTER MODULATION IN
VCA
VCA
VCA
VCA
WAVE A OUT
WAVE B OUT
WAVE C OUT
WHITE NOISE
RING MODULATION
SUB OSCILLATOR
RING
NOISE
WAVE C
MIXER
LEVEL
OSCILLATOR B
OCTAVE
WAVE B
PWM
PW MOD
SYNC
ON
– FREQUENCY +
OSCILLATOR MODULATION
B AMOUNT
B MOD SELECT
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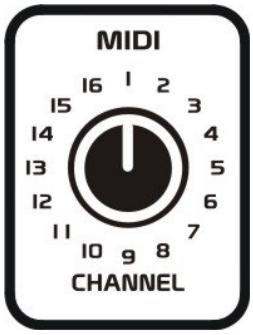
OSCILLATOR A
OCTAVE
WAVE A
AUDIO IN
OSCILLATOR MOD
A AMOUNT
A MOD SELECT
– FINE TUNE +
CV OUT
CV IN
PITCH CONTROL
GLIDE TIME
CV TRACK
LFO
WAVE
RATE
SYNC
ON
OSCILLATOR MODULATION IN
LFO OUT
VELOCITY IN
MOD WHEEL OUT
VELOCITY OUT
GATE OUT
GATE IN
MIDI
MIDI THRU
MIDI IN

CONTROLLING YOUR XS

There are several ways to control your XS.
One way is to use MIDI (Musical Instrument Digital Interface), a standard developed to allow one electronic instrument to talk to another using only a single 5-pin DIN cable. Nearly all modern electronic instruments have and support MIDI.
Before MIDI was developed, the standard practice was to use control voltages and logic gate signals as a means of controlling, modifying, and triggering electronic circuits in synthesizers.
The XS supports both standards, old and new, and even allows you to mix the use of both at the same time. The XS also converts MIDI data it receives into control voltages and logic gate signals to control other pre-MIDI instruments, sound modules, and other circuits.



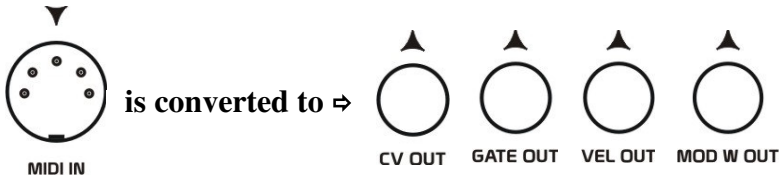
USING MIDI
The XS responds to MIDI Note On/Off, Pitch (C2-C7), Pitch Bend, Mod Wheel, Velocity, and MIDI Clock messages. Any MIDI instrument capable of sending this data can be used to play the XS. The most practical way to play the XS would be to connect it to a MIDI keyboard or MIDI sequencer. Simply connect the MIDI OUT of your keyboard or sequencer to the MIDI IN of the XS using a 5-pin DIN MIDI cable.
The XS can receive MIDI data on only 1 of the 16 possible MIDI channels at any time. In order for the XS to receive MIDI data from the keyboard or sequencer, you must first set both instruments to the same MIDI channel. Setting the MIDI channel that the XS will receive data on is done with the MIDI Channel control. Simply rotate this control so its indicator points to the desired MIDI channel.

Note: Changing the MIDI channel selection on the XS while notes are currently being played may cause these notes to become latched, which prevents them from turning off. Avoid changing the MIDI channel selection while notes are being played. Should notes become latched, first stop the master device sending MIDI data to the XS, then turn the XS off and then back on again.

If you have multiple MIDI devices in your studio that need to be controlled by your main MIDI keyboard or sequencer, you can connect the MIDI THRU of the XS to the MIDI IN of another device.

Using this method, all MIDI information the XS receives will be then be sent on to the other MIDI device.

CONTROLLING YOUR XS



MIDI TO CV/GATE CONVERTER

When MIDI information is received by the XS, the MIDI data is then converted into control voltages and logic gate signals that control the internal analog sound section. These control voltages and logic signals are also available at the 1/4" output jacks, which allows you to control other external analog circuits.

The CV OUT signal generated represents the pitch of MIDI notes received. This control voltage follows the 1 V/Oct (volt per octave) standard, where each semitone note equals 1/12th of a volt, and each octave equals 1 volt. Since the XS responds to MIDI notes C2 through C7, this control voltage can range from 0 to +5 volts.

MIDI pitch bend messages will also affect this control voltage, causing a note's voltage to become slightly more positive or negative than typically produced for that note.

If more than one note is played at a time by the MIDI controller, the XS will activate its internal glide circuit which will slew the voltage from one note to another at the rate set by the Glide Time control.

This output can be used to control the pitch of oscillators, filters, or other voltage-controlled circuits.

The GATE OUT signal generated represents Note On/Off messages. When no notes are being played, this logic signal will output 0 volts. When a notes is being played, this logic signal will output approximately +14 volts.

This output can be used to trigger envelope generators or circuits with other logic inputs.

The VEL OUT signal generated represents the Velocity of MIDI notes received. This control voltage can range from 0 to +10 volts respectively, so notes with a higher Velocity value generate higher voltages.

This control voltage is generally used to affect the volume of sound by controlling an amplifier, but could also be used to affect a filter's cutoff frequency or any other voltage-controlled circuit.

The MOD W OUT signal generated represents any MIDI Mod Wheel messages received. This control voltage can range from 0 to +10 volts respectively, so as you increase the mod wheel amount this voltage increases.

This control voltage is generally used to add expression to a sound, by assigning it to modify various parameters within a synthesizer.

TIP: You can use this MOD W control voltage as a way to animate and record parameter value changes in a sequencer. Let's say you assign the MOD W control to a filter's cutoff frequency. You have a sequence playing notes already, and now you wish to record some tweaks to the filter cutoff. Simply move the mod wheel of your master MIDI controller, and record this data into your sequencer.

CONTROLLING YOUR XS

USING CV/GATE CONTROL SIGNALS

External control voltage and logic gate signals can be used at any time in any combination to control the XS, even while MIDI note data is being received. Receiving MIDI data is the default way to play the XS. But when an analog voltage or gate signal is inserted into one of the control inputs it can either be selected to modulate a specific parameter, or in some cases will automatically override the control signal being generated by the internal MIDI to CV/Gate converter.

The CV IN input is routed to the CV Track control in the PITCH CONTROL section. This control determines which source Oscillator A and B will use to control their pitch.

In the **A B** position, both oscillators will be controlled by MIDI notes received.
In the **A BX** position, Oscillator A will respond to MIDI notes received, while Oscillator B will be controlled by an external voltage inserted into the CV IN jack.
In the **AX B** position, Oscillator A will be controlled by an external voltage inserted into the CV IN jack, while Oscillator B will be controlled by MIDI notes received.
In the **ABX** position, both oscillators will be controlled by an external voltage inserted into the CV IN jack.

Note: If no signal is inserted into the CV IN jack, and one or both of the oscillators are selected to use the external voltage, these oscillators will produce a stationary pitch, which can be useful for certain effects.

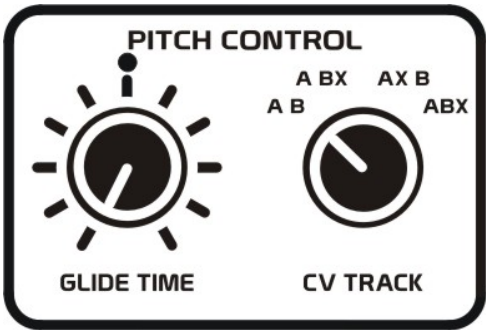
The GATE IN input is used to trigger the internal envelope circuits. Any time a cable is inserted into this jack, it will override MIDI triggering of the envelopes. Typically, you will want to use any logic gate signal ranging from 0 to +15 volts. Any voltage received higher than +1.5 volts will be considered as a Gate On, and any voltage less will be considered as a Gate Off. This input can also accept negative voltages without harming the unit, but if they do not exceed the +1.5 volt trip level, no gate will be produced.

TIP: With a trip point of +1.5 volts, you can also use audio signals to trigger the envelopes in the XS.

The VEL IN input is used to control the amplitude of both envelopes (depending on the velocity amount setting used for each), and can also be used to directly modify the pitch of Oscillator B and the pulse width duration of its square/pulse wave. Any time a cable is inserted into this jack, it will override the MIDI Velocity control voltages being generated to control these parameters. Typically, you will want to use any control voltage ranging from 0 to +10 volts as the VEL IN source, although input voltages can range from –15 to +15 volts without harming the unit.

TIP: Using Velocity control signals that swing both positive and negative can have interesting results. For instance, if the Velocity input goes negative and is controlling Envelope 1's amplitude, it will cause the output of this envelope to become inverted. However, negative control voltages applied to Envelope 2 (the amplifier) will not allow the amplifier to pass audio to the output during the negative period. If you do not desire this effect on the amplifier, simply turn down the Velocity control for the amplifier.

ANALOG CONTROLS



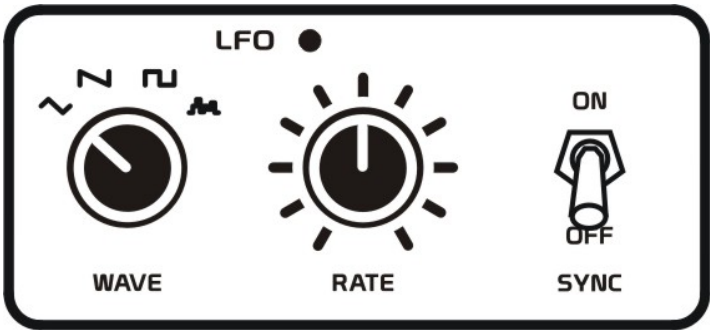
PITCH CONTROL
This section determines how the pitch control voltage affects the oscillators.

GLIDE TIME: If more than one note is played at a time by a MIDI controller or sequencer connected to the MIDI input of the XS, the XS will activate its internal glide circuit which will slew the voltage from one note to another at the rate set by this control. With this control rotated fully counter-clockwise, the glide time from one pitch to another will be instant, with no apparent slewing of pitch. The glide time will increase as you rotate this control in the clockwise direction.

CV TRACK: This control determines which source each oscillator will use to control its pitch.
In the **A B** position, both oscillators will be controlled by MIDI notes received.
In the **A BX** position, Oscillator A will respond to MIDI notes received, while Oscillator B will be controlled by an external voltage inserted into the CV IN jack.
In the **AX B** position, Oscillator A will be controlled by an external voltage inserted into the CV IN jack, while Oscillator B will be controlled by MIDI notes received.
In the **ABX** position, both oscillators will be controlled by an external voltage inserted into the CV IN jack.

Note: If no signal is inserted into the CV IN jack, and one or both of the oscillators are selected to use the external control voltage, these oscillators will produce a stationary pitch that can be useful for certain effects.

ANALOG CONTROLS



LOW FREQUENCY OSCILLATOR
A low frequency oscillator (LFO), is a modulation source whose frequency is generally below the range of human hearing. The LFO provides multiple waveshapes and a variable rate at which it can modify other parameters of a synthesizer. Common uses would be to add vibrato or tremolo to a sound, or to create slowly evolving sweeps or changes to parameter settings.

WAVE: This control selects one of four waveforms for the LFO, including triangle, sawtooth, square, and random shapes.

The TRIANGLE waveform provides a smooth linear rising/falling waveform, which is ideal for vibrato and tremolo effects.

The SAWTOOTH waveform provides a smooth linear falling waveform with a quickly rising edge. The effect of this waveform is similar to a decaying envelope with a fast attack.

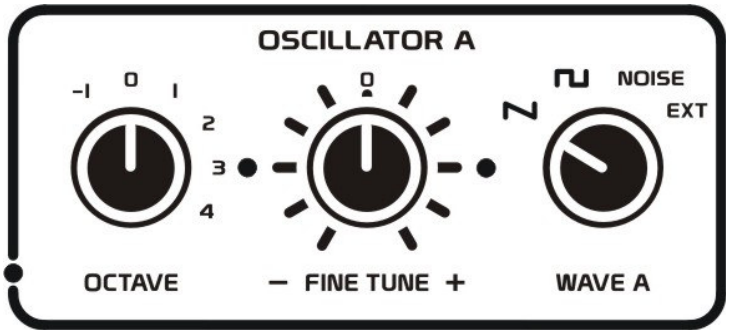
The SQUARE waveform has only two possible states: high or low. This may be useful for creating trill effects. In addition, the square waveform may also be used as a logical gate signal for triggering other circuits such as envelope generators, analog sequencers, or arpeggiators.

The RANDOM waveform will produce varying amplitudes of voltages at a rate which is once per every period of the other LFO waveshapes. This is useful when you wish to create sounds which are rather unpredictable, having parameters jump around to various settings.

RATE: The RATE control determines the frequency at which the LFO will produce its waveform. This control has two different modes of operation that are determined by the LFO SYNC switch.
When the LFO SYNC switch is in the OFF position, the LFO will be free running at variable rates from 4 seconds to 18 Hz. Rotate this control counter-clockwise for slower LFO rates, and clockwise for faster LFO rates. The LFO LED will flash on and off at the rate of oscillation.
When the LFO SYNC switch is in the ON position, the LFO will generate its waveform at defined divisions of a MIDI clock. There are 16 MIDI clock divisions in all, including 8 bars, 4 bars, 2 bars, 1 bar, 1/2, 3/8, 1/3, 1/4, 3/16, 1/6, 1/8, 3/32, 1/12, 1/16, 1/24, and 1/32 notes divisions.

In order to use the LFO MIDI SYNC function, make sure you have a MIDI sequencer or other MIDI clock source's MIDI OUT connected to the MIDI IN jack of the XS. You'll need to set up your MIDI sequencer to send MIDI clock/start/stop messages. When you first set the LFO SYNC switch to ON, your sequencer needs to send a MIDI start command in order for the LFO to start syncing. Adjusting the LFO's rate while the LFO is syncing can cause the LFO waveform to become out of phase. To resync the phase of the LFO waveform, simply send a new MIDI start message from your sequencer.

ANALOG CONTROLS



OSCILLATOR A
Oscillator A is one of the main audio sources in the XS, although it can also be used as a modulation source. This is a wide range, ultra-stable oscillator capable of generating frequencies from approximately 0.5 Hz to more than 100 kHz.

OCTAVE: This control is used to transpose Oscillator A through its different ranges. Zero is the default setting for this control. If we were to play note C2 on a MIDI keyboard and switch through the different octave ranges, we would find that the –1 setting produces 16.352 Hz, the 0 setting produces 32.703 Hz, the 1 setting produces 65.406 Hz, the 2 setting produces 130.81 Hz, the 3 setting produces 261.63 Hz, and the 4 setting produces 523.25 Hz. If we were to leave this octave setting in the 4 position, and play our highest MIDI note C7, we would find that this oscillator produces a frequency of 16,744.04 Hz or 16.74 kHz. As you can see, using just this octave control and a 5-octave keyboard, we can cover the frequency range of 16 Hz to 16 kHz. We will discuss later in the manual how to access this oscillator's full range.

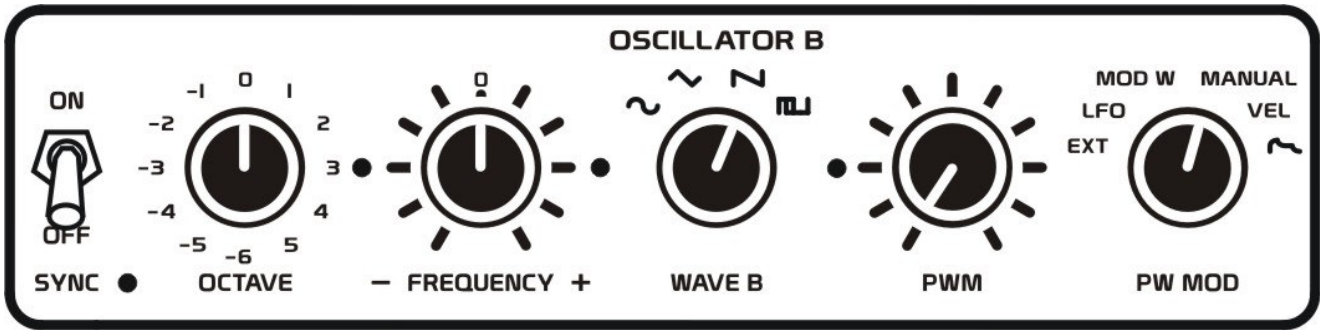
NOTE: When using an external control voltage to control the oscillator, MIDI note C2 = 0 volts, C3 = +1 volt, C4 = +2 volts, C5 = +3 volts, C6 = +4 volts, and C7 = +5 volts.
Therefore, with an octave setting of 0, if we input 0 volts into the CV IN jack, Oscillator A will produce a frequency of 32.703 Hz. If the CV IN voltage changes to +5 volts with the octave control changed to 4, Oscillator A will then produce a frequency of 16.74 kHz.

FINE TUNE +/-: This is the master fine tune control for both Oscillators A and B. When this control is set to its mid position marked with a "0" both oscillators should be in tune. This control covers a range of approximately 12 cents total, providing us with –6 to +6 cents in detuning. Rotating this control counter clockwise of the "0" mark will cause both oscillators to sound flat. Rotating this control clockwise of the "0" mark will cause both oscillators to sound sharp. You can use this control to match the pitch of the internal oscillators to an external reference if they are slightly out of tune with one another.

WAVE A: This control selects which waveshape will be used for Oscillator A. Although Oscillator A actually only generates the sawtooth and square waveforms which will track the playing of notes up and down a keyboard.

The SAWTOOTH setting selects Oscillator A's sawtooth waveform.
The SQUARE setting selects Oscillator A's square waveform, which has a 50% duty cycle.
The NOISE setting will select the internal white noise source, which contains an even amount of frequencies throughout the audio spectrum.
The EXT setting will select any external audio source that is inserted into the AUDIO IN jack.

ANALOG CONTROLS



OSCILLATOR B
Oscillator B is similar to Oscillator A in that it can be an audio source or a modulation source. This is a wide range, ultra-stable oscillator capable of generating frequencies from approximately 0.5 Hz to more than 100 kHz.

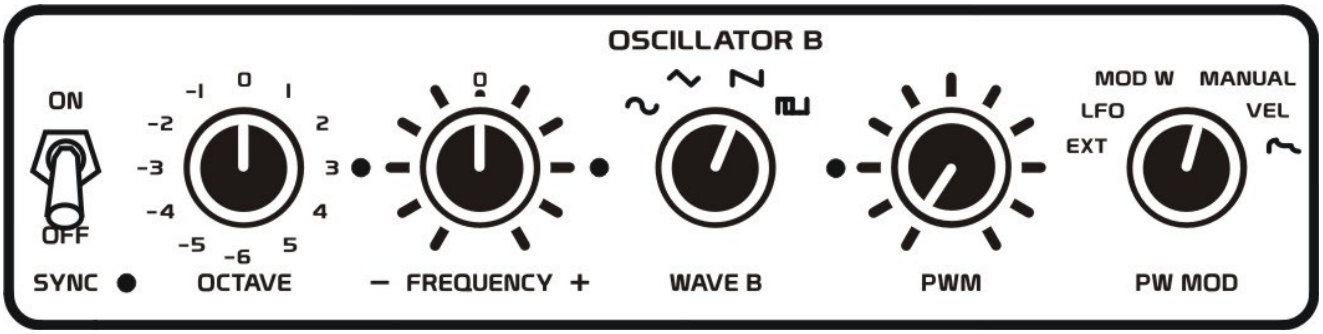
SYNC: Oscillator B has the ability to sync its waveform to the pitch that Oscillator A is producing. When this SYNC switch is in the ON position, every time Oscillator A's waveform goes through a positive transition (once every periodic cycle), it will force Oscillator B to start regenerating its waveform shape. This then will cause Oscillator B to start introducing new harmonics in each of its waveforms. In order to really hear this sync effect, however, you will want to make sure the frequency of Oscillator B is always higher than that set for Oscillator A. When the SYNC switch is set to the OFF position, Oscillator B will produce its four waveforms with their original harmonic content.

OCTAVE: This control is used to transpose Oscillator B through its different ranges. Zero is the default setting for this control. If we were to play note C2 on a MIDI keyboard and switch through the different octave ranges we would find that the –1 setting produces 16.352 Hz, the 0 setting produces 32.703 Hz, the 1 setting produces 65.406 Hz, the 2 setting produces 130.81 Hz, the 3 setting produces 261.63 Hz, the 4 setting produces 523.25 Hz, and the 5 setting produces 1,046.5 Hz. If we were to leave this octave control in the 5 setting, and play our highest MIDI note C7, we would find that this oscillator produces a frequency of 33,488.08 Hz or 33.48 kHz. As you can see, using just this octave control and a 5-octave keyboard, we can cover the frequency range of 16 Hz to 33 kHz. Octave settings from –2 to –6 will cause Oscillator B to generate frequencies below the audio range (as low as 0.5 Hz in frequency, or 2 seconds of time) when C2 is played on a MIDI keyboard. This is useful when using Oscillator B as a modulation source. In this way, Oscillator B acts more like a second LFO in the XS. The benefit of using Oscillator B as an LFO is that its frequency can either be stationary or can track pitches played on a keyboard.

Remember, the CV Track control in the PITCH CONTROL section can be used to determine whether Oscillator B's frequency will track notes played on a keyboard or remain at a stationary frequency.

NOTE: When using an external control voltage to control the oscillator, MIDI note C2 = 0 volts, C3 = +1 volt, C4 = +2 volts, C5 = +3 volts, C6 = +4 volts, and C7 = +5 volts.
Therefore, with an octave setting of 0, if we input 0 volts into the CV IN jack, Oscillator B will produce a frequency of 32.703 Hz. If the CV IN voltage changes to +5 volts with the octave control changed to 5, Oscillator B will then produce a frequency of 33.48 kHz.

ANALOG CONTROLS



FREQUENCY +/-: This control allows Oscillator B's frequency to be offset approximately –9 to +9 semitones from Oscillator A. When this control is set to its mid position marked with a "0", Oscillator B should be in tune with Oscillator A (as long as nothing is selected to modulate the frequency of either oscillator). Rotating this control counter clockwise of the "0" mark will decrease Oscillator B's frequency. Rotating this control clockwise of the "0" mark will increase Oscillator B's frequency. You can use this control to create everything from slight oscillator detuning for that "phat" chorus/flanging sound, or also to create chord intervals between each oscillator.

WAVE B: This control selects which waveshape will be used for Oscillator B. As you can see Oscillator B generates four waveshapes being the sine, triangle, sawtooth, and square/pulse waveforms.

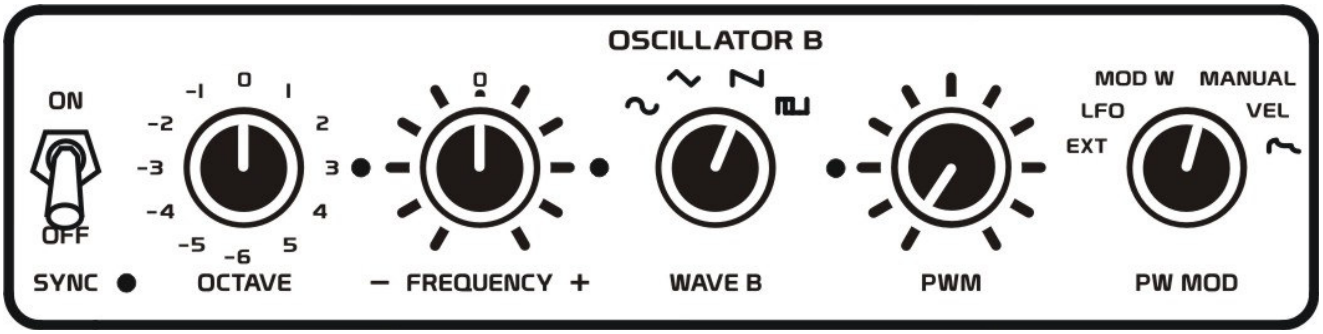
A SINE wave (the one that looks like an S turned sideways) is the most basic waveform, having only a fundamental frequency and no additional harmonics. Sine waves sound very thin and are pure in sound.

A TRIANGLE waveform contains a fundamental frequency and all odd harmonics (3rd, 5th, 7th, and so on) of that frequency. This causes it to sound slightly fuller than a sine wave.

The SAWTOOTH waveform is one of the most complex shapes, which contains a fundamental frequency and all harmonics of that frequency. Sawtooth waves are very full sounding and have a unique raspy quality to them.

A SQUARE wave also contains a fundamental frequency and all odd harmonics of that frequency; the difference between it and a triangle waveform is that the harmonics are more pronounced in the square wave, giving it a somewhat hollow yet fuller sound than the triangle. In the XS, the duty cycle of this square wave can also be varied to create what is known as a square/pulse waveform. The width of this pulse alters the harmonic content of the waveform, and this is determined by the PWM control. Consider the true square wave whose pulse is 1/2 the period of the waveform. We know that the 2nd harmonic and its multiples have been eliminated leaving only the odd harmonics. Let's say the pulse width is changed to 1/3 the period, which then eliminates the 3rd harmonic and its multiples such as the 6th, 9th, and 12th harmonics. A pulse width of 1/4 the period would then eliminate the 4th, 8th, and 12th harmonics.

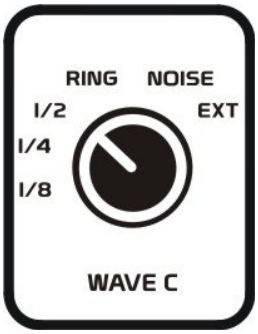
ANALOG CONTROLS



PULSE WIDTH MODULATION AMOUNT: The PWM control sets the amount of modulation that the PW MOD source will have on Oscillator B's square/pulse waveform. When this control is rotated fully counter-clockwise, no modulation of the square/pulse wave will occur producing a true square wave. As you rotate this control clockwise, the affect of modulation will increase, causing the square wave to narrow its pulse width duration.
All of the modulation sources pre-wired in the PW MOD control will have a range of 0 to +10 volts. This allows these sources to vary the pulse width duration from 50% duty cycle to 3% duty cycle. When the modulation source is 0 volts a true square wave will be produced. As the modulation source voltage becomes more positive (up to +10 volts) the pulse width duration will decrease. The exception here is that an external modulation source that goes in the negative voltage range could also be used, causing this pulse width duration to increase its duty cycle. The useable range for these external modulation sources would be –10 to +10 volts.

PULSE WIDTH MODULATION SOURCE: The PW MOD control selects which modulation source will be used to alter the pulse width duration of Oscillator B's square/pulse wave. A control voltage source that varies its voltage over time can be used to animate the harmonic content of the square/pulse waveform.
In the EXT position, any external control voltage connected to the OSC MOD input jack can be used to modulate the pulse width. Keep in mind that the useful range for this external control voltage would be –10 to +10 volts.
The LFO setting will route the internal LFO to modulate the pulse width duration.
The MOD W setting will route the mod wheel messages from a MIDI keyboard to modulate the pulse width duration.
The MANUAL setting is an internal +10 volt stationary reference. When this is selected, the PWM control is used to manually adjust the pulse width duration.
The VEL setting will route Velocity messages from a MIDI keyboard to modulate the pulse width duration. The exception here is that if an external control voltage is inserted into the VEL IN jack, this external control voltage will override Velocity messages received from the MIDI keyboard.
The ENVELOPE setting selects Envelope 1 to modulate the pulse width duration.

ANALOG CONTROLS



WAVE C
Wave C can be used as an audio source or a modulation source. Consider this more of an accessory module to Oscillator A and B. This control provides three sub oscillators, a ring modulator, white noise source, and access to any external audio source.

The 1/8 setting will select a square wave sub oscillator, which will be one eighth the frequency (or 3 octave below) the frequency of Oscillator B.
The 1/4 setting will select a square wave sub oscillator, which will be one fourth the frequency (or 2 octave below) the frequency of Oscillator B.
The 1/2 setting will select a square wave sub oscillator, which will be half the frequency (or 1 octave below) the frequency of Oscillator B.

TIP: Modulating the frequency of Oscillator B, can also affect the frequency of these sub oscillator waveforms. The result can sometimes sound like the sub oscillators are syncing their frequencies, jumping from one tone to another for interesting results.

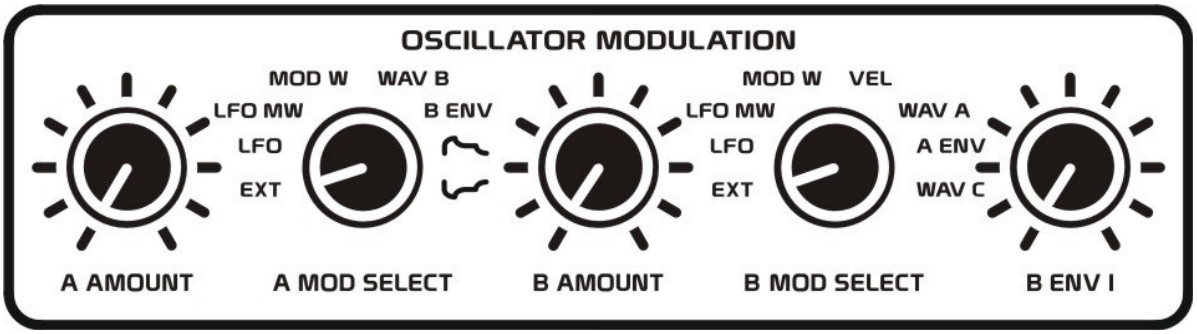
The RING setting will select the output of the ring modulator. A ring modulator takes two different input signals, determines the sum and difference of their frequencies, and outputs the results to create new harmonic combinations. By default one input of the ring modulator is determined by the waveform selected with the WAVE A control for Oscillator A. The other input of the ring modulator is determined by the waveform selected with the WAVE B control for Oscillator B. If you wish to ring modulate an external audio signal, insert it into the AUDIO IN jack, select EXT with the WAVE A control, and select the modulation waveform with the WAVE B control.

TIP: Ring modulating an external audio source such as a person talking can add sci-fi like effects to the voice. Try using the sine wave for Oscillator B as the modulation source, which will be more transparent, and play Oscillator B up and down the keyboard range to create pseudo pitch-shifting effects.

The NOISE setting will select the internal white noise source, which contains an even amount of frequencies throughout the audio spectrum.

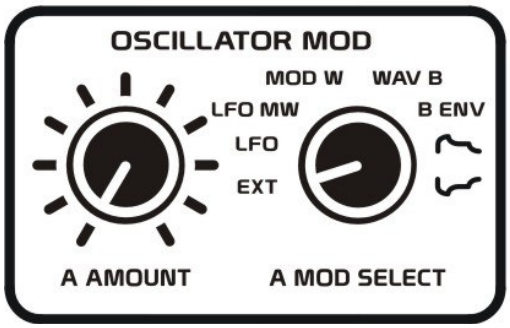
The EXT setting will select any external audio source which is inserted into the AUDIO IN jack.

ANALOG CONTROLS



OSCILLATOR MODULATION

The oscillator modulation section is used to route internal and external modulation sources to modify the frequency of Oscillators A and B. With these sources one can create numerous effects such as vibrato, FM, cross-modulation, self-modulation, pitch sweeping, and more. When oscillators are modulated with an audio range source, this FM effect can alter a waveforms harmonic content quite drastically for new timbral possibilities.



OSCILLATOR A MODULATION

The A AMOUNT and A MOD SELECT controls are used to modulate the frequency of Oscillator A. The A AMOUNT control sets the amount of modulation that the A MOD SELECT source will have on Oscillator A's frequency. When this control is rotated fully counter-clockwise, no modulation will occur. As you rotate this control clockwise, the amount of modulation will increase.

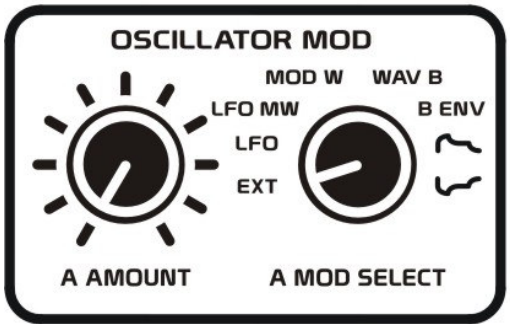
The A MOD SELECT control selects which modulation source will be used to alter the frequency of Oscillator A.

In the EXT position, any external control voltage connected to the OSC MOD input jack can be used to modulate the frequency of Oscillator A. Keep in mind that positive control voltage will increase the oscillator's frequency, while negative control voltages will decrease the oscillator's frequency.

The LFO setting will route the internal LFO to modulate Oscillator A. This LFO waveform will range from –5 to +5 volts, causing Oscillator A's frequency to rise about and fall below the normal frequency for a note. You can use this to create vibrato-like effects.

The LFO MW setting lets the mod wheel messages from a MIDI keyboard control the amplitude of LFO signal used to modulate Oscillator A's frequency. In this way, one could record mod wheel messages into a MIDI sequencer to animate the effect the LFO will have on Oscillator A's frequency.

ANALOG CONTROLS



The MOD W setting will route the Mod Wheel messages from a MIDI keyboard to modulate Oscillator A's frequency. With your mod wheel set to 0, there will be no affect on Oscillator A's pitch. Increasing the value of your mod wheel will cause Oscillator A's frequency to increase accordingly.

The WAV B setting routes Oscillator B's waveform, as determined by the WAVE B control setting, to modulate the frequency of Oscillator A. Use this to create direct FM sounds when Oscillator B is in its audio range, or more traditional vibrato effects when Oscillator B is producing frequencies below the audio range. Note that all of Oscillator B's waveforms range from –5 to +5 volts, causing Oscillator A's frequency to rise above and fall below the normal frequency for a note's pitch.

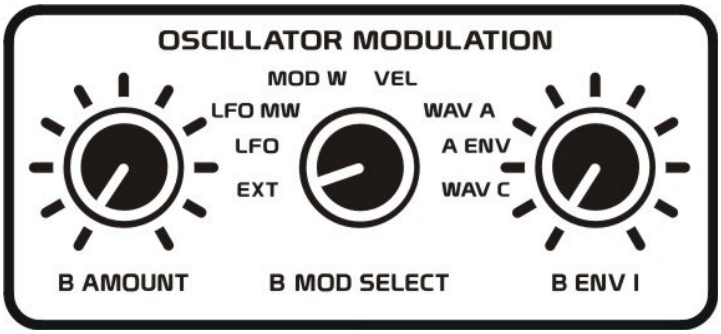
The B ENV setting lets Envelope 1 control the amplitude of Oscillator B's waveform, as determined by the WAVE B control setting, to modulate Oscillator A's frequency. This provides a more traditional form of FM where the modulation source varies its amplitude over time.

The + ENVELOPE setting selects the positive polarity of Envelope 1 to sweep the frequency of Oscillator A. Since envelope 1 has a range of 0 to +10 volts, this will cause Oscillator A's frequency to rise above the normal frequency for a note's pitch.

The - ENVELOPE setting selects an inverted polarity of Envelope 1 to sweep the frequency of Oscillator A. Although Envelope 1 is now inverted it is also level-shifted keeping it in the 0 to +10 volts range just as the positive polarity envelope. This will cause Oscillator A's frequency to rise above the normal frequency for a note's pitch.

NOTE: Most traditional synthesizers with a negative polarity envelope would have a range of say 0 to –10 volts. The problem with this is if Oscillator A is our main audio source covering the entire audio range, if we begin applying negative voltages to the frequency of an oscillator, the pitch can be easily pushed below the audio range making it useless as an audio source. Instead the XS keeps its inverted envelope in the same voltage range as the positive polarity envelope to keep this oscillator within the usable audio range.

ANALOG CONTROLS



OSCILLATOR B MODULATION

The B AMOUNT, B MOD SELECT, and B ENV 1 controls are used to modulate the frequency of Oscillator B.

The B AMOUNT control sets the amount of modulation that the B MOD SELECT source will have on Oscillator B's frequency. When this control is rotated fully counter-clockwise, no modulation will occur. As you rotate this control clockwise, the amount of modulation will increase.

The B MOD SELECT control selects which modulation source will be used to alter the frequency of Oscillator B.

In the EXT position, any external control voltage connected to the OSC MOD input jack can be used to modulate the frequency of Oscillator B. Keep in mind that positive control voltage will increase the oscillator's frequency, while negative control voltages will decrease the oscillator's frequency.

The LFO setting will route the internal LFO to modulate Oscillator B. This LFO waveform will range from –5 to +5 volts, causing Oscillator B's frequency to rise above and fall below the normal frequency for a note's pitch. You can use this to create vibrato-like effects.

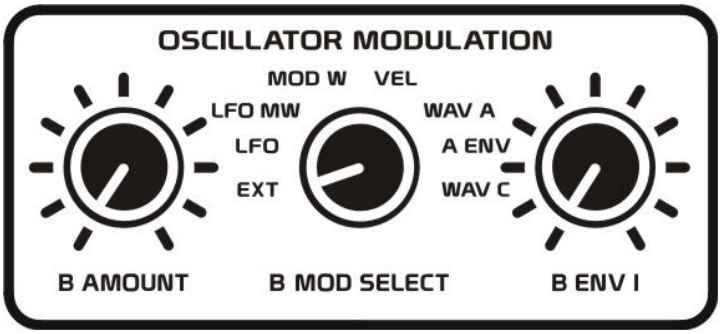
The LFO MW setting lets the Mod Wheel messages from a MIDI keyboard control the amplitude of LFO signal used to modulate Oscillator B's frequency. In this way, one could record Mod Wheel messages into a MIDI sequencer to animate the effect the LFO will have on Oscillator B's frequency.

The MOD W setting will route the Mod Wheel messages from a MIDI keyboard to modulate Oscillator B's frequency. With your mod wheel set to 0, there will be no affect on Oscillator B's pitch. Increasing the value of your mod wheel will cause Oscillator B's frequency to increase accordingly.

The VEL setting will route Velocity messages from a MIDI keyboard to modulate the frequency of Oscillator B. The exception here is that if an external control voltage is inserted into the VEL IN jack, this external control voltage will override Velocity messages received from the MIDI keyboard.

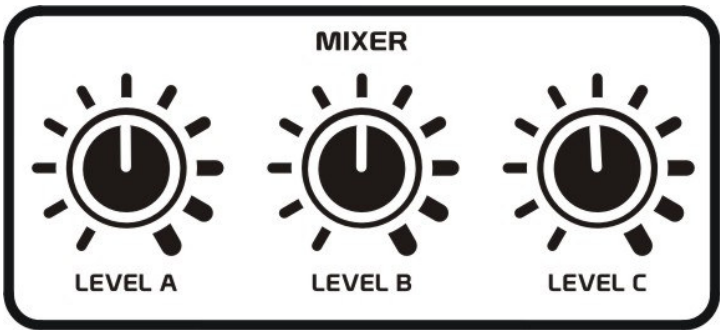
The WAV A setting routes Oscillator A's waveform, as determined by the WAVE A control setting, to modulate the frequency of Oscillator B. Use this to create direct FM sounds. Note that all of Oscillator A's waveforms, including white noise range from –5 to +5 volts, causing Oscillator B's frequency to rise above and fall below the normal frequency for a note's pitch.

ANALOG CONTROLS



The A ENV setting lets Envelope 1 control the amplitude of Oscillator A's waveform, as determined by the WAVE A control setting, to modulate Oscillator B's frequency. This provides a more traditional form of FM where the modulation source varies its amplitude over time.

The B ENV 1 control sets the amount of pitch sweep that Envelope 1 will have on Oscillator B's frequency. When this control is rotated fully counter-clockwise, no pitch sweep will occur. As you rotate this control clockwise, the amount of pitch sweep will increase. Since Envelope 1 has a range of 0 to +10 volts, this will cause Oscillator B's frequency to rise above the normal frequency for a note's pitch.



MIXER

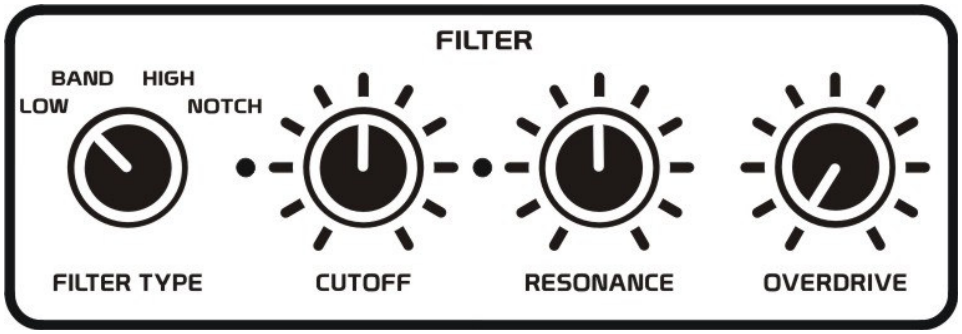
The XS provides a three-channel audio mixer for combining different audio sources that will be routed to the input of the filter section. In addition to summing these audio signals going to the filter, the mixer also allows you to overdrive the input of the filter section. Notice how the tick marks around the mixer controls become increasingly thicker in appearance. This is to indicate where overdriving the filter input will occur. If you are using a single audio source routed to the filter, you will typically want to set the mixer level somewhere between the middle tick mark to two ticks to the right of the middle position to provide the best signal-to-noise ratio and to maintain full resonance response in the filter. As you add more audio sources to the mix you may need to decrease each part's level to maintain full resonance response in the filter. The harder you drive the input of the filter, the less noticeable effect filter resonance will have.

LEVEL A: This control determines the amount of signal selected by the WAVE A control to be sent to the filter.

LEVEL B: This control determines the amount of signal selected by the WAVE B control to be sent to the filter.

LEVEL C: This control determines the amount of signal selected by the WAVE C control to be sent to the filter.

ANALOG CONTROLS



FILTER

The most common way to alter the harmonic content of a sound is by using a filter. The XS provides a 12 dB filter with four filter types including lowpass, highpass, bandpass, and notch responses. There is also a cutoff control for determining the frequency of the filter and a resonance control for accentuating these frequencies. In addition, the filter has a dedicated overdrive section at its output for adding that essential extra crunch we love so much!

FILTER TYPE: The filter type control selects one of four possible filter responses to determine how the filter will attenuate certain frequencies of a sound.

The LOW setting selects the lowpass filter, where low frequencies are allowed to pass through the filter while higher frequencies are attenuated.

The BAND setting selects the bandpass filter, where only the frequencies closest to the filter's cutoff frequency are allowed to pass through the filter, while attenuating all frequencies higher and lower than the cutoff frequency.

The HIGH setting selects the highpass filter, where only the high frequencies are allowed to pass through the filter while the lower frequencies are attenuated.

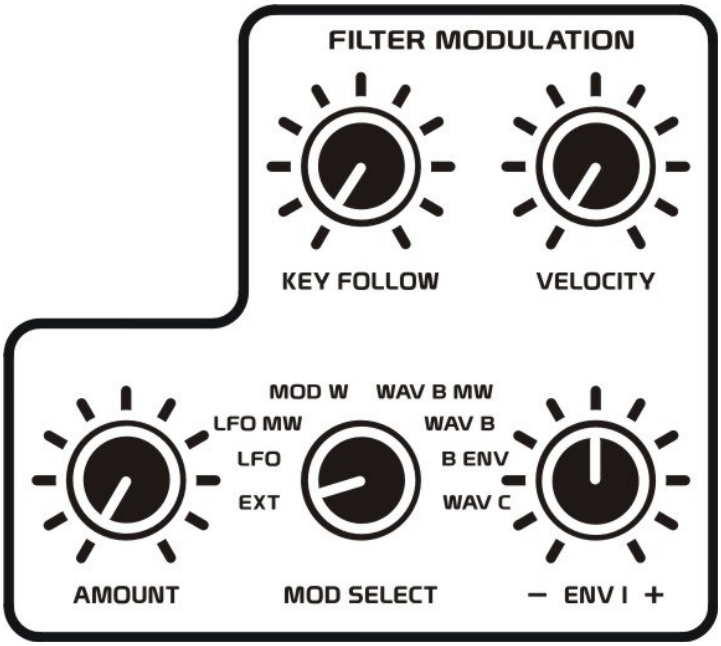
The NOTCH setting selects the notch filter, where harmonics closest to the cutoff frequency are attenuated while all other harmonics are allowed to pass through the filter.

CUTOFF: The cutoff control determines the point at which frequencies are attenuated by the filter. The filter cutoff range is approximately 5 Hz to 18 kHz. Rotate this control counter-clockwise to select lower frequency settings, or clockwise to select higher frequency settings for the filter. In addition to this control, you can also use modulation sources to animate the filter's cutoff frequency, which will be described in more detail under the Filter Modulation section of the manual.

RESONANCE: The resonance control is used to increase or accentuate those frequencies closest to the cutoff frequency set for the filter. When this control is rotated fully counter-clockwise, no resonance will occur in the filter. By rotating this control clockwise more resonance will be introduced into the filter, with the highest setting causing the filter to self-oscillate. When the filter self-oscillates it will produce a pure sine wave tone that can be used as an audio source.

OVERDRIVE: The overdrive control clips the output of the filter in a unique way to provide harmonically rich tones. When this control is rotated fully counter clockwise, sounds will pass cleanly through the filter without any distortion. Rotate this control clockwise to increase the amount of distortion. *Note the amount of signal being sent to the filter's input will also affect the overdrive tone produced.*

ANALOG CONTROLS



FILTER MODULATION
The filter modulation section of the XS provides a way to animate the cutoff frequency of the filter.

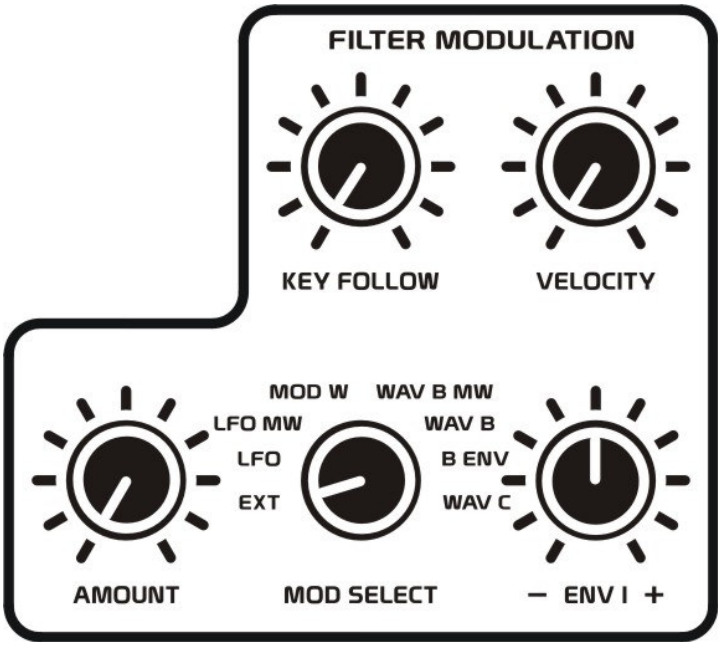
KEY FOLLOW: The key follow control allows the filter cutoff frequency to track the pitch of notes received from a MIDI keyboard, when this control is rotated fully clockwise. With this control rotated fully counter clockwise, no key tracking will occur.

TIP: The key follow control can also be useful when the filter is set to self-oscillate, producing a sine wave, so then you can play the frequency that the filter is generating. Although the pitch tracking of the filter is not nearly as precise as your typical oscillator, for the most part, it will track decently over a three octave range.

VELOCITY: The velocity control will determine the amount of effect that Velocity messages from a MIDI keyboard will have when attenuating the amplitude of Envelope 1 routed to sweep the filter's cutoff frequency. The exception here is that if an external control voltage is inserted into the VEL IN jack, this external control voltage will override Velocity messages received from the MIDI keyboard. When this control is rotated fully counter-clockwise, Velocity will have no effect on Envelope 1's overall amplitude. When this control is rotated clockwise, the amount of effect that Velocity has on Envelope 1's amplitude will increase. Therefore, higher Velocity values will generate larger envelope sweeps, while lower Velocity settings will generate smaller envelope sweeps.

TIP: Using external Velocity control signals that swing both positive and negative can have interesting results. For instance, if the Velocity input goes negative and is controlling Envelope 1's amplitude, it will cause the output of this envelope to become inverted. However, negative control voltages applied to Envelope 2 (the amplifier) will not allow the amplifier to pass audio to the output during the negative period. If you do not desire this effect on the amplifier, simply turn down the Velocity control for the amplifier.

ANALOG CONTROLS



AMOUNT: The amount control sets the amount of modulation that the MOD SELECT source will have on the filter's cutoff frequency. When this control is rotated fully counter-clockwise, no modulation will occur. As you rotate this control clockwise, the amount of modulation will increase.

MOD SELECT: The mod select control selects which modulation source will be used to alter the cutoff frequency of the filter.

In the EXT position, any external control voltage connected to the FILTER MOD input jack can be used to modulate the cutoff frequency of the filter. Keep in mind that positive control voltage will increase the filter's frequency, while negative control voltages will decrease the filter's frequency.

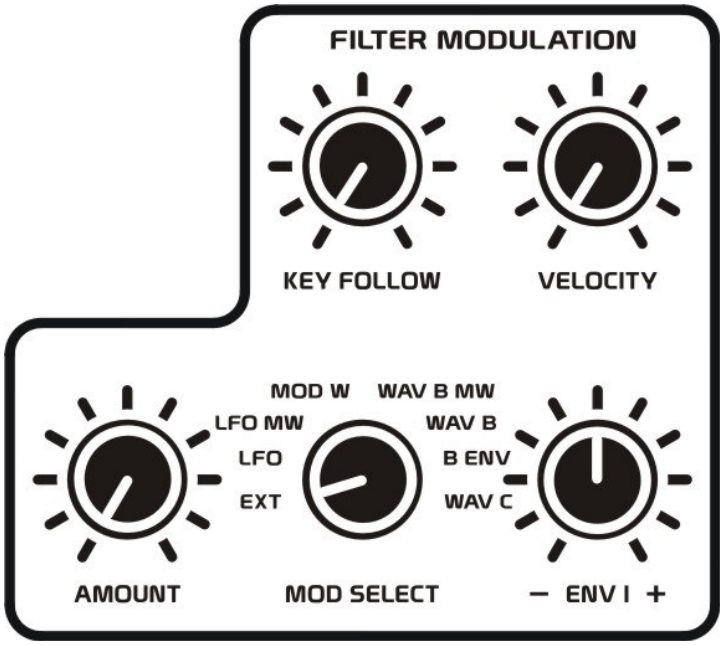
The LFO setting will route the internal LFO to modulate the filter's cutoff frequency. This LFO waveform will range from –5 to +5 volts, causing the filter's frequency to rise above and fall below the normal frequency for the filter set by the cutoff control. You can use this to create slow or fast sweeping type effects.

The LFO MW setting lets the Mod Wheel messages from a MIDI keyboard control the amplitude of LFO signal used to modulate the filter's cutoff frequency. In this way, one could record Mod Wheel messages into a MIDI sequencer to animate the effect that the LFO will have on the filter's frequency.

The MOD W setting will route the Mod Wheel messages from a MIDI keyboard to modulate the filter's cutoff frequency. With your mod wheel set to 0, there will be no affect on the filter's frequency. Increasing the value of your mod wheel will cause the filter's frequency to increase accordingly.

The WAVE B MW setting lets the mod wheel messages from a MIDI keyboard control the amplitude of WAVE B's signal which is used to modulate the filter's cutoff frequency. In this way, one could record Mod Wheel messages into a MIDI sequencer to animate the effect that WAVE B's waveform will have on the filter's frequency.

ANALOG CONTROLS



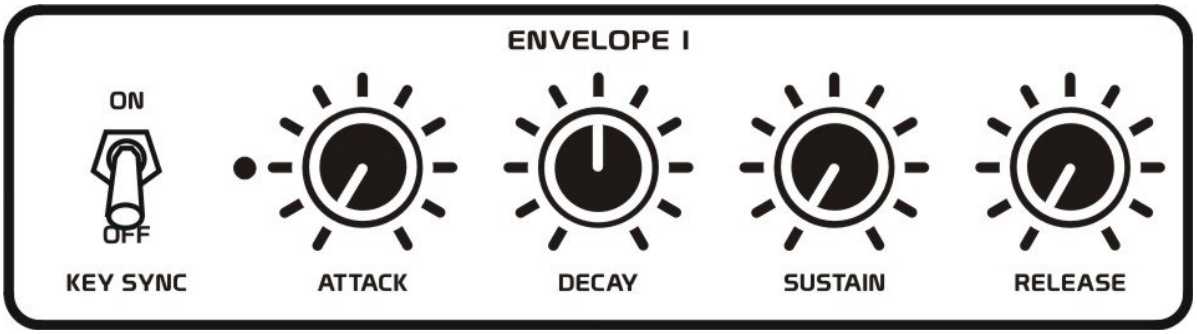
The WAV B setting routes Oscillator B's waveform, determined by the WAVE B control setting, to modulate the filter's cutoff frequency. Use this to create direct FM modulations when Oscillator B is in its audio range, or to create slower sweeping effects when Oscillator B is producing frequencies below the audio range. Note that all of Oscillator B's waveforms range from –5 to +5 volts, causing the filter's frequency to rise above and fall below the filter frequency set by the filter's cutoff control.

The B ENV setting lets Envelope 1 control the amplitude of Oscillator B's waveform, determined by the WAVE B control setting, to modulate the filter's cutoff frequency. This provides a more complex form of FM where the modulation source varies it's amplitude over time.

The WAV C setting routes the waveform selected with the WAVE C control to modulate the filter's cutoff frequency. This allows you to modulate the filter's cutoff frequency with any of the sub oscillators, the ring modulator, the white noise source, or any external audio which is inserted into the AUDIO IN jack.
Note that the ring modulator and the white noise source waveforms range from –5 to +5 volts, causing the filter's frequency to rise above and fall below the filter frequency set by the filter's cutoff control, while all three sub oscillator waveforms have a 0 to +15 volt range. When the sub oscillators are selected for WAVE C and are modulating the filter's cutoff frequency, the filter frequency will become higher than that set with the filter's cutoff control.

ENV 1 -/+: The ENV 1 control sets the amount of sweep that Envelope 1 will have on the filter's cutoff frequency. This control provides both positive and negative polarity envelope shapes to sweep the filter's frequency. With this control set to it middle position, Envelope 1 will have no effect on the filter's frequency. When this control is rotated counter-clockwise of the middle position negative polarity envelope sweeps will occur. When this control is rotated clockwise of the middle position, positive polarity envelope sweeps will occur. Since both positive and negative polarity envelope shapes have a range of 0 to +10 volts, this will cause the filter's frequency to always rise above the normal frequency set with the filter's cutoff control. This keeps both envelope polarities within the same usable range to eliminate unnecessary adjustments of the filter's cutoff frequency as is typical with most synthesizers.

ANALOG CONTROLS



ENVELOPE 1
An envelope generator is designed to accurately and repetitively sweep sound parameters such as pitch, tone or amplitude in a way which would be physically impossible for human hands to do.
Envelope 1 is the main modulation envelope in the XS. It can be used to modulate the frequency of the internal oscillators and filter, as well as control external devices.
Envelope 1 is similar to a typical ADSR type envelope, with the addition of our unique accent envelope times which will be described in more detail in the ACCENT section of this manual. This envelope has a range of 0 to +10 volts. The Envelope 1 LED will light to indicate every time a note is being played.

KEY SYNC: When this switch is set to the ON position, each time a new note is played on your MIDI keyboard, the envelope will start regenerating the attack portion of its shape from 0 volts. The exception to this is that if a logic gate signal is inserted into the GATE IN jack, this logic signal will override Note On/Off messages coming from your MIDI keyboard, and instead will use this external gate signal to trigger the envelopes in the XS. When this switch is set to the OFF position, the attack portion of the envelope will start at whatever amplitude the envelope is currently at when a new note is played.

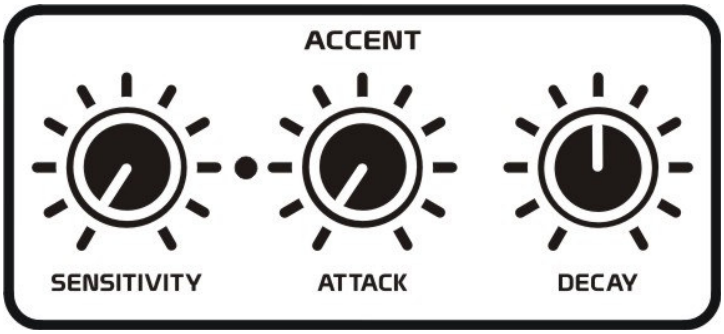
ATTACK: The attack control determines the rate at which the envelope will transition from its current amplitude to +10 volts. This attack time can vary from 0.5 milliseconds to 4 seconds. When this control is rotated fully counter-clockwise, the fastest attack time will occur. Rotate this control clockwise to increase the attack time.
Ideally the attack portion of the envelope will begin at 0 volts, unless a note was recently played and the envelope has not yet fully decayed to 0 volts.

DECAY: Once the attack portion of the envelope has reached +10 volts, the DECAY control determines the rate at which the envelope will transition from this +10 volt level to the amplitude set by the sustain control. This decay time can vary from 2 milliseconds to 10 seconds. When this control is rotated fully counter-clockwise, the fastest decay time will occur. Rotate this control clockwise to increase the decay time.

SUSTAIN: The sustain control determines the level that the envelope will decay to as long as a note is currently being played. This level can range from 0 to +10 volts. Rotate this control fully counter-clockwise for the minimum sustain level. As you rotate this control clockwise the sustain level will increase.

RELEASE: The release control determines the rate at which the envelope will transition from the envelope's current level to 0 volts when a note is released from playing. When this control is rotated fully counter-clockwise the fastest release time will occur. Rotate this control clockwise to increase the release time.

ANALOG CONTROLS



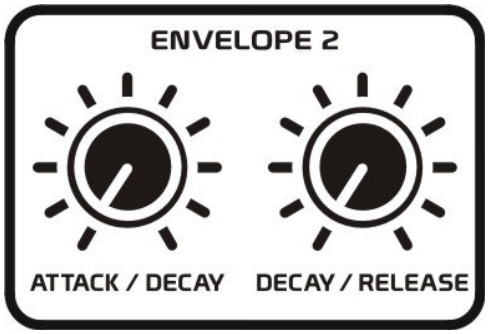
ACCENT
The accent section determines how Velocity messages received from a MIDI keyboard will affect the envelopes in the XS. The exception here is that if an external control voltage is inserted into the VEL IN jack, this external control voltage will override Velocity messages received from the MIDI keyboard, allowing the external control voltages to trigger the accent circuit instead.
This accent section provides additional attack and decay times for Envelope 1, and a sensitivity control that determines at what level will the Velocity make both Envelopes 1 and 2 use their accent times instead of their normal times.

SENSITIVITY: The sensitivity control determines what level of Velocity will activate the accent envelope times. When the sensitivity control is rotated fully counter-clockwise, no internal Velocity value will be great enough to make the envelopes use their accent times. The exception here is that if an external control voltage is inserted into the VEL IN jack, and this signal goes higher than +10 volts it could still activate the accent envelope times. When the sensitivity control is rotated fully clockwise, all internal Velocity values will cause the envelopes to use their accent times. The exception here is if an external control voltage is inserted into the VEL IN jack, and this signal goes more negative than 0 volts it could cause the envelopes to use their normal times instead.
Settings of the sensitivity control other than the extreme high or low values will cause the certain lower Velocity values to trigger the normal envelope times while higher Velocity values will trigger the accent envelope times.
When a Velocity value exceeds the sensitivity threshold, the accent LED indicator will light to show that the accent decay times are currently being used for Envelopes 1 and 2.

ATTACK: The attack control determines the rate at which the envelope will transition from its current amplitude to +10 volts when the accent section is activated by Velocity. This attack time can vary from 0.5 milliseconds to 4 seconds. When this control is rotated fully counter-clockwise, the fastest attack time will occur. Rotate this control clockwise to increase the attack time.
Ideally, the attack portion of the envelope will begin at 0 volts, unless a note was recently played and the envelope has not yet fully decayed to 0 volts.

DECAY: Once the attack portion of the envelope has reach +10 volts, the DECAY control determines the rate at which the envelope will transition from this +10 volt level to the amplitude set by the sustain control when the accent section is activated by Velocity. This decay time can vary from 2 milliseconds to 10 seconds. When this control is rotated fully counter-clockwise the fastest decay time will occur. Rotate this control clockwise to increase the decay time.

ANALOG CONTROLS



ENVELOPE 2
The XS provides four envelope types to help shape the amplitude of a sound passing through the amplifier.
These envelope types include attack/decay, attack/sustain/release, accented decay/sustain/release, and accented decay/normal decay. Only two controls, however, are required to set these various envelope times.

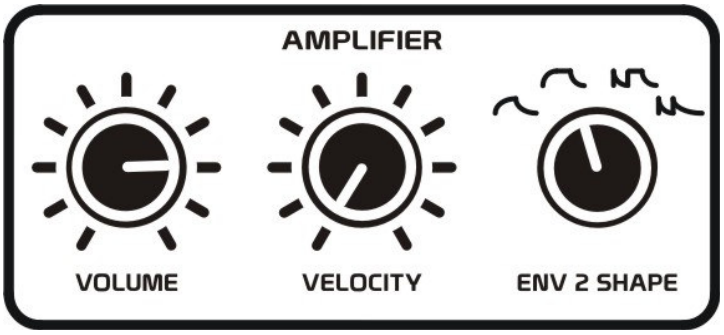
ATTACK/DECAY: The attack/decay control determines the rate at which the envelope will transition from its current amplitude to +10 volts, when the attack/decay or attack/sustain/release envelope types are selected in the amplifier section. This attack time can vary from 1 milliseconds to 4 seconds.
If the accented decay/sustain/release or accented decay/normal decay envelope types are selected in the amplifier section, this control will then determine the accented rate at which the envelope will decay to 0 volts. This decay time can vary from 3 milliseconds to 7 seconds.
When this control is rotated fully counter-clockwise, the fastest attack or decay time will occur depending on the envelope type selected. Rotate this control clockwise to increase the attack or decay time depending on the envelope type selected.
Ideally the attack portion of the envelope will begin at 0 volts, unless a note was recently played and the envelope has not yet fully decayed to 0 volts.

DECAY/RELEASE: The decay/release control determines the rate as which the envelope will decay from its current level to 0 volts, when the attack/decay or attack/sustain/release envelope types are selected in the amplifier section. *NOTE: the sustain level is always +10 volts; however, if the attack portion of the envelope has not yet reached +10 volts, the envelope will start decaying from whatever level the envelope is currently at.*

If the accented decay/sustain/release or accented decay/normal decay envelope types are selected in the amplifier section, this control will then determine the accented rate at which the envelope will decay from +10 to 0 volts. This decay time can vary from 3 milliseconds to 7 seconds.
When this control is rotated fully counter-clockwise the fastest decay or release time will occur depending on the envelope type selected. Rotate this control clockwise to increase the decay or release time depending on the envelope type selected.

NOTE: The SENSITIVITY control in the ACCENT section determines when both Envelopes 1 and 2 will use their accent envelope times. However only two envelope types for the amplifier use these accented envelope times. These envelopes are the accented decay/sustain/release, and accented decay/normal decay type envelopes.

ANALOG CONTROLS



AMPLIFIER

The amplifier is used to shape the overall volume or amplitude of a sound.
The XS provides four envelope types to help shape the amplitude of sounds passing through the amplifier.
These envelope types include attack/decay, attack/sustain/release, accented decay/sustain/release, and accented decay/normal decay. The amplifier's envelopes are also Velocity sensitive to add dynamic expression to your playing.

VOLUME: The volume control determines the overall level of audio sent to the MAIN OUT jack. Adjust this control for maximum output level to your mixer or audio system.

VELOCITY: The velocity control will determine the amount of effect Velocity messages from a MIDI keyboard will have on the overall amplitude of Envelope 2 controlling the amplifier. The exception here is that if an external control voltage is inserted into the VEL IN jack, this external control voltage will override Velocity messages received from the MIDI keyboard.
When this control is rotated fully counter-clockwise, Velocity will have no effect on the Envelope 2's amplitude. When this control is rotated clockwise, the amount of effect Velocity has on Envelope 2's amplitude will increase. Therefore, higher Velocity values will generate slightly higher than normal envelope levels, while lower Velocity settings will generate smaller envelope levels.

TIP: Using external Velocity control signals which swing both positive and negative can have interesting results. Negative Velocity control voltages applied to Envelope 2 (the amplifier) will not allow the amplifier to pass audio to the output during the negative period of a control voltage. If you do not desire this effect on the amplifier, simply turn down the Velocity control for the amplifier. On the other hand, you could insert a modulation source such as the LFO OUT signal into the VEL IN jack and have the amplifier create tremolo-like effects.

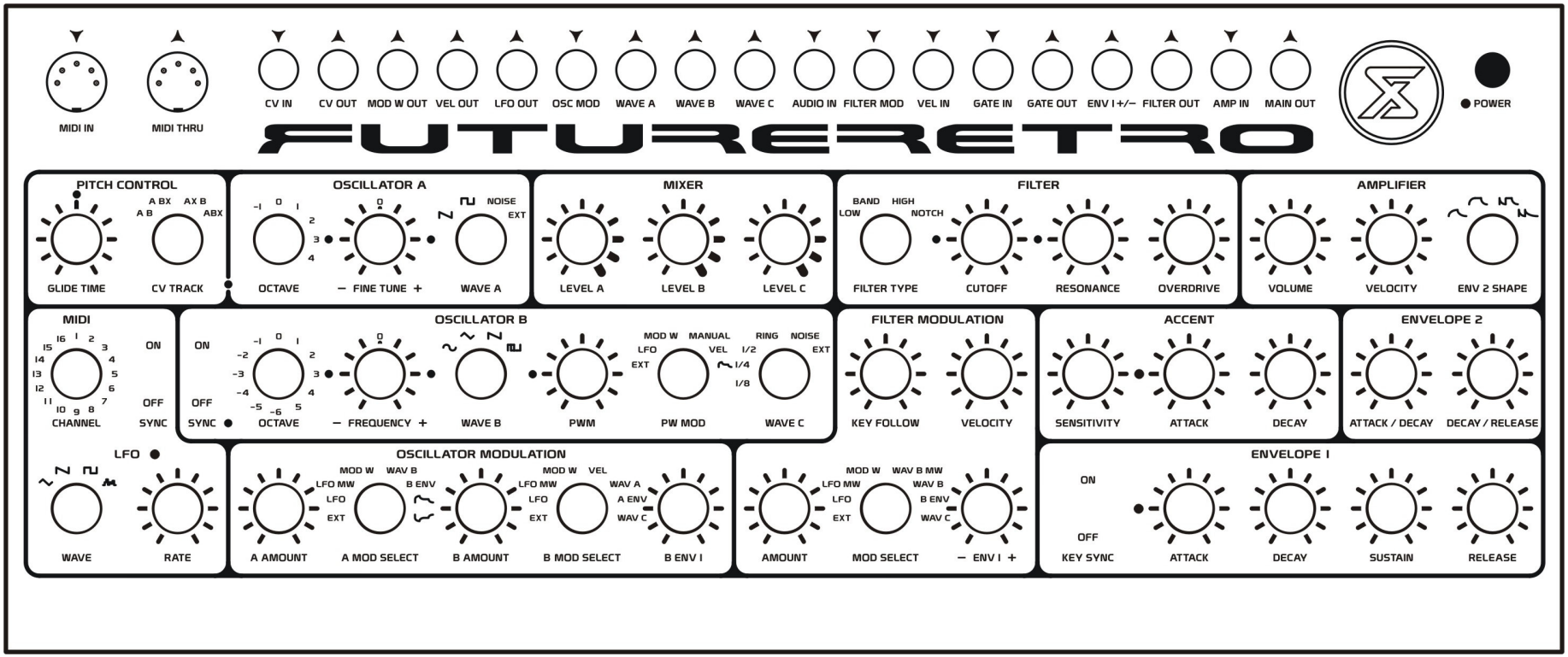
ENV 2 SHAPE: This control selects the shape of Envelope 2 which will affect the amplifier's volume.

Select the ATTACK/DECAY setting to create sounds that require only an attack, a decay, or both attack and decay. This type of envelope is nice for simple pads or even percussion sounds.

Select the ATTACK/SUSTAIN/RELEASE setting to create sounds which may require an attack or release. This type of envelope is nice for many traditional sounds, including leads and basslines.

Select the ACCENTED DECAY/SUSTAIN/RELEASE setting to create Velocity controlled sounds that are capable of imitating a pluck/strum effect, or an alternating percussive/lead-type sound.

Select the ACCENTED DECAY/NORMAL DECAY setting to create Velocity controlled percussive sounds that require alternating decay times.


MIDI IN
MIDI THRU
CV IN
CV OUT
MOD W OUT
VEL OUT
LFO OUT
OSC MOD
WAVE A
WAVE B
WAVE C
AUDIO IN
FILTER MOD
VEL IN
GATE IN
GATE OUT
ENV I +/−
FILTER OUT
AMP IN
MAIN OUT
POWER
FUTURERETRO
PITCH CONTROL
GLIDE TIME
CV TRACK
OSCILLATOR A
OCTAVE
FINE TUNE
WAVE A
NOISE
EXT
MIXER
LEVEL A
LEVEL B
LEVEL C
FILTER
FILTER TYPE
CUTOFF
RESONANCE
OVERDRIVE
AMPLIFIER
VOLUME
VELOCITY
ENV 2 SHAPE
MIDI
CHANNEL
SYNC
OSCILLATOR B
OCTAVE
FREQUENCY
WAVE B
PWM
PW MOD
WAVE C
FILTER MODULATION
KEY FOLLOW
VELOCITY
ACCENT
SENSITIVITY
ATTACK
DECAY
ENVELOPE 2
ATTACK / DECAY
DECAY / RELEASE
LFO
WAVE
RATE
OSCILLATOR MODULATION
A AMOUNT
A MOD SELECT
B AMOUNT
B MOD SELECT
B ENV I
AMOUNT
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ENVELOPE I
KEY SYNC
ATTACK
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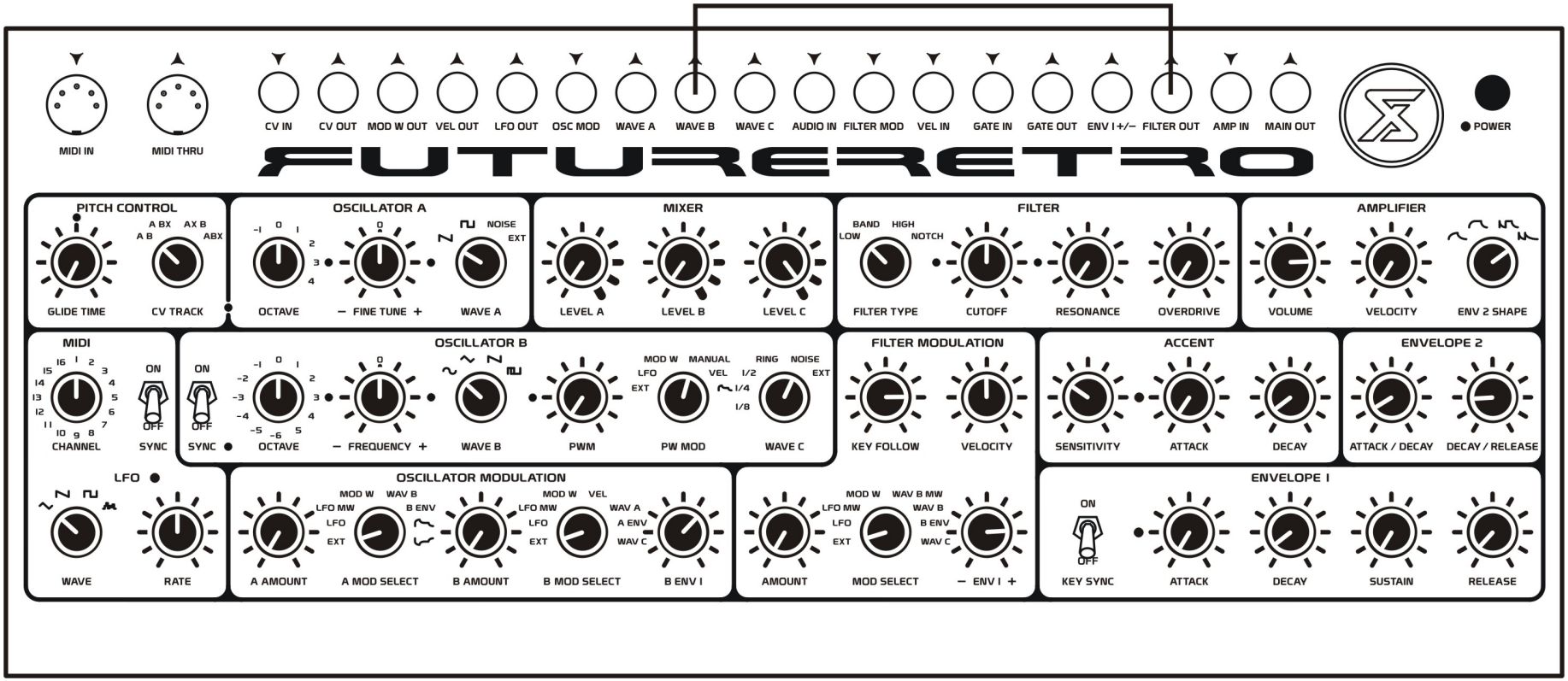
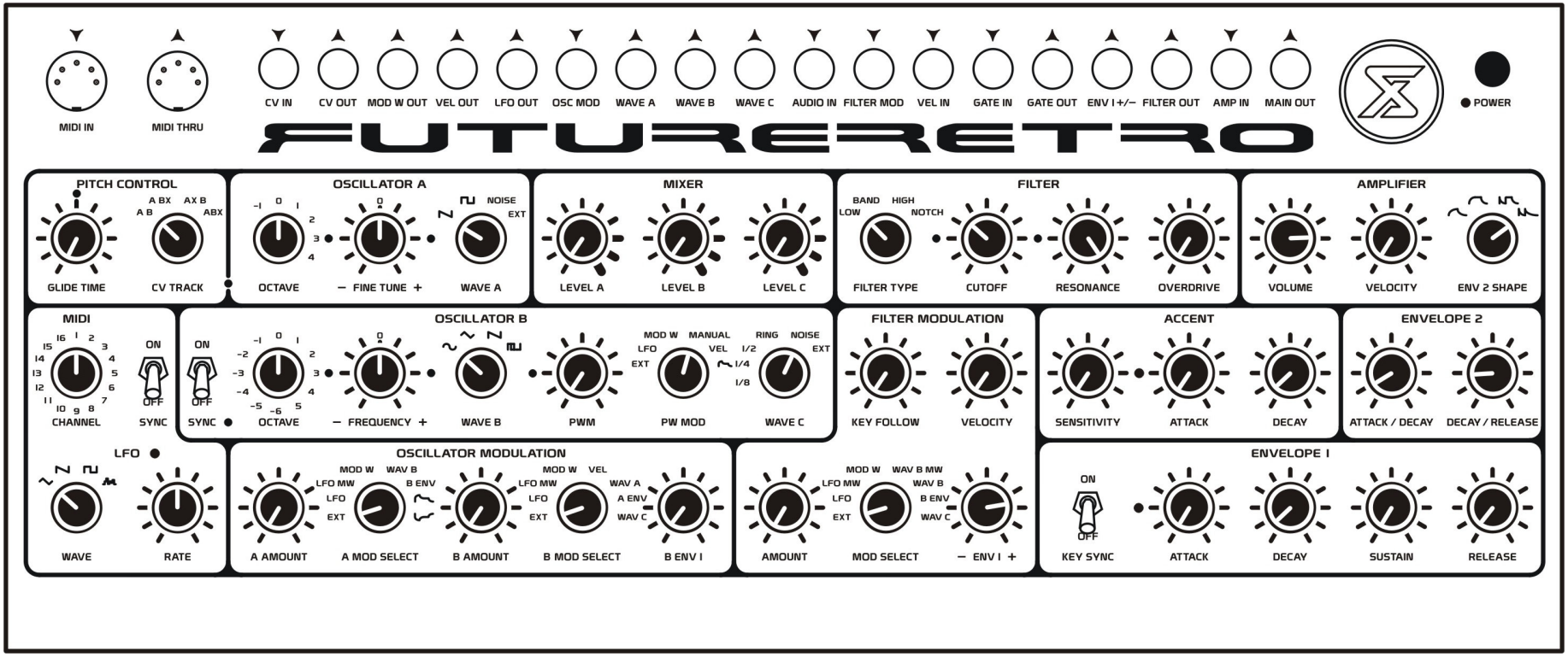
SUSTAIN
RELEASE

PATCH NAME: _____



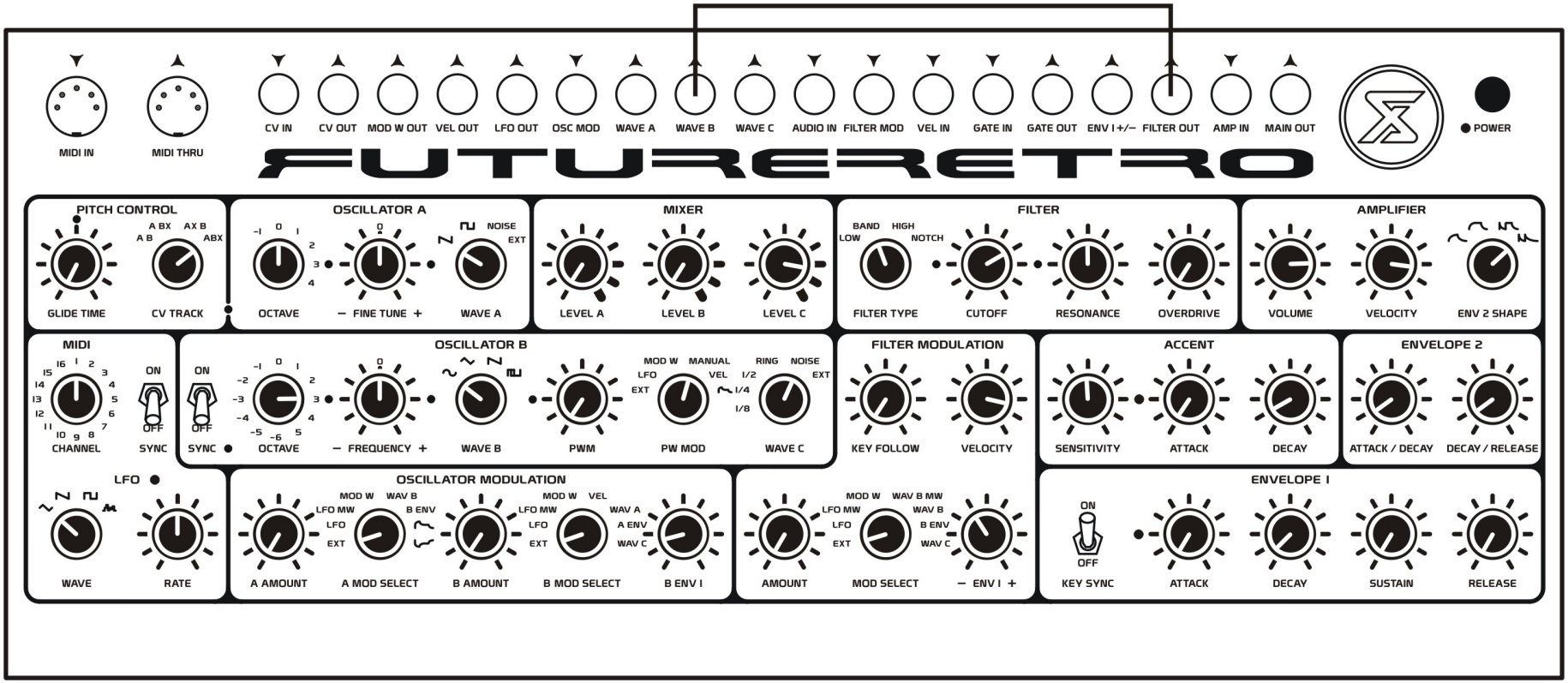
NOISE KICK

Nice sine wave kick with white noise attack. Connect the WAVE B jack to the FILTER OUT jack.



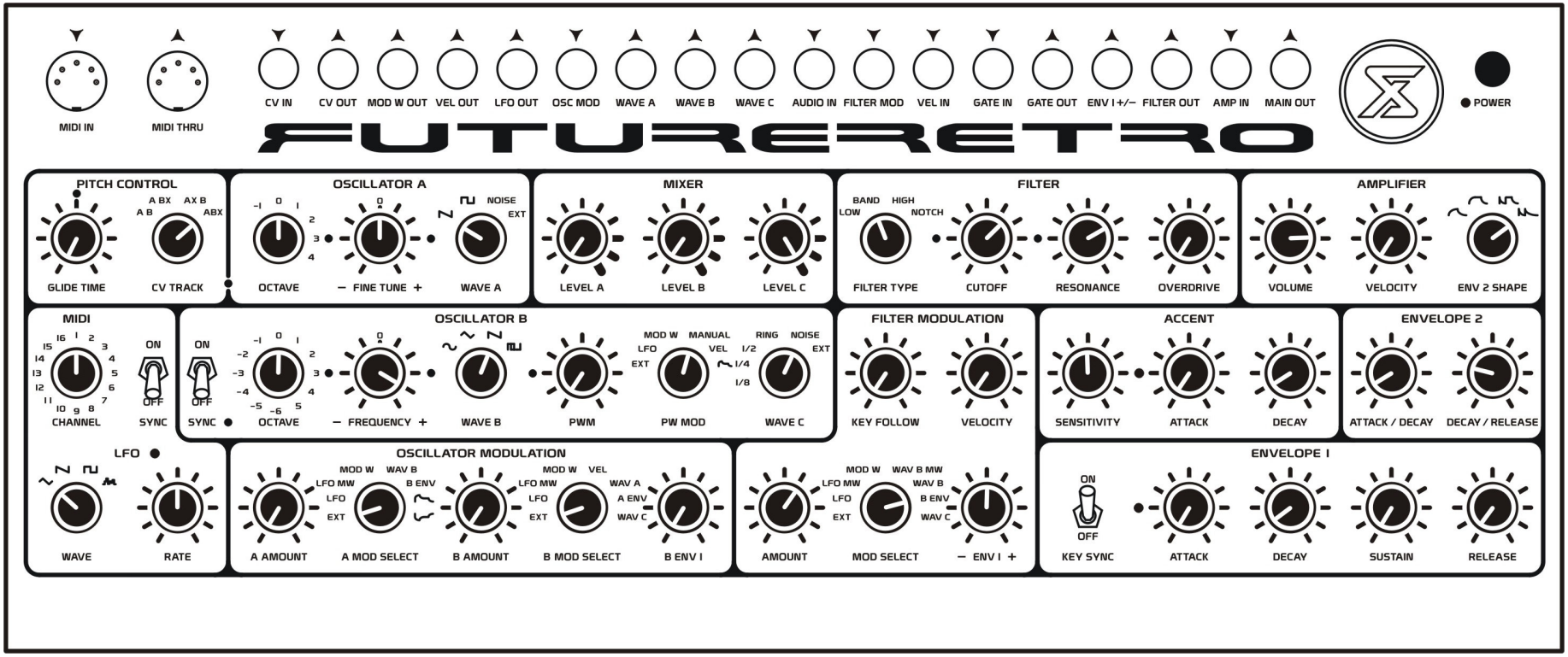
TECHNO KICK

Tight kick using just the filter self oscillating.



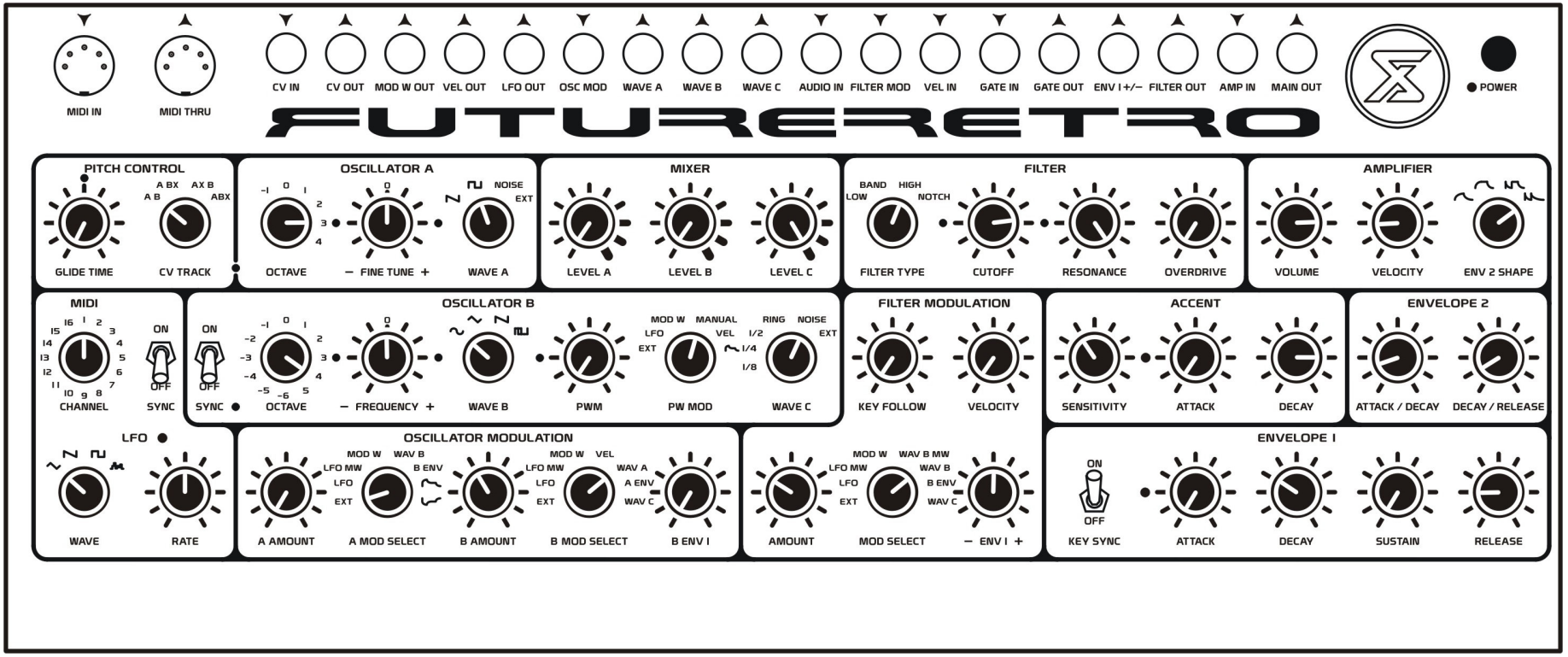
SNARE DRUM

Electronic snare drum, similar to the classics. Connect the WAVE B jack to the FILTER OUT jack. Notice how we take the output of WAVE B and insert it into the FILTER OUT jack. By doing so we sum the output of the filter with WAVE B.



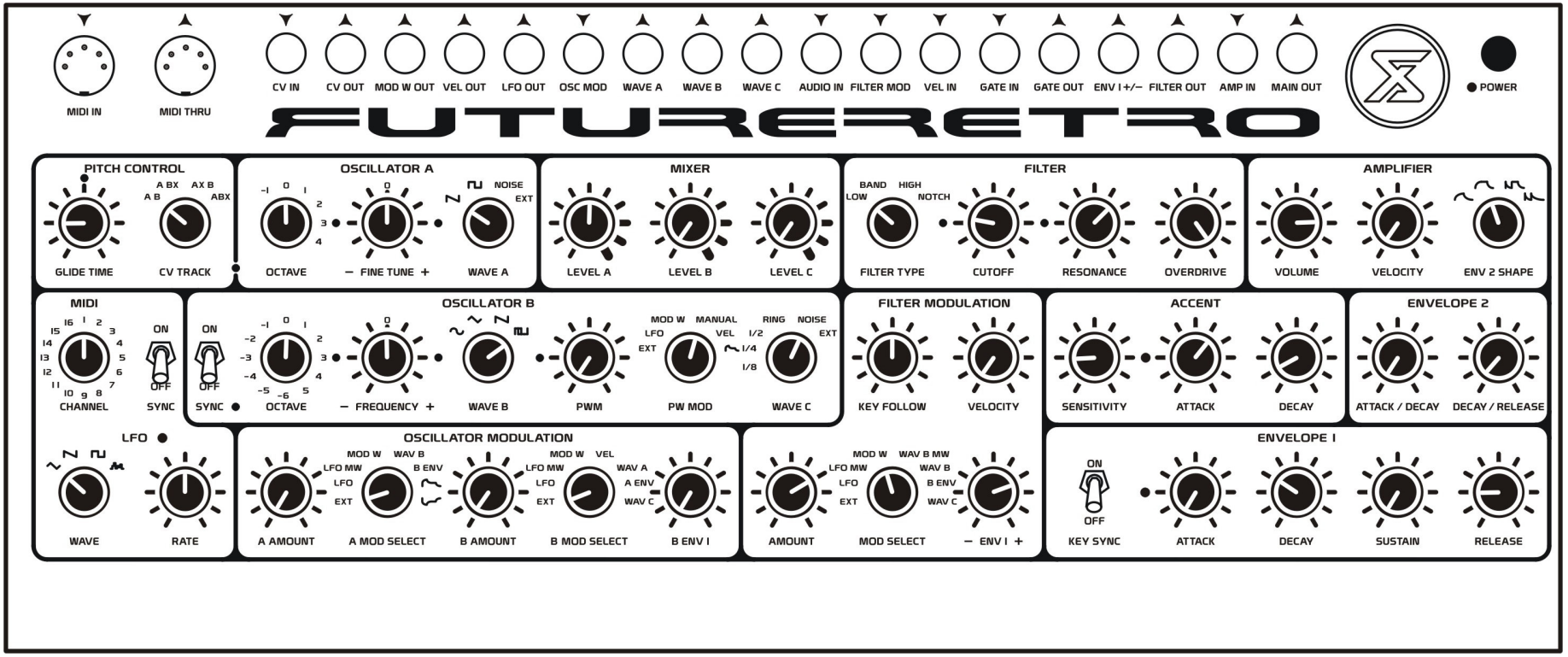
HAND CLAP

Electronic hand clap sound. Try varying the velocity of notes to change the duration of the clap.



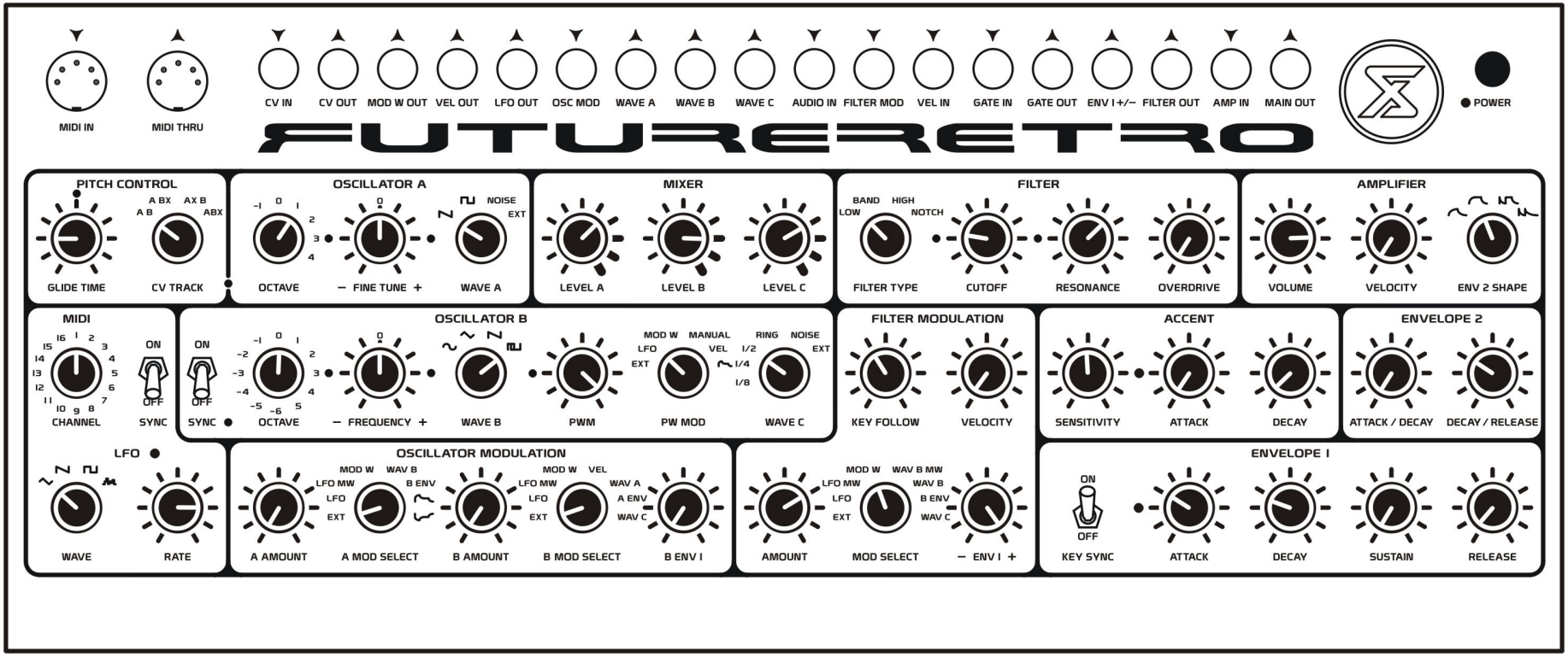
HIGH HATS

Electronic high hat sounds. Try playing with the filter cutoff frequency, Oscillator B's frequency and modulation amount to dial in the tone. Adjust envelope 2's attack and decay controls to vary the open/closed high hat durations. Use varying velocity values to trigger open or closed high hat durations.



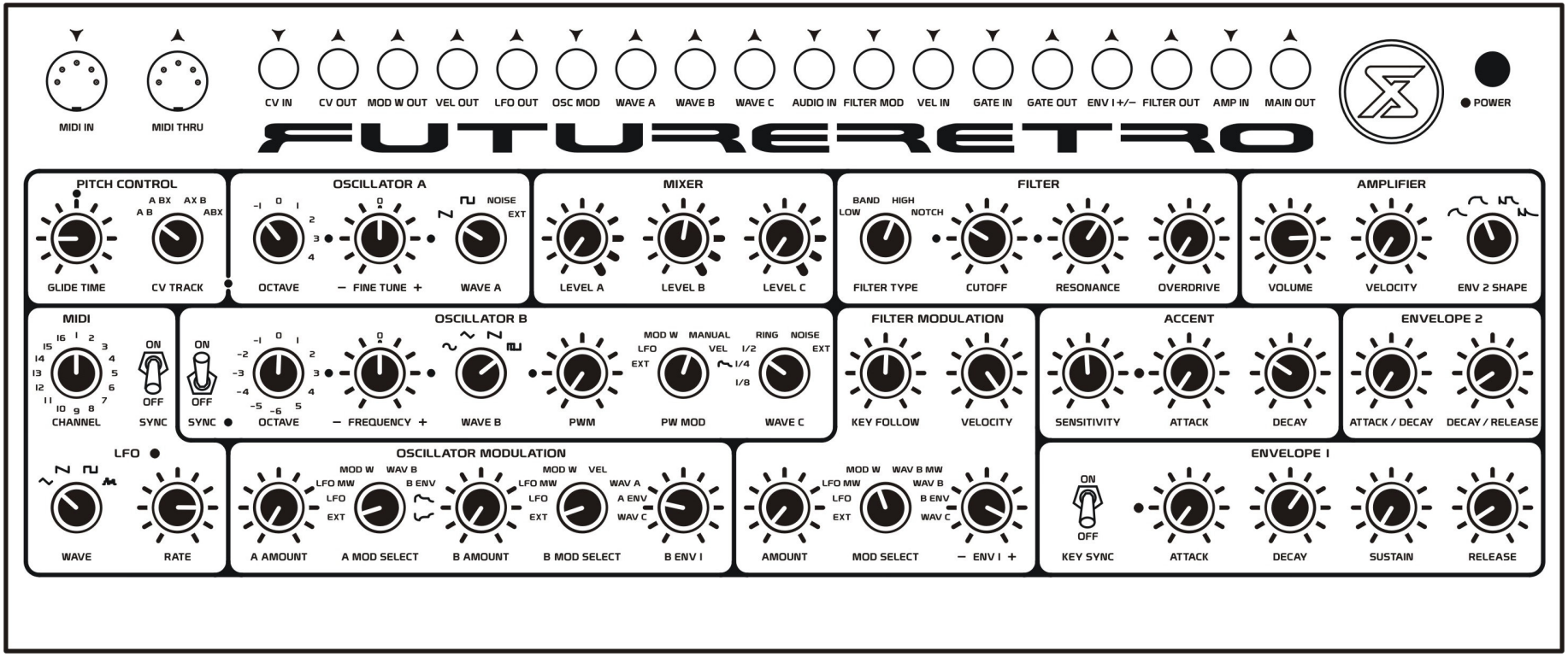
DISTORTED BASS / LEAD

Nice and crunchy, just the way we like! Record mod wheel movements in your sequencer to animate the filter cutoff frequency. And experiment with play notes with different velocity values, and selecting different filter types.



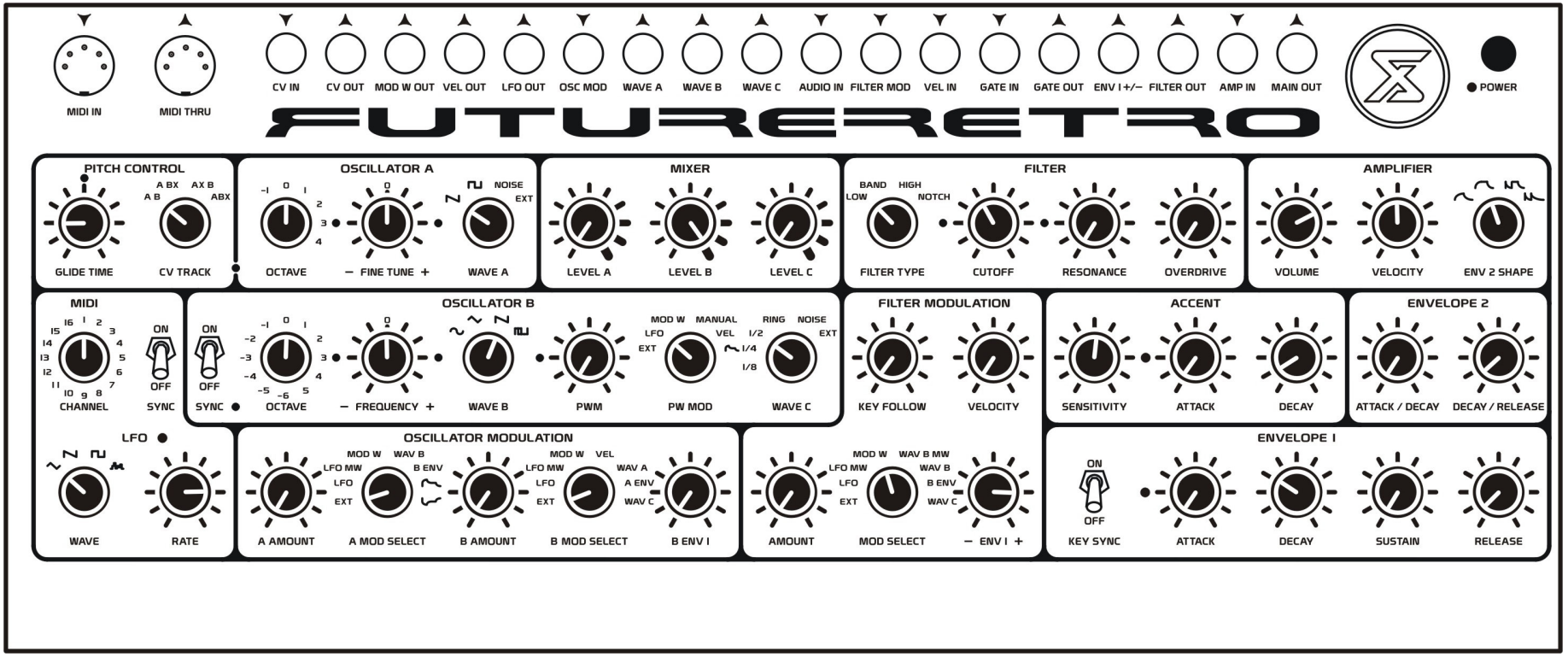
FUNKY TRANCE LEAD

Nice full lead sound. Play different velocity values to vary the attack portion of the sound. Adjust the mod wheel to change the filter frequency.



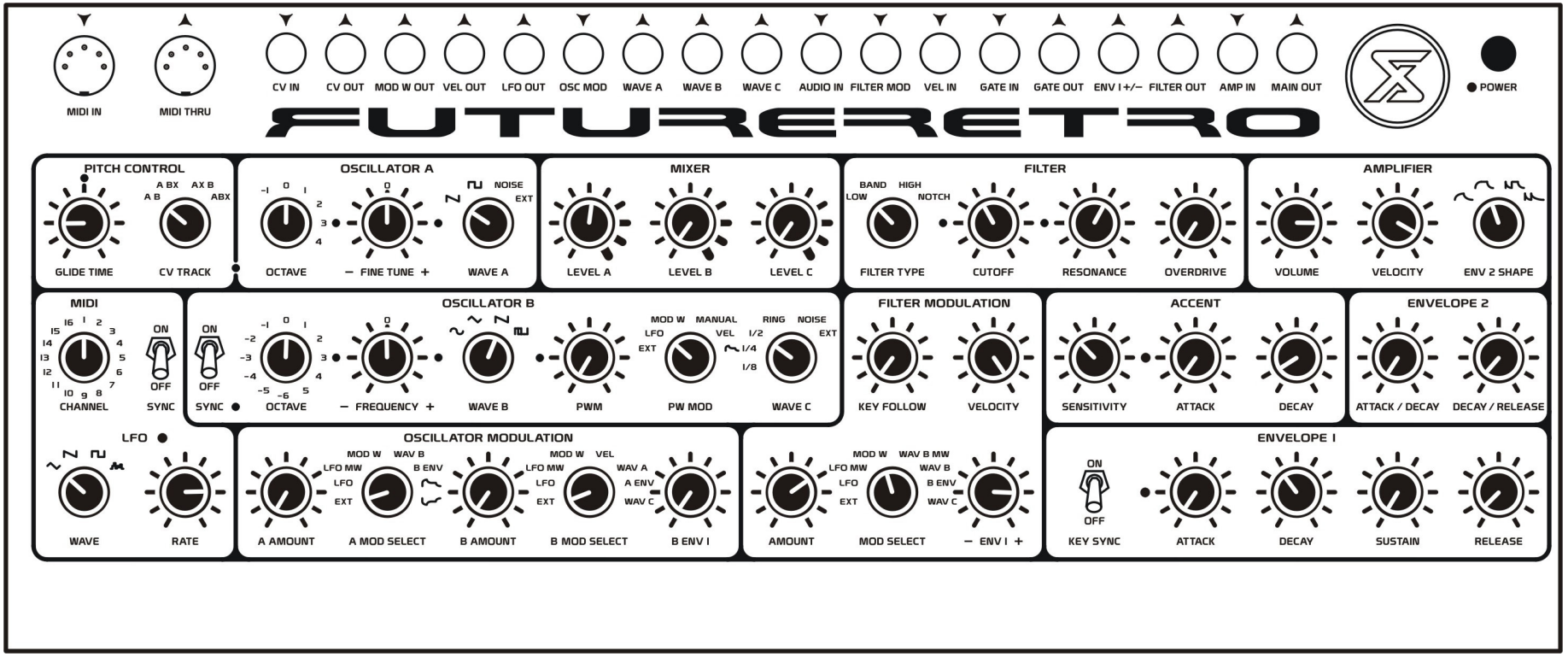
CLASSIC SYNC LEAD

Your typical synced lead sound. For a more aggressive sound, try increasing the overdrive amount. Play notes with varying velocity values to change the brightness of the filter frequency.



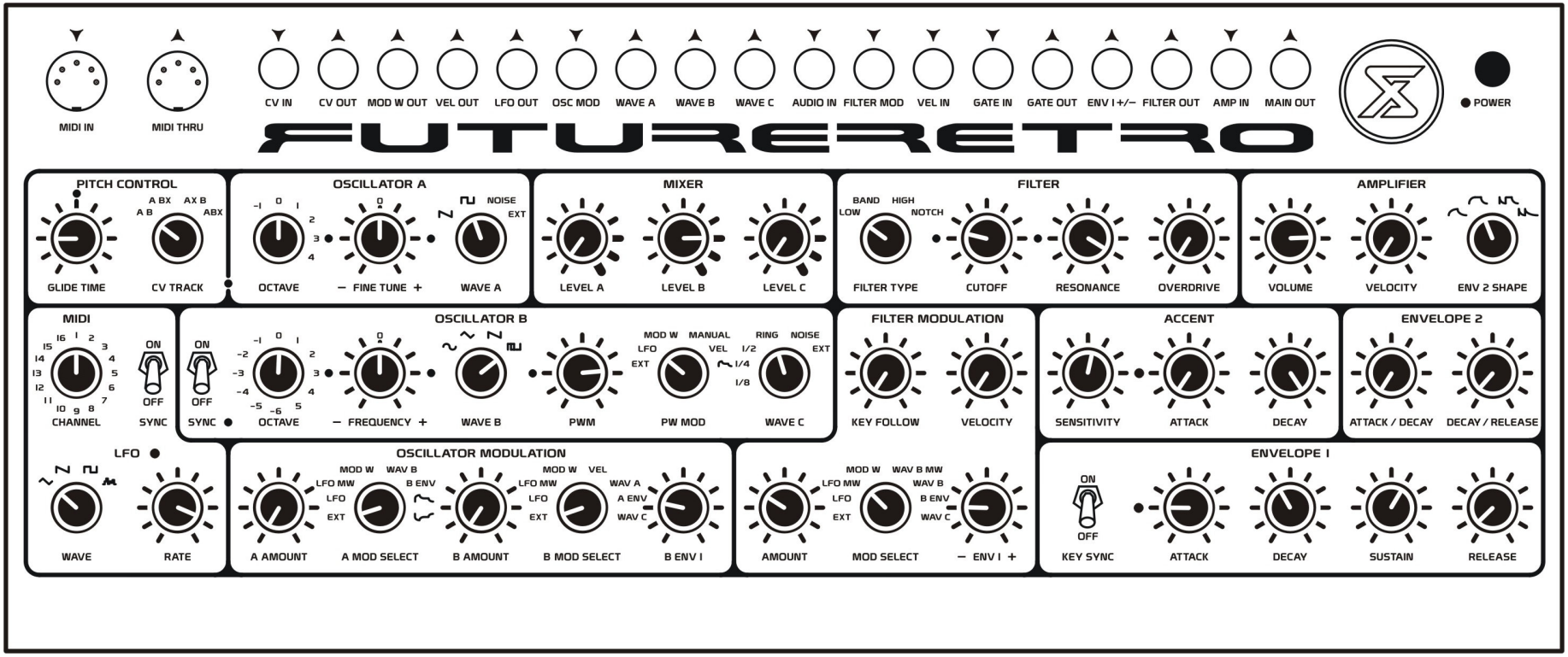
PHAT SAW

Nice in-your-face bass sound. For bass bin rockers, try selecting Octave –1 and the sine wave for Oscillator B.



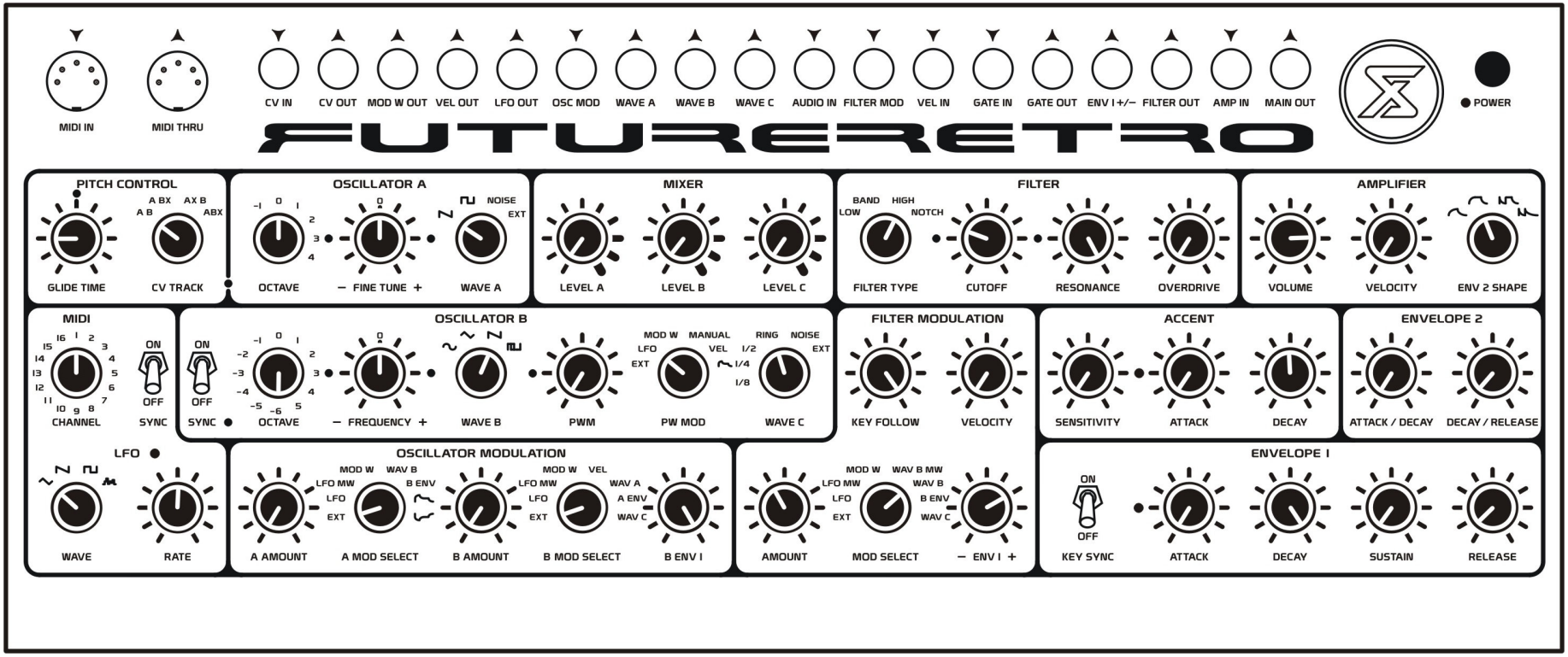
ACID BASS

Not quite a 303 but similar. Use Mod Wheel messages to control the filter cutoff frequency. Try using the different filter types, and increase the overdrive for a more aggressive sound.



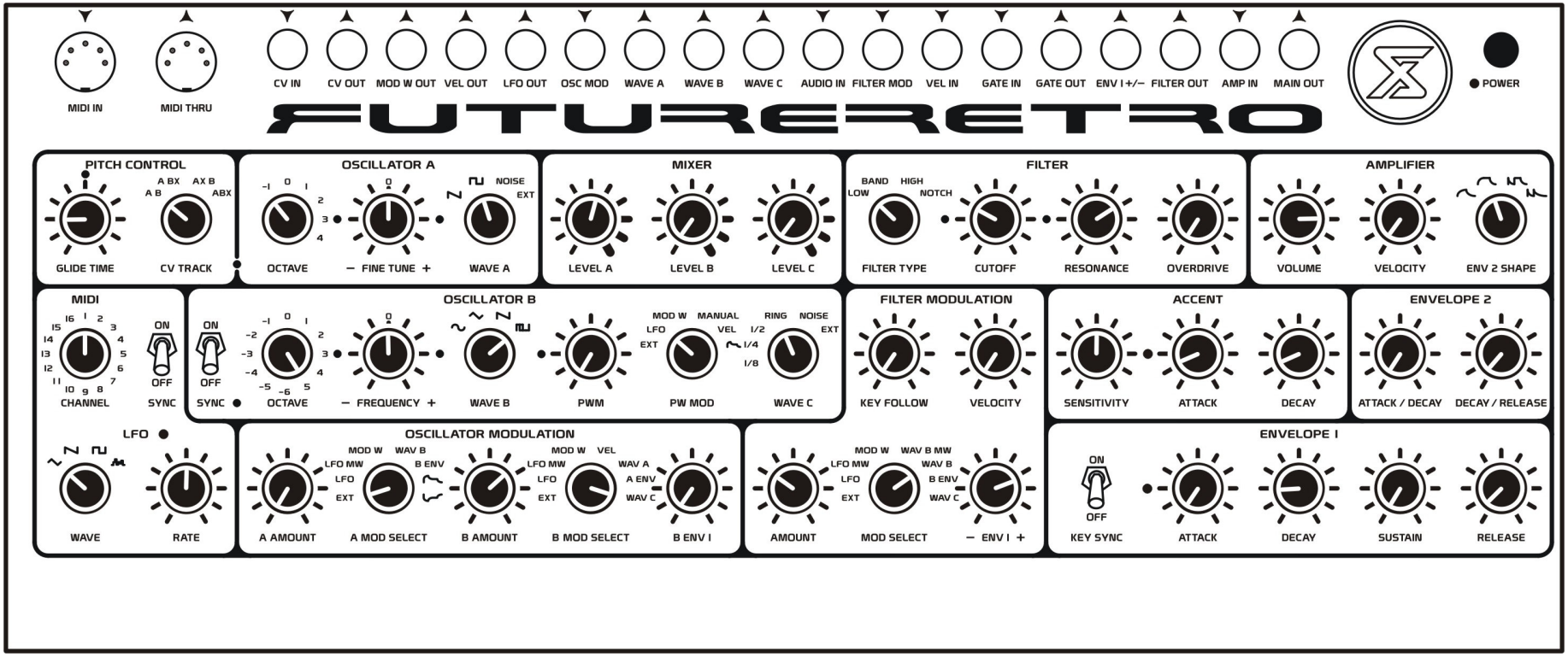
JUNGLE BASS

Nice warbling tones for your subs. Increase the mod wheel setting to increase the warble effect.



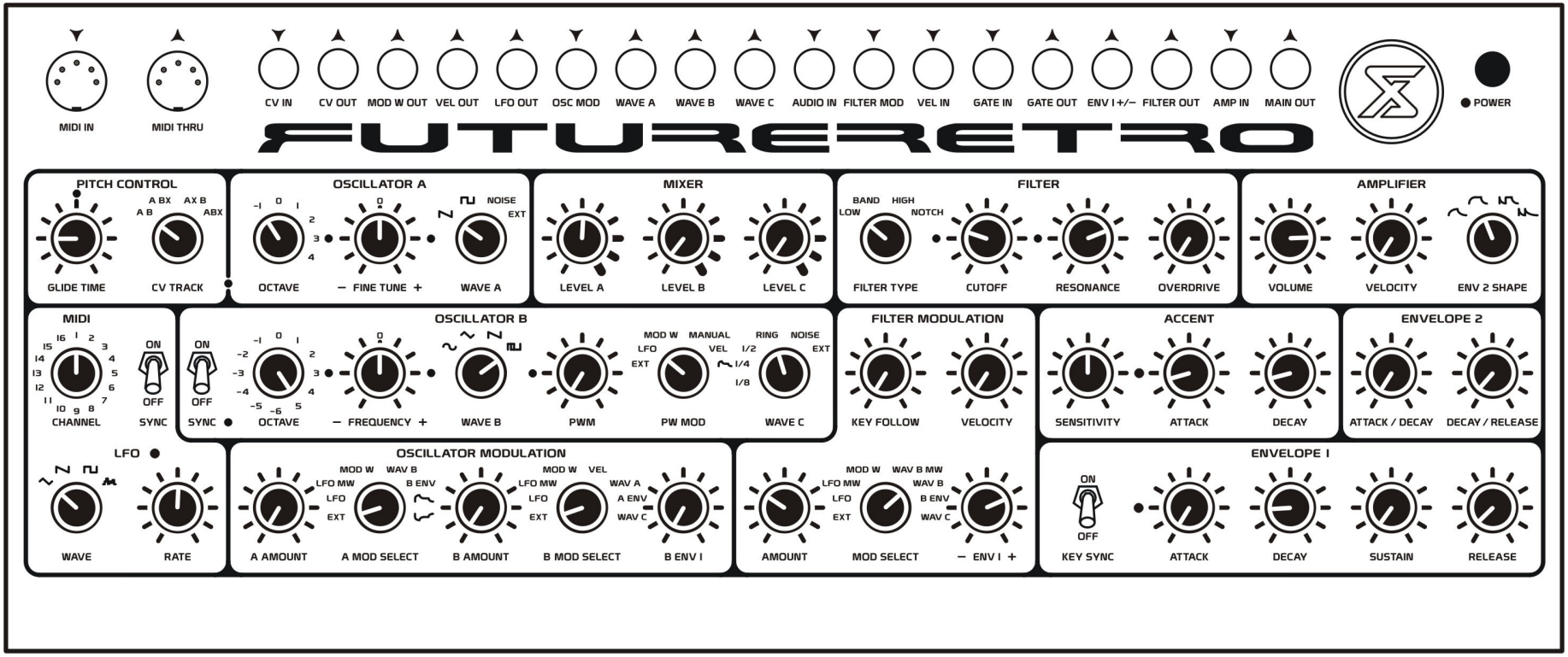
WINDING DOWN

More of a typical sci-fi transition effect. Experiment with various control settings to suit to your taste.



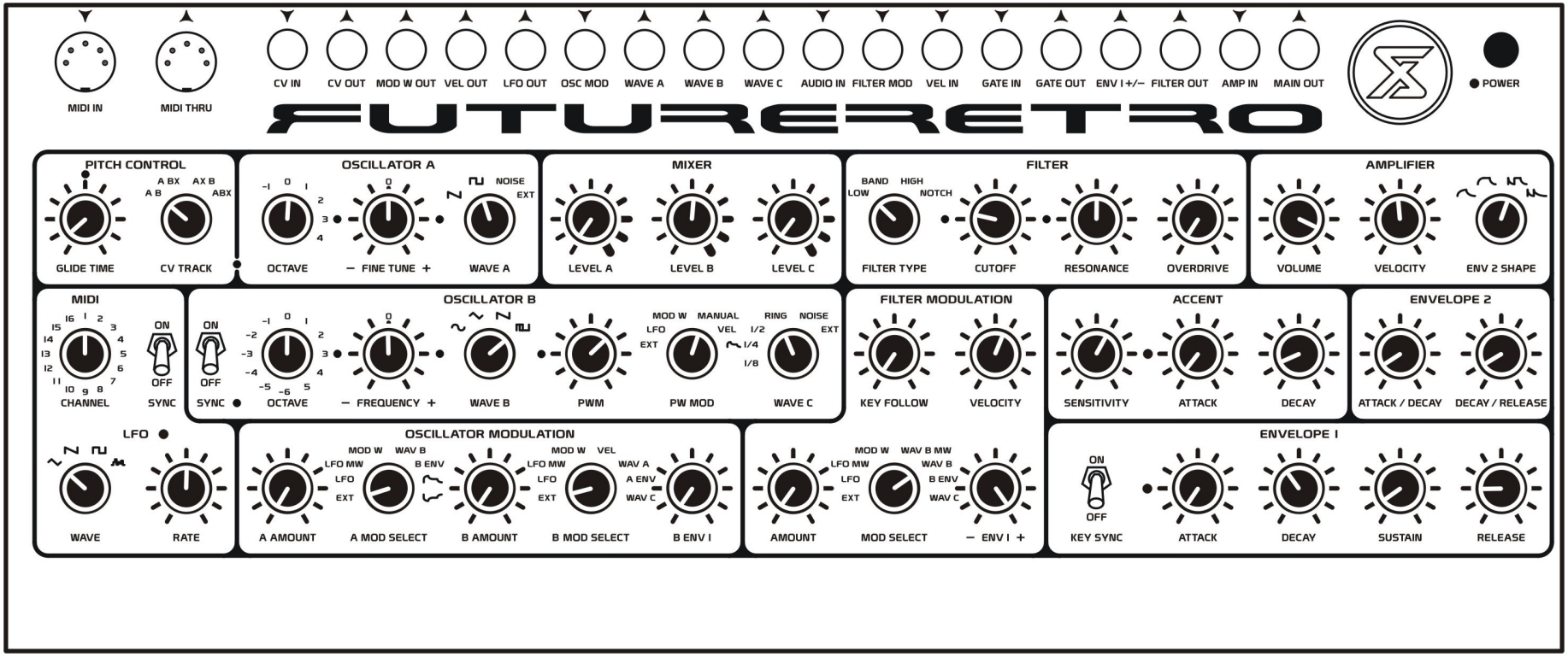
BUZZY BASS

Nice bass with some added high frequency content.



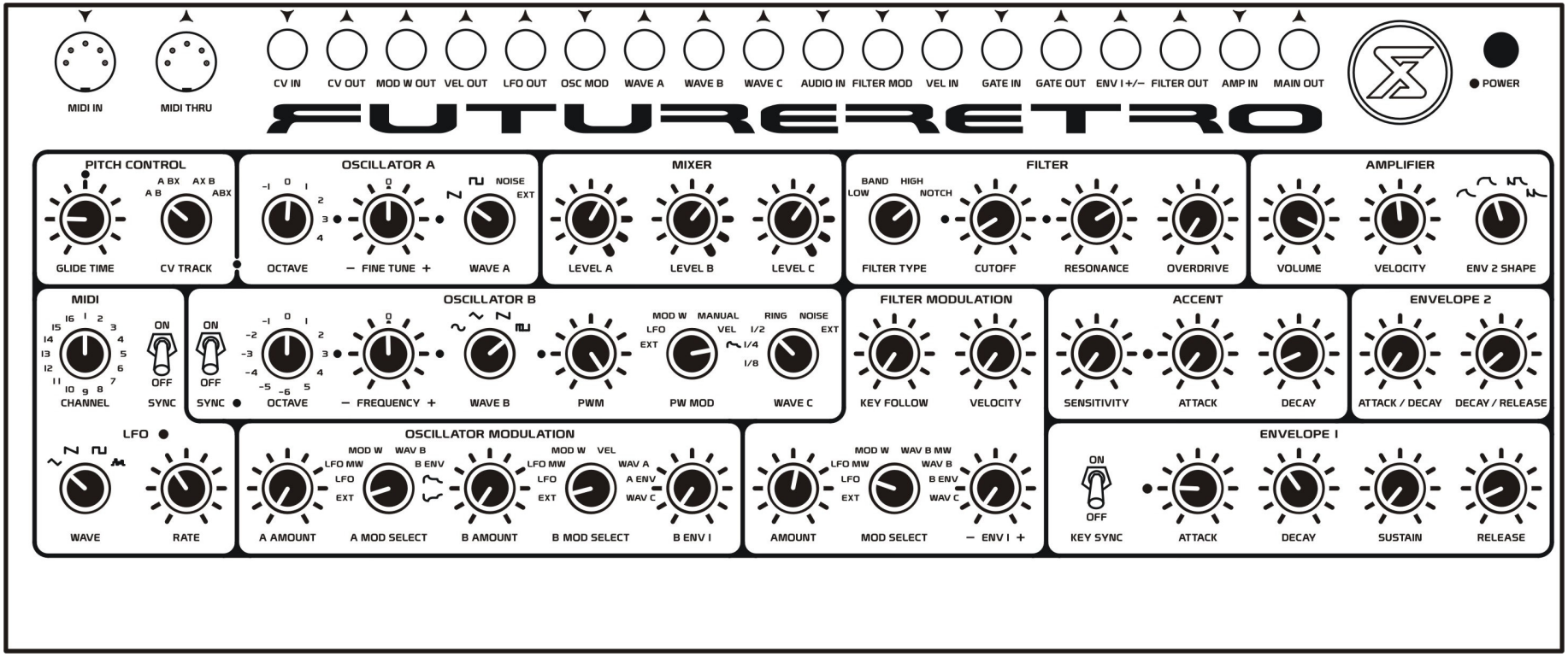
8 BIT TALKING BASS

Nice lo-fi bass sound. Try varying the velocity notes are played.



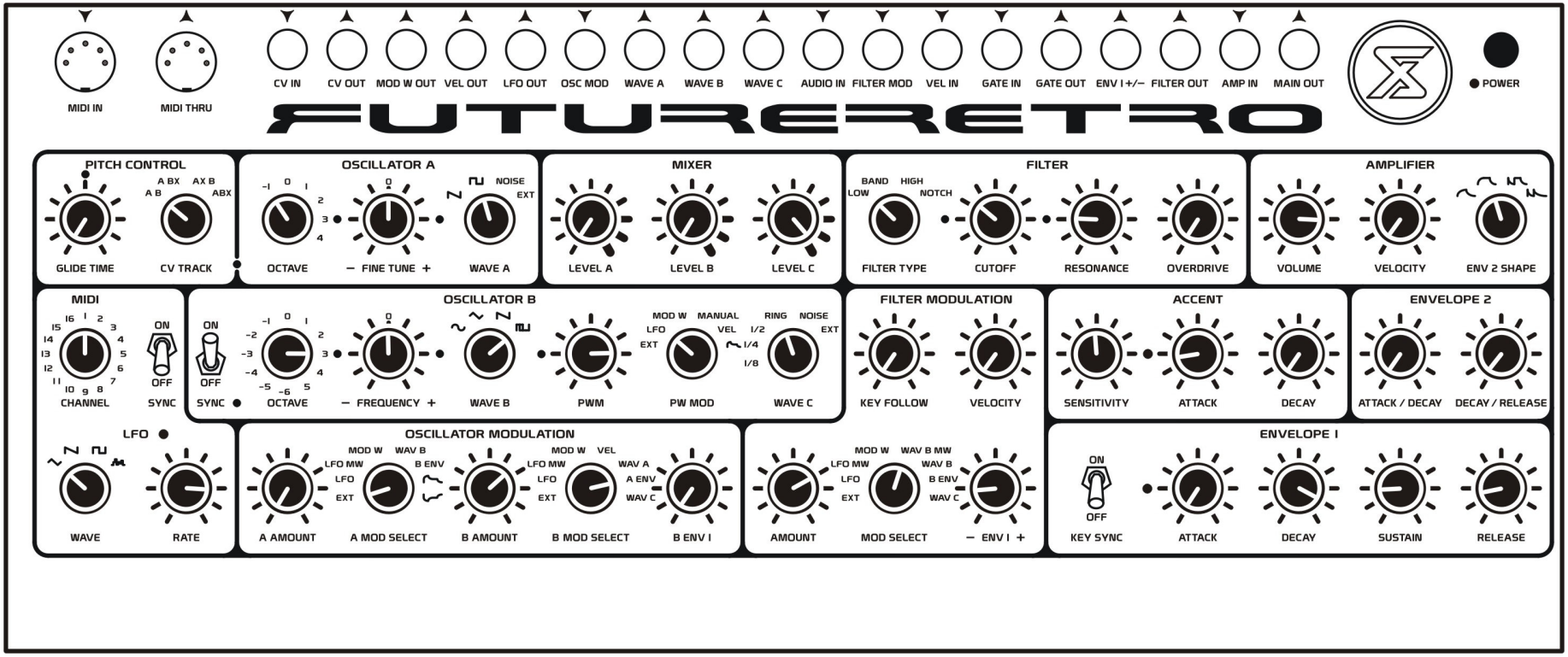
ELECTRIC BASS

More realistic bass sound. Try playing notes with different velocity values to achieve a pluck / strum effect.



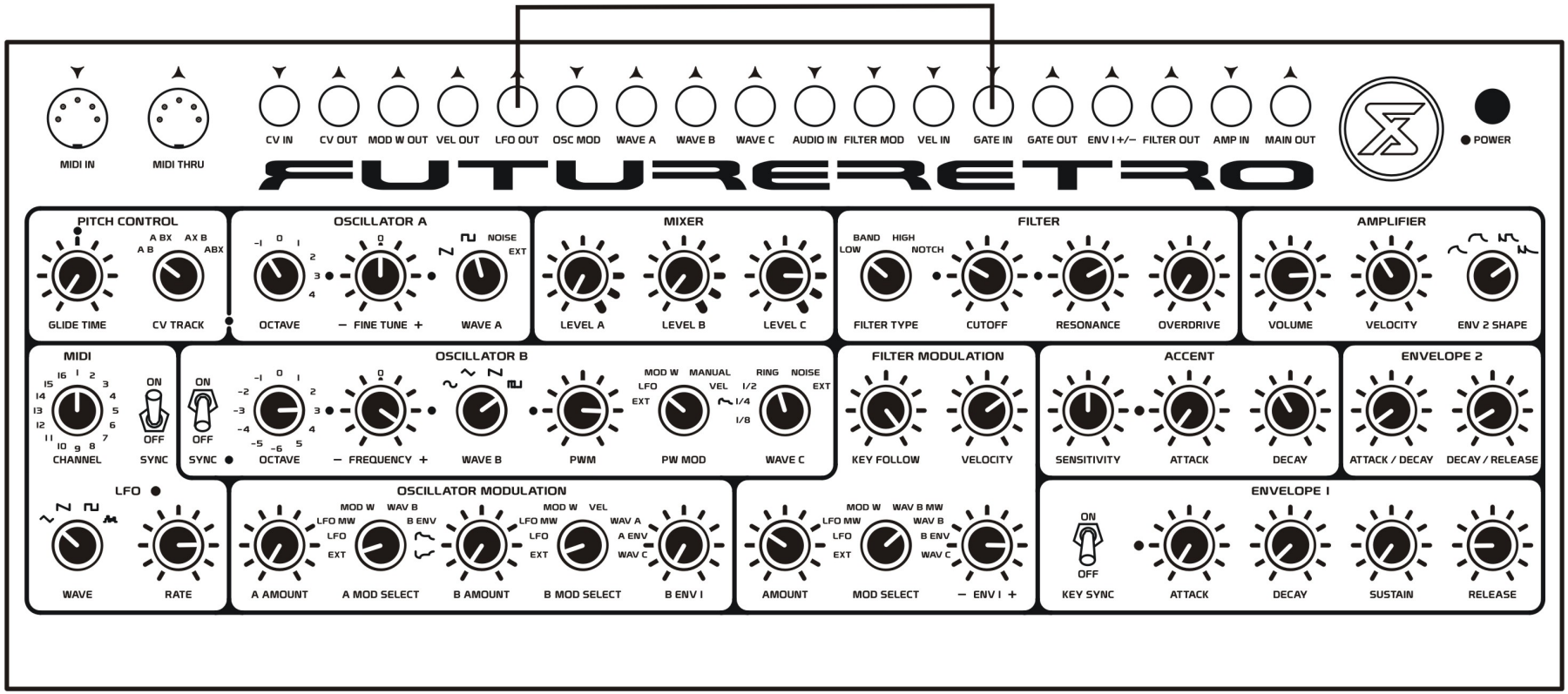
PHAT STACK PHASED

Thick lead sound. Here we use the notch filter to obtain a phased sound. Adjust the LFO rate to change the phasing rate.



GRINDER

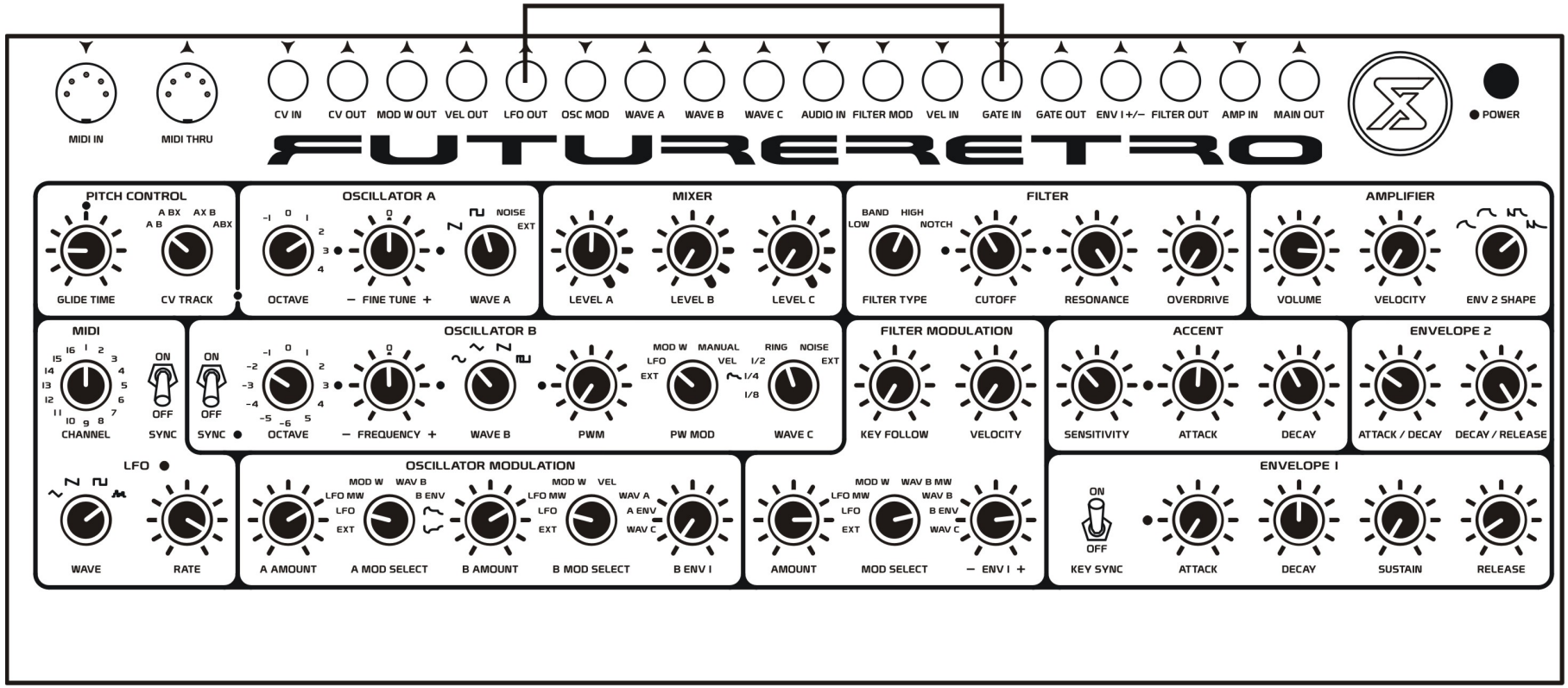
Metallic-like tones, nice for low end trance pads.



MIDI SYNCED PSEUDO ARPEGGIATOR

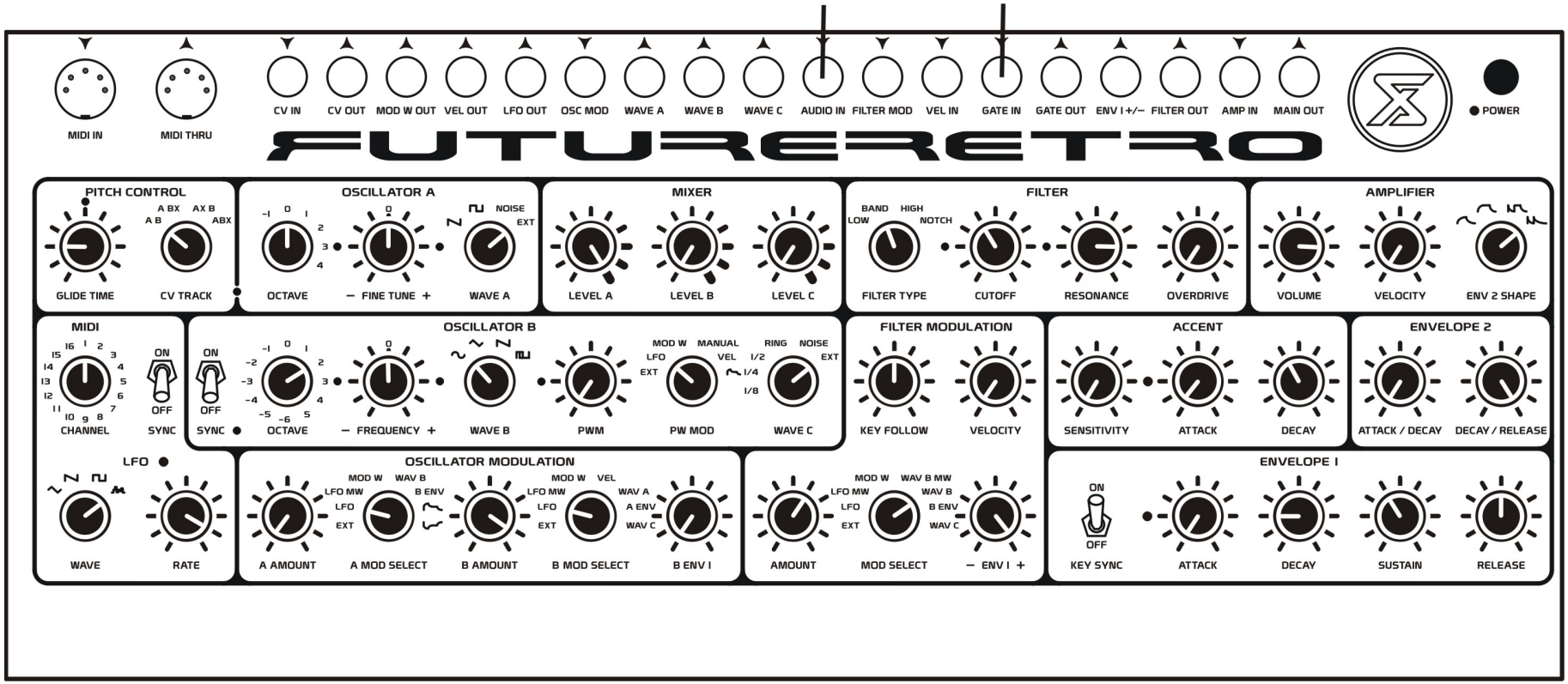
Play notes on your MIDI controller or sequencer to control the pitch. Try setting the LFO to different clock divisions. Connect the LFO OUT jack to the GATE IN jack. If Envelope 1's Key Sync control is set to ON, Envelope 1 can then be retriggered by both the LFO and any MIDI notes received by the XS. If the Key Sync control is set to OFF, only the LFO will trigger Envelope 1.

Note, you can use the square wave output of the LFO to clock your other analog sequencers in a similar way. Just connect the LFO OUT jack to the CLOCK IN of your sequencer or arpeggiator.



COMPUTER

This is more of a chaotic beep generator patch. Connect the LFO OUT jack to the GATE IN jack.



STRANGE BEATS

Here's one way to mangle your beats. If your drum machine has stereo outputs, route one channel to the AUDIO IN jack, and the other to the GATE IN jack. In this way the audio is also triggering the envelope generators. But you need to make sure the output of the drum machine is loud enough to trigger the envelopes in the XS. As an alternative, you could connect the FILTER OUT jack directly to your mixer, or you could use MIDI notes to trigger the envelopes as well. But to do so you would first need to remove the cable connected to the GATE IN jack. Adjust the filter cutoff frequency to suit your taste. And experiment with different Envelope 1 time settings.

TIPS AND TRICKS

LATCH A NOTE

In some cases you may find it desirable to latch a Note On to create droning-type sounds without having to constantly play a note on a MIDI keyboard or sequencer. To do so, play a note on your MIDI keyboard and then change the MIDI Channel control to a different value, and then release the key of your MIDI keyboard. What happens is the XS receives the proper MIDI Note On to play a sound, but since we've changed the MIDI channel the XS responds to, it never receives the proper note off to stop playing the sound. It is important to remember which MIDI note you have latched so that you can unlatch it. To unlatch the note, play the same note on your MIDI keyboard and then change the MIDI Channel control of the XS back to the value you are sending MIDI data on, and then release that note on your MIDI keyboard. This then generates the proper MIDI Note Off command for the XS to stop playing the latched note.

SPECIAL USES FOR THE OSCILLATOR OUTPUTS

As mentioned in the Connections section of this manual, both the WAVE A and WAVE B outputs provide continuous signals on the tip portion of the jack, while the ring portion of the jack provides the same signal attenuated by Envelope 1's shape. Here are some neat things you can do with the envelope-controlled signal:

You could take one of these envelope-controlled outputs (let's say Oscillator B) and run it back into the AUDIO IN jack. Use the WAVE C control to select External as its source to use the envelope-controlled output as an audio source. Now let's set Oscillator A's waveform to sawtooth or square wave, and set the Level A control in the Mixer to its mid position. Make sure Level B in the Mixer is turned all the way down. Then adjust Level C in the Mixer to determine the amount of Oscillator B signal we hear. Now Envelope 1 shapes the amount of signal we hear from Oscillator B. Try detuning Oscillator B's pitch to a fifth. If we set Envelope 1 with a very fast attack, and a medium decay and sustain of zero, what you will hear is a fifth interval fading into a single tone. By increasing Envelope 1's attack you can go from the single tone fading into the fifth.

The other interesting thing you can do is use the Level C control in the Mixer to overdrive the input of the filter for a duration controlled by Envelope 1. In order to do this, you will need to set Level C in the Mixer to values higher than the mid position, adjust the level for your own taste. When the input of the filter is overdriven, less resonance occurs within the filter which can create other interesting tones.

You could also use the two methods described here to affect only a single oscillator, such that you are listening to both the continuous oscillator mixed with the envelope-controlled level of the same oscillator to introduce more dynamics, or control when the input of the filter is overdriven.
These techniques can also be applied to combine say a white noise burst from Oscillator A with a continuous sine wave from Oscillator B to create the attack and body of most percussive sounds.

Note: Some 1/4" mono cables can cause both the tip and ring portions of a jack to be shorted together when the cable is pulled out to connect the tip of the cable to the ring of the jack. Whether or not this occurs depends on the dimensions of the cable's metal tip. No harm will be done to the unit, although what you end up with is the tip and ring signals of the jack summed together which may not produce the same effect as we describe in the manual. For best results we recommend using a cable that provides a 1/4" stereo connector on one end and two 1/4" mono connectors on the other end.

TIPS AND TRICKS

USING CV IN AS AN ADDITIONAL MODULATION SOURCE

Although the CV IN jack is designed for V/Oct control voltages to generate semitone steps of pitch in the oscillators, you can also use this input as an additional FM input to modulate the internal oscillators. Make sure you select which oscillator you want to modulate with the external control voltage using the CV Track control. The drawback to this method is the oscillator you are modulating will no longer follow pitches played on a MIDI keyboard, and there is no control over the modulation amount. But in some cases where you are already using the internal modulation on the oscillator and would like to add a second modulation source, this just might do the trick.

USING THE VELOCITY INPUT AS AN FM SOURCE

You can use the VEL IN jack as a means of frequency modulation for both the filter cutoff frequency and the amplifier's amplitude. Try connecting the WAVE B output to the VEL IN jack. Use Oscillator A as your audio source. You can then turn up the Velocity amount control in the amplifier section to create tremolo and AM-type effects. Or turn up the Velocity control in the filter to create FM effects in the filter. Notice that Envelope 2's shape will affect the amount the external signal modulates the amplifier while Envelope 1's shape will affect the amount the external signal modulates the filter.

A/B ENVELOPE SIGNALS ARE VELOCITY-SENSITIVE

The A ENV and B ENV signals used as modulation sources, and output on the ring of the WAVE A and WAVE B jacks are Velocity-sensitive when the Velocity control is turned up in the filter section.
So as you increase the Velocity setting for the filter, these modulation and audio sources also become more Velocity-sensitive, providing more dynamics in your modulations and overall sound.

ENVELOPE SIGNALS THAT ARE NOT VELOCITY SENSITIVE

The B ENV 1 modulation source for Oscillator B is not a Velocity-sensitive envelope, nor are the positive or negative polarity envelopes used to modulate Oscillator A. However the ENV 1 +/- jack does output Velocity-sensitive envelopes. So if you wish to sweep the pitch of either oscillator using Velocity-senstive envelopes, simply route one of the outputs from the ENV 1 +/- jack to the OSC MOD input jack. Then select EXT as the modulation source for the oscillator you want to control, and adjust the modulation amount to achieve the desired effect. Note that you do need to increase the Velocity control setting amount in the filter section to make the envelopes Velocity-sensitive.

USING AUDIO TO TRIGGER THE ENVELOPES

Since the envelopes within the XS can be triggered with any voltage higher than +1.5 volts, we can then use audio signals to trigger the internal envelopes. To do so, connect the line-level audio output of, for example, a drum machine to the GATE IN jack of the XS. Since audio is always alternating above and below 0 volts, you need to adjust the attack, decay and release portions of the envelopes within the XS so they will average the peak levels of audio instead of abruptly turning the envelope on and off at audio rate.
In some cases you may find that the line-level output of another instrument is still not enough to trigger the envelopes in the XS, in which case, you could either use a preamp stage before sending the audio to the GATE IN jack of the XS, or you could route the audio to the AUDIO IN jack of the XS first, as the AUDIO IN provides an additional gain stage that will boost the external signal. Then select EXT as your source for WAVE C, and connect the WAVE C jack to the GATE IN jack using a 1/4" mono cable. This may be the ideal setup anyway if you want to filter the audio through the XS as well as use the audio to trigger the envelopes. If that's the case, you can select EXT for Oscillator A's source, use Level A in the mixer section to determine the amount of external audio to go to the filter, while WAVE C ends up boosting the audio signal and feeding the GATE IN jack to trigger the envelopes.

TIPS AND TRICKS

SUB OSCILLATOR SYNC
When you are syncing Oscillator B's frequency to Oscillator A, listen to the effect this has on the different Sub Oscillator waveforms provided in the WAVE C section. The results can be quite pleasing with their pitches stepping in unusual ways.

SUB OSCILLATOR SELF MODULATION
The Sub Oscillator waveforms provided in the WAVE C section are derived by dividing the pitch that Oscillator B is generating. One of the internal modulation sources for Oscillator B is WAVE C, and we can use WAVE C's control to select one of the sub oscillators to then self modulate Oscillator B's pitch. What this creates is what I will call a pseudo-duophonic serial tone, where we are generating what appears to the ear to be two different pitches from a single oscillator at one time. In truth, what is happening is when the sub oscillator waveform is in the low state of its square wave, Oscillator B's pitch remains at its unmodulated pitch, and when the sub oscillator is in the high state of its square wave you get a second modulated pitch. Depending on which sub oscillator division you choose to use as the modulation source, you can cause Oscillator B's frequency to alternate between these two pitches in single periodic cycles, two periodic cycles, or four periodic cycles. You can then use the B AMOUNT control in the Oscillator Modulation section to set the desired ratio of the two pitches being produced. You will find that only small amounts of modulation are needed to create realistic duotones with a single oscillator.

OVERDRIVING THE FILTER WITH TWO OSCILLATORS
In previous sections of the manual we explain that when the input of the filter is overdriven the filter produces less resonance. However something that might not be so obvious is, let's say, when we overdrive the filter with square waves from both Oscillator A and B at the same time. When these waveforms are in phase less or no resonance may be produced by the filter, but as the waveforms become out of phase their amplitudes cancel each other out producing a lower level which then does allow the filter to become resonant during these periods. Try detuning the oscillators slightly from one another to hear the results.

USING THE OVERDRIVE
The Overdrive section of the XS adds so many harmonics to a sound that you may find it is most pleasing when using only a single oscillator. If you wish for the sound to be more complex try modulating the single oscillator you are listening to, or if using Oscillator B try syncing its frequency to Oscillator A.

SUMMING SIGNALS AT THE FILTER OUTPUT
Although it is a general rule that you never want to connect two outputs of a device directly together, the XS does make an exception to this rule. This exception is that you can connect the output of an oscillator directly to the output of the filter, which will then sum the oscillator signal with the signal coming from the filter. This is possible due to the circuit protection we provide in the XS at the output of the filter section. Let's say you want to route the sine wave of Oscillator B directly into the Amplifier section, but you also want to route white noise through the band pass filter to shape the tone of this noise before it goes to the amplifier. Simply connect the sine wave signal on the WAVE B jack to the FILTER OUT jack. You can then balance the ratio of these two signals by adjusting the white noise feeding the input of the filter.
Remember that if instead, we were to route the WAVE B jack to the AMP IN jack, signal coming from the filter output would no longer be routed to the amplifier's input, which would then only allow us to hear WAVE B through the amplifier.

TROUBLE SHOOTING

WARM UP
Due to the nature of analog circuits, you will want to let your XS warm up for about 15 minutes before playing the unit. This allows the unit to reach its typical operating temperature, which will provide the best tuning and performance.

NO SOUND?
First, check the power supply is plugged into the wall outlet and into the XS, and the XS is turned on (power LED should be lit). Second, make sure the MIDI channel of the XS is set to the same channel your MIDI keyboard or sequencer is sending data on. If MIDI notes are being received, you should see the blue LED flashing in the Envelope 1 section (as long as no cable in inserted into the Gate In jack). Third, make sure the Level controls in the mixer are turned up for the audio source you are using. Fourth, make sure a cable is not inserted into the Amp In jack, or if there is, make sure it has a live signal on it. Fifth, check that the volume control is turned up, and you have properly connected the Main Out jack to your outboard mixer and/or audio system. And finally, check to see that the rest of your audio system is working properly, by testing with another known working audio source.
Check over your connections and routings carefully. It's often just a simple mistake that gets overlooked. And occasionally both MIDI and audio cables do go bad, so try using different cables for the same routings.

LATCHED NOTES
Should notes ever become latched or stuck where they continue playing, you can turn the unit off and then back on again, and playback should resume to normal.
Common causes for latched notes might be due to the XS not receiving a proper MIDI Note Off command, or the reception of too much MIDI data. It is always good practice to send only the MIDI data to the XS that it responds to for optimum MIDI timing.

OSCILLATOR B's PITCH DOESN'T SEEM TO CHANGE
Make sure the Sync switch is in the off position.

NOTHING HAPPENS WHEN I SWITCH THE LFO SYNC SWITCH ON
In order for the LFO to sync to a MIDI clock, it needs to receive a MIDI Clock from your master sequencer, and it also needs to receive a MIDI Start command for syncing to begin.
Note: When the LFO is syncing to a MIDI clock and you adjust the Rate control, the phase of the LFO waveform may sound off from what you typically think of as synced. If you stop playback on your master sequencer and then restart playback, you will hear that the LFO realigns its waveform phase to be "on-beat."

THE FILTER DOESN'T SEEM TO BE VERY RESONANT
If the input of the filter is being overdriven, you will notice less resonance response in the filter. The solution is to back off your levels in the Mixer section until the desired resonance amount is possible.

I HEAR POPPING OR CLICKING IN THE AUDIO OUTPUT
To reduce audible popping in the output, you may wish to slightly increase the attack/decay/release times for Envelope 1 or 2. Popping may also occur due to abrupt changes in Velocity values controlling the amplifier. Try dialing back the Velocity amount in the amplifier section.

For more help on troubleshooting, please visit the Support page of our website: www.future-retro.com

SPECIFICATIONS

MIDI
Channel: 1-16
MIDI Messages Recognized: pitch C2 to C7, Note On/Off, Pitch Bend -/+ 2 semitones, Velocity, Mod Wheel, MIDI clock

LFO
Waveshapes: triangle, saw, square, random
Free Running Rate: (MIDI SYNC off) 4 seconds to 18 Hz
MIDI Clock Divisions: (MIDI SYNC on) 8 bars, 4 bars, 2 bars, 1 bar; 1/2, 3/8, 1/3, 1/4, 3/16, 1/6, 1/8, 3/32, 1/12, 1/16, 1/24, 1/32 note divisions

OSCILLATOR A
Total Frequency Range: 0.5 Hz to 100 kHz
Octave Control Range: 6 octaves
Fine Tune Control Range: -6 to +6 cents (master fine tuning for both oscillators)
Waveforms: saw, square, white noise, external audio

OSCILLATOR B
Total Frequency Range: 0.5 Hz to 100 kHz
Oscillator Sync: on/off
Octave Control Range: 12 octaves
Frequency Control Range: -9 to +9 semitones
Waveforms: sine, triangle, saw, square/pulse width
Pulse Width Modulation Amount: typically 50% to 3%
Pulse Width Modulation Source: external source, LFO, Mod Wheel, manual adjust, Velocity, Envelope 1

WAVE C
Waveforms: 1/8, 1/4, 1/2 sub oscillators, ring modulator, white noise, external audio

OSCILLATOR MODULATION
Modulation Sources for Oscillator A: external source, LFO, LFO controlled by Mod Wheel, Mod Wheel, Waveform B, Waveform B controlled by Envelope 1, Envelope 1 positive and negative polarity.
Modulation Sources for Oscillator B: external source, LFO, LFO controlled by Mod Wheel, Mod Wheel, Velocity, Waveform A, Waveform A controlled by Envelope 1, Waveform C, and Envelope 1 positive polarity

MIXER
Controls: level A, level B, level C (all capable of overdriving filter input)

FILTER
Filter Types: (12 dB) lowpass, bandpass, highpass, notch
Filter Frequency Range: 5 Hz to 18 kHz
Resonance: 0 to self oscillation
Overdrive: clean to fully crunch

SPECIFICATIONS

FILTER MODULATION
Key Follow: 0 to 100%
Velocity: amplitude control for Envelope 1
Modulation Sources: external source, LFO, LFO controlled by Mod Wheel, Mod Wheel, Waveform B controlled by Mod Wheel, Waveform B, Waveform B controlled by Envelope 1, Waveform C
Envelope 1: negative and positive polarity covering 10 octaves

ENVELOPE 1
Key Sync: on/off (retriggering)
Attack Time: 0.5 milliseconds to 4 seconds
Decay Time: 2 milliseconds to 10 seconds
Sustain Level: 0 to 100% (+10 volts)
Release Time: 1 millisecond to 10 seconds

ACCENT SECTION
Sensitivity: 0 to +10 volts
Attack Time: 0.5 milliseconds to 4 seconds
Decay Time: 2 milliseconds to 10 seconds

ENVELOPE 2
Attack Time: 1 millisecond to 4 seconds
Decay Time: 3 milliseconds to 7 seconds
Sustain Level: 100%
Release Time: 3 milliseconds to 7 seconds

AMPLIFIER
Velocity: 0 to 100%
Envelope Shapes for Control: attack/decay, attack/sustain/release, accented decay/sustain/release, accented decay/normal decay

INPUTS/OUTPUTS
CV In: 1 V/Oct standard, typically 0 to +5 volts (+15 volts max)
CV Out: 1 V/Oct standard, 0 to +5 volts
Mod Wheel Out: 0 to +10 volts
Velocity Out: 0 to +10 volts
LFO Out: -5 to +5 volts
Oscillator Modulation In: typically –10 to +10 volts (-/+15 volts max)
Waveform A: -5 to +5 volts
Waveform B: -5 to +5 volts
Waveform C: 0 to +15 volts (for sub oscillator divisions), -5 to +5 volts (for ring modulator and white noise source)
Audio In: accepts line-level audio signals
Filter Modulation In: typically –10 to +10 volts (-/+ 15 volts max)
Velocity In: typically 0 to +10 volts (-/+15 volts max)
Gate In: gate on equals +1.5 volts or higher, gate off equals 0 volts
Gate Out: 0 to +15 volts
Envelope Out +/-: 0 to +10 volts
Filter Out / Amp In Range: -15 to +15 volts max
Main Out Range: 11 volts peak/peak max